



PCAF UK 2020/21

Year 1 Report of the UK Partnership for Carbon Accounting Financials

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PCAF

Partnership for
Carbon Accounting
Financials

Foreword from the Chair



PCAF UK was founded in October 2020, six months into the global pandemic that has continued to dominate all of our lives. Among other things, the global impacts of COVID19 have engendered a recognition that we are all component parts of a larger collective. The sloping curve placed over a population-scale dataset has become perhaps the foremost visual representation of our collective behaviour.

At the same time, the pandemic highlighted not only commonalities but fundamental differences in the experience of space and place. Bookshelf-inspecting became a national sport, it was reported, but so too was a more general increase in awareness of the varied accessibility of space to escape from the pressures of working and caring from home. For many, the home became the primary location for their personal, professional, and familial lives. Housing inequalities were increasingly pronounced, as too were differences in access to unbounded and restorative, ‘natural’ environments.

It is in this context that PCAF UK has conducted its first year of activities, and it is these contexts which provide the increased impetus of our collaborative work. The group elected to focus on the financed emissions of two core asset classes: emissions from residential lending, including mortgages, and emissions from debt or equity-based investments into agriculture and forestry (‘AFOLU’).

A global PCAF standard enabling banks and investors to account for the emissions they finance through residential lending activity pre-dated the establishment of PCAF UK. A PCAF standard for agriculture and/or forestry did not, but a standard for accounting for financed ‘negative emissions’ is currently in development, and is something that the UK group is feeding into, noting that many natural sources of emissions removal (such as farm soils or peatland) can be either a carbon sink or a source of emissions, depending on how they are managed.

Indeed, the twin purpose of PCAF UK was not simply to discuss the arithmetic of the PCAF carbon accounting standards per se, but also the centrality of timely and accurate data on the underlying ‘real’ assets in question – whether it be people’s homes, or UK farms or woodlands – to producing accurate accounts for financed emissions. For this reason, PCAF UK has primarily acted as a forum for the collective identification of obstacles to acquiring timely and accurate data on the energy and carbon performance of the homes and farms that members of the group finance. This report represents a summary of our findings. It also includes specific proposals for policy makers which would better enable banks and investors to understand the carbon performance of the UK’s standing residential stock in the context of the transition to net zero.

We are not the only group to be considering these vital issues. In the last 12 months, the number of public policy consultations and cross-industry working groups considering the energy and carbon performance of the built and natural environments has increased dramatically. A number of these important initiatives – such as for e.g. the Future Homes Task Force, Sustainability for Housing, Construct Zero, Financing UK Nature Recovery, and many more, including the recent publication of the UK Government’s Net Zero Strategy and the Heat and Buildings Strategy – are driving positive change in the pursuit of net zero carbon, reduced fuel poverty and the restoration of carbon-absorbing, wellbeing-enhancing ecosystems. Looking forward, PCAF UK will monitor the output of these and other initiatives, consider the role of the PCAF standard in the transition to net zero, and collaborate where possible in order to further leverage our

ability to aggregate insight and action across financial services and the real economy.

Lastly, I want to thank all of the members of PCAF UK for their continued dedication throughout an unusual and difficult year. I also want to extend a special thanks to Alison Vipond (Sustainability Lead at Ecology Building Society), Cara Merusi and Tiange Wei (PCAF UK secretariat, Guidehouse), without whom neither this report nor PCAF UK would have been possible.

Robert Hall, PCAF UK Chair, Associate Director, Federated Hermes



“To achieve net zero we need a whole economy transition - every company, every bank, every insurer and investor will have to adjust their business models, develop credible plans for the transition and implement them. For financial firms, that means measuring and reporting the emissions generated by their investment and lending.

The £1.5 trillion UK residential mortgage market is an important piece of this puzzle and PCAF’s work to standardise the approach to measuring financed emissions in this sector is vital to ensure that every financial decision takes climate change into account.”

Mark Carney, COP26 Private Finance Hub



“The transition to a net zero economy by 2050 requires the transformation of all sectors. Through PCAF, financial institutions are taking an active role in the net zero transition by measuring and reporting on the climate impacts of their lending and investment decisions.

This report from PCAF UK shows how collaboration can uncover common challenges financial institutions are facing when trying to measure and report financed emissions from key sectors. Only by collaborating, these challenges can be solved to hasten the pace to net zero.”

Giel Linthorst, PCAF Executive Director

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About PCAF UK

The Partnership for Carbon Accounting Financials (PCAF) is an industry-led initiative. PCAF developed the Global GHG Accounting and Reporting Standard for the Financial Industry (‘the Global Standard’) to harmonise greenhouse gas (GHG) accounting methods and enable financial institutions to consistently measure and disclosure the GHG emissions financed by their loans and investments.

PCAF UK was formed in October 2020 and aims to embrace and strengthen the global PCAF effort by bringing together UK financial institutions to collaboratively meet the challenges in measuring and reporting financed emissions.

PCAF UK members are committed to climate action and believe that by measuring financed emissions, they are better prepared to take actions and engage with relevant stakeholders to help steer towards net zero portfolios.



The group’s core work focuses on increasing the empirical accuracy of its measurement of financed emissions. It also seeks to encourage other UK financial institutions to embark on their journey in measuring financed emissions by sharing learning, engaging with external experts and working collectively to overcome data challenges.

PCAF UK is chaired by the International Business of Federated Hermes. As of October 2021, members¹ of PCAF UK include²:

- Barclays
- CDC Group
- Charity Bank
- Ecology Building Society
- HSBC Holdings plc
- The International Business of Federated Hermes
- Investec plc
- Lloyds Banking Group
- Nationwide Building Society
- NatWest Group
- Phoenix Group
- PIDG - The Private Infrastructure Development Group Ltd
- Santander UK
- Triodos Bank UK
- TSB Bank plc
- Virgin Money UK plc.

Together, the group represents a total of over \$8.4 trillion (£6.1 trillion) in financial assets through lending and investments.³ The group is supported by Mark Carney in his capacity as COP26 advisor. The UK Department of Business, Energy, and Industrial Strategy (BEIS), the Bank of England, and the Green Finance Institute (GFI) Coalition for the Energy Efficiency of Buildings (CEEB) are observers. Other organisations have also supported PCAF UK's efforts this year.

PCAF UK Observers:

- The Bank of England
- UK Department of Business, Energy, and Industrial Strategy (BEIS)
- Green Finance Institute (GFI) Coalition for Energy Efficiency of Buildings (CEEB)
- Carbon Laces
- Satellite Applications Catapult
- Global Ethical Finance Initiative
- Cambridge Institute for Sustainability Leadership
- UCL Energy Institute
- The Church Commissioners for England
- Igloo

1 This list is not exhaustive for all financial institutions in the UK that have committed to PCAF. Rather, this is the group of institutions in the UK who have been working collaboratively on the implementation of PCAF methodologies in 2020/21

2 Contributors do not necessarily endorse all policy recommendations in the report.

3 The value reflects the sum of total financial assets reported to PCAF by each participating financial institution at the time of committing to PCAF or was taken from financial reports.

Report of the Residential Lending Working Group



1. Introduction

The PCAF UK Residential Lending Working Group (UKRLWG) was formed by a number of the most prominent residential mortgage providers and lenders against the residential building stock in the UK.

This report presents a to-the-point summary of approaches being used to calculate residential financed emissions in the UK, the current challenges and technological solutions which can partially mitigate these, and our recommendations for UK policy makers which would facilitate the determination of the accurate carbon performance of the UK's residential building stock.

2. About the PCAF UK Residential Lending Working Group

The UKRLWG is co-chaired by Robert Hall (the International Business of Federated Hermes) and Alison Vipond (Ecology Building Society).

As of October 2021, members of the UKRLWG include Barclays, Ecology Building Society, the International Business of Federated Hermes, HSBC Holdings plc, Investec, Lloyds Banking Group, Nationwide Building Society, NatWest Group, TSB, Virgin Money. Together, the group represents a total of over \$7.7 trillion in financial assets through lending and investments.⁴

The purpose of the UKRLWG is to act as an action-oriented forum for identifying and sharing lessons learned on the practical, institutional and technical processes required to disclose financed residential emissions using the Global Standard – and the challenges encountered along the way. In this respect the purpose of the UKRLWG is less to act as a forum for principled discussion, important though that is, and more to act as a forum for collaboratively identifying problems and solutions with the purpose of increasing the ability of financial institutions to understand, in detail, the energy and carbon performance of their residential lending books. The group moved as efficiently as possible to identify the information required to understand this performance, and – where information is currently lacking – identified remedies that are realistic, appropriate, and practicable.

The UKRLWG's work on improving present data quality and disclosures for the residential property sector leverages historic and ongoing work from other groups, both domestic and international.

⁴ The value reflects the sum of total financial assets reported to PCAF by each participating financial institution at the time of committing to PCAF or was taken from financial reports.

3. Progress to date

Members of the UKRLWG are at different stages of their carbon accounting journeys to measure and report the emissions they finance through mortgages and lending on residential property ('scope 3 financed emissions'), using the Global Standard. Some members of the UKRLWG have already integrated the Global Standard into their reporting processes and made disclosures; others are preparing their first accounts, and some organisations have only recently begun to integrate the PCAF attribution methodology into their financed emissions calculation process.

The UKRLWG has hosted a number of knowledge exchanges sessions. Ecology Building Society, Lloyds Banking Group, Nationwide Building Society and NatWest Group have shared their experiences in compiling their carbon accounts. Further information is provided in the Annex.

The main findings relating to carbon accounting are summarised below, with section 4 providing a deeper dive into the data that is currently available, the limitations and approaches that are being used by UKRLWG members.

The UKRLWG has benefitted from Observers sharing their insights. Section 5 summarises Observers' knowledge share on data innovation which is being opened up by new digital technologies. Section 6 summarises some of the catalytic activities of the Green Finance Institute's Coalition for the Energy Efficiency of Buildings (CEEB) to develop and accelerate financial solutions and data tools to decarbonise the building stock.

Section 7 sets out the UKRLWG's recommendations arising from our activities. They include how to move towards more accurate data for carbon accounts for residential mortgage property in the near term.

3.1 Main findings

Below we summarise the main findings relating to carbon accounting gained from the knowledge exchange sessions of the UKRLWG to date. More information is provided in later sections.

Members who have prepared carbon accounts found that the Global Standard methodology was transparent and straightforward, but that the main challenge in calculating financed emissions was data quality and coverage.

- The accuracy of prepared carbon accounts depends critically on reliable data, which the financial institutions must access from external sources. Accuracy will depend on the choice of data and how data gaps have been overcome. It is therefore essential to be transparent about the quality of data as recommended in the Global Standard.
- Energy Performance Certificates (EPCs) provide carbon emissions arising from a property's space heating, lighting and hot water heating. EPCs are currently the mostly widely available source of information on residential property carbon emissions, however they are not available for every property. Just over half of the 29 million properties in the UK have a valid EPC. To date, EPCs have been used as an input for UKRLWG members that have disclosed residential mortgage financed emissions.

- While the issues with EPCs are well known (a brief summary of these is in section 4), there are considerable improvements and innovation ongoing within the governmental and the research communities which could potentially lead to improvements in data quality and availability; some of which is summarised briefly in section 5.
- To improve accuracy and transparency, financial institutions need straightforward access to up to date property-level data that reflects real energy use and the carbon intensity of the fuels used, and ideally does not require further manipulation to calculate current carbon emissions.
- Unlocking real energy use data recorded by smart meters in residential properties could significantly help improve data quality and insight into the greenhouse gas emissions associated with mortgage portfolios. Access to property-level smart meter data is restricted for general use for data privacy reasons and appropriate ways of accessing the data will need to be developed that can address data privacy concerns.
- Despite current limitations in data, the UKRLWG emphasises the importance and urgency of all mortgage providers and lenders getting started on their carbon accounting journeys, enabling them to acquire new insights into the energy performance and emissions of mortgage portfolios which underpin climate change mitigation strategies and climate disclosures. The Annex provides further information on UKRLWG members' carbon accounting activity.

4. Understanding data

To calculate financed emissions from residential properties, data is required to calculate (i) the building emissions and (ii) the attribution of emissions to the financial institution.

The UKRLWG has acquired greater understanding of the currently available data and its limitations, together with potential future developments which could improve the accuracy of carbon accounts. Key aspects are summarised below.

4.1 Building emissions

Emission scopes covered

Financial institutions shall cover the absolute scope 1 and 2 emissions related to the energy use of the property financed through the mortgage (energy use includes the energy consumed by the building occupant)”

Note: Emissions arise when a property is in use. They are impacted by the energy efficiency of the building and its services. Scope 1 emissions arise from direct fuel combustion at the property (e.g. gas) and scope 2 emissions arise from purchased electricity, heat or steam.

Reference: PCAF (2020).
The Global GHG Accounting and Reporting Standard for the Financial Industry. First Edition.

The first step to prepare carbon accounts is to evaluate the building emissions. Carbon accounts should transparently disclose the type of data being used to evaluate emissions and the quality of this data.

4.1.1 Energy Performance Certificates

Almost all UKRLWG members are currently using EPCs as the source of best available information on residential property emissions. A minority have access to whole-building smart meter data, though with incomplete portfolio coverage.

EPCs were originally introduced to summarise the energy efficiency of a dwelling and to recommend measures to increase energy efficiency and reduce running costs. The EPC provides emissions from regulated energy use (for space heating, lighting and water heating) calculated using the SAP (Standard Assessment Procedure) model⁵, based on a property’s size, fabric, heating system, lighting and renewable technologies. EPCs do not report emissions from other energy consumption, such as use of appliances and chargers. The EPC provides an Energy Efficiency (EE) Rating, from A (very efficient) to G (inefficient), based on energy costs per square metre to heat and light the property, and an Environmental Impact (EI) Rating (A to G) based on the annual carbon emissions per square metre of floor area from heating and lighting of the property. Both EE and EI are independent of location, as all homes are modelled assuming an

⁵ The Standard Assessment Procedure (SAP) is the UK government’s recommended methodology to assess and compare the energy and environmental performance of dwellings. Its purpose is to provide accurate reliable assessments that are needed to underpin energy and environmental policy initiatives. SAP is used to calculate the information included in the Energy Performance Certificates. For building regulations, SAP helps define the targets and constitutes the assessment of the measures proposed. Existing homes, which make up the majority of UK properties, are normally modelled using a Reduced Data SAP (RdSAP) which uses defaults based on the property age rather than property specific information where this is unavailable. This report uses the generic term SAP to refer to both SAP and RdSAP assessments

average UK weather, not the local or year specific weather. The EPC Action Plan⁶ sets out a series of actions to improve EPCs to maximise their effectiveness in improving the performance of the existing building stock.

Summary of limitations of carbon emissions calculated using EPC

The UKRLWG recognises that EPCs contain a great deal of valuable property-level data, thanks to the considerable effort and investment by homeowners, industry, the research community and government. In their current form, their limitations in providing accurate carbon emissions are summarised below:

- Many EPCs do not reflect the current situation. EPCs are valid for ten years. Property owners are required to have a valid EPC in order to sell or rent their property. As such, the EPC on record can be very out of date. For example, a homeowner may have made considerable changes to their property that affect the energy efficiency, but not updated the EPC. The Government's online databases are updated regularly as EPCs become available, however, there is a lag of some months in the data being accessible via the API.
- Many properties do not have a valid EPC, either because it has expired, or the last house sale pre-dates when EPCs were required (2008 in England and Wales; 2009 in Scotland). UKRLWG members who have prepared their carbon accounts found that coverage was quite poor, with only around 50% of properties having a 'valid' EPC (further information on 'valid' is below). Members used different approaches at various levels of complexity to estimate emissions for those without a valid EPC, which is an area for further work.
- The EPC is based on a normative energy which was never designed to reflect actual energy use, but to allow purchasers to compare the running costs of different properties independent of occupant behaviour, location or property size. As a consequence, there can be a considerable gap between modelled and actual energy use in any specific property.
- Research⁷ has shown there can be a considerable 'building performance gap' where the achieved performance (in real life) under standard conditions does not meet the designed performance (using the SAP model). The EPC is based on modelled energy use with no correction for building performance and may therefore significantly underestimate real emissions.
- Carbon emission factors are used to convert modelled energy use into carbon emissions. Carbon emission factors for electricity are rapidly changing, as the ratio of fossil fuels to renewables and nuclear for electricity generation declines. The EPC gives a measurement of carbon emissions at a fixed point in time, dependent on the SAP version used during the assessment.

6 The EPC Action Plan is available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/922660/EPC_Action_Plan.pdf

7 Building Performance Evaluation Programme, Innovate UK https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/497758/Domestic_Building_Performance_full_report_2016.pdf

4.1.2 Real-life data exists but access is limited

The Global Standard provides guidance on data quality scoring. Primary data on actual building energy consumption (i.e. metered data) scores the highest, with 1a using supplier-specific emission factors; and 1b using average emission factors.

Smart meters are gradually replacing traditional gas and electricity meters. Smart meters automatically provide energy usage data to the supplier, as well as enabling the user to see exactly how much energy they are using and the cost. Energy suppliers replacing traditional gas and electricity meters with smart meters, is described by Government as “an essential national infrastructure upgrade for Great Britain that will help make our energy system cheaper, cleaner and more reliable”. Energy consumption data, which includes gas and electricity metered data for every meter in the country, are annualised, aggregated and summarised in the National Energy Efficiency Data Framework (NEED).⁸ There, domestic consumption is assessed in terms of a number of factors, such as size of the property and household, property age, type and tenure. This meter data has been linked at property level to each EPC and so could in theory be used to augment the EPC data.

As well as benefitting energy suppliers and customers, unlocking real energy use data from residential properties could significantly help improve data quality and insight into the greenhouse gas emissions associated with mortgage portfolios. Access to real energy use data would give a better understanding of the real energy performance of the property and could remove the need for an EPC altogether.

At present, access to smart meter data is restricted for general use for data privacy reasons. Some institutions have limited access for non-commercial research purposes. However, there is growing recognition of advances in understanding that could come from greater access to smart meter data.

4.1.3 Energy use related to the energy efficiency of the building

As SAP calculations are based on notional standard occupancy, to normalise for the differing ways in which people utilise their homes, the EPC does not report ‘unregulated emissions’ from energy used for other appliances or chargers.

From the mortgage lenders’ perspective, the carbon emissions from regulated energy use associated with the fabric of the mortgaged property, are of critical importance. They can demonstrate to lenders, as well as policymakers, developers and homeowners, the carbon emission impact of energy efficiency improvements to the property.

Smart meter data, although not publicly available, provides total energy use. Next generation metering may segregate different appliances usage but that is a medium-term possibility only.

So far, UKRLWG members have used different approaches, using carbon emissions provided in the EPC with or without an estimation of emissions from unregulated energy use. This is an area that warrants further exploration.

⁸ The NEED framework can be found at <https://www.gov.uk/government/collections/national-energy-efficiency-data-need-framework>

4.2 Valuation used to calculate the attribution factor and the need for transparency

Attribution of emissions

When calculating financed emissions, a building's annual emissions are attributed to the mortgage provider using a loan-to-value approach. Thus, the attribution is equal to the ratio of the outstanding amount at the time of GHG accounting to the property value at loan origination.

$$\textit{Attribution factor}_b = \frac{\textit{Outstanding amount}_b}{\textit{Property value at origination}_b}$$

(with $b = \textit{building}$)

When the property value at origination is not feasible to obtain, financial institutions shall use the latest property value available and fix this value for the following years of GHG accounting (i.e., the denominator remains constant).¹³³

Reference: PCAF (2020).

The Global GHG Accounting and Reporting Standard for the Financial Industry. First Edition.

The Global Standard states for each property, the valuation at origination should be used to calculate the attribution factor. The attribution factor is multiplied by the property's annual operational carbon emissions to calculate the 'financed emissions', which the lender includes in its annual carbon accounts.

UKRLWG members have found that in practice, in some cases, property valuation at origination is not available (for example, where a mortgage originated several decades ago), or is no longer appropriate, for example where further advances have been released for property improvements, or as a property is built.

The Global Standard does not currently specify in detail how the valuation should be derived if the valuation at origination is not available or appropriate, and this is an area for further work. Given the valuation is used to determine the annual emissions that are attributed to the lender, it is essential to have transparent data governance and to disclose information on the approach to valuations where value at origination is not used. Unless there is a further advance, the property valuation used to calculate financed emissions should be fixed for following years.

For new properties that are under construction, the property should be excluded from the carbon accounts until the works are completed (and the property is occupied), as stated in the Global Standard. Members have then used the valuation at the time of completion, as a fixed data point, with the same requirements for data transparency.

4.3 Emission intensity metrics and comparability

A number of metrics can be used to express carbon emissions from residential property portfolio:

- Absolute emissions (the property's emissions measured in tonnes of CO₂e)
- Financed emissions (where the property's annual emissions are attributed to the mortgage provider using a loan-to-value approach)
- Financed emission intensity (financed emissions per £ of lending)
- Physical emission intensity (Absolute or financed emissions per m² of property floor area)

Emission intensity metrics enable a degree of comparability and benchmarking by translating absolute or financed emissions into an emissions intensity metric (emissions per a specific unit).

Physical emission intensity is an important metric for science-based targets, where lenders can track and benchmark the performance of the energy efficiency performance of their portfolios, in terms of emissions per square metre of property floor area. However, even when the Global Standard is applied, depending on the data used, the financed emission intensities will not be directly comparable. Nevertheless, financed emission intensity is a valuable strategic metric for lenders to monitor the carbon emissions associated with their mortgage lending.

5. Innovation to improve data

In recognition that data needs to improve, significant research and innovation is taking place, particularly relating to spatial data and real energy use data, which is in turn leading to new commercial applications.

The UKRLWG hosted knowledge exchanges sessions with observers to explore new developments in data, which are summarised briefly in this report. PCAF UK does not endorse the activities that are summarised below, but welcomes the important advances being made and looks forward to further evaluating how they may be utilised in the future as they develop.

5.1 Improving the Standard Assessment Procedure

The Standard Assessment Procedure which is used to provide EPC data, has been the subject of debate and criticism over the last ten years. A recent report (Making SAP and RdSAP 11 fit for Net Zero, June 2021) commissioned by the Department for Business, Energy and Industrial Strategy, put forward 25 recommendations to improve the Standard Assessment Procedure, to make it the best possible methodology for 2023-24, based on wide industry input and support. The UKRLWG welcomes improvements to the procedure and data, to improve the accuracy of carbon accounts and to encourage the right decisions for design, construction and retrofit of energy efficient buildings.

5.2 Research and innovation in data

A number of academic institutions have collaborated with government departments and received funding from UK research bodies to undertake applied research and development activities related to increasing the quantity and/or quality of information relating to the energy and carbon performance of the UK's building stock. Indeed, the UK is something of a world leader in the practice of 'building stock modelling' and the large-scale simulation of towns and cities.

The UCL Energy Institute, a PCAF UK observer, is one of the core institutions involved in this work and has been working in an advisory capacity to the UK government for a number of years on the assessment of the interaction of the UK's energy infrastructure and building stock in the context of the transition to net zero. This includes several government research projects including the establishment of the Centre for Research in Energy Demand Solutions (CREDS),⁹ the Smart Energy Research Lab (SERL)¹⁰ and the Active Building Centre (ABC).¹¹

Key advances in data include:

1. Generation of data from a model of global significance called '3DStock',¹² which builds a digital twin¹³ of every building (residential and commercial) using Lidar, Valuation Office Agency (VOA), NEED¹⁴, EPC and other data. This model has been applied to

9 CREDS: <https://www.creds.ac.uk>

10 SERL: <https://serl.ac.uk>

11 ABC: <https://abc-rp.com>

12 3DStock: <https://www.creds.ac.uk/wp-content/uploads/Building-stock-energy-modelling-uk-2020.pdf>

13 For information on Digital Twin:

<https://www.ucl.ac.uk/bartlett/energy/news/2020/may/3dstock-national-digital-twin-decarbonising-uks-building-stock>

14 The NEED framework can be found at

<https://www.gov.uk/government/collections/national-energy-efficiency-data-need-framework>

every building in London (see, the GLA London Building Stock Model¹⁵ and Solar Opportunity Map¹⁶).

Over the next two years this work is being continued in order to create the first ever global model of every building in a country, including its detailed 3D representation and energy demand by modelling England and Wales with 3DStock. The data-set produced by this analysis will deliver a range of innovations and applications ranging from the creation of a virtual EPC through to the foundations for a digital building passport. It will also enable for the first time an accurate representation of the building stock in England and Wales (residential, commercial and mixed use) for administrative, planning and research purposes.

2. Data collected from smart meters as part of the 13,000 home SERL Observatory where homeowners have provided consent to use their half-hourly gas and electricity smart meter data for public good research. This energy data is linked at the individual property to local weather data, public EPC data, and contextual data provided by an occupant completed questionnaire.

This data is being used to help create a series of innovations:

- **Generating Virtual EPCs** for the 50% of properties that currently do not have a surveyor-based EPC. Virtual EPCs are calculated by searching around the target dwelling for properties of similar character that have certificates, and assuming the target would obtain a similar grading. Premises closer to the target—for instance, other flats in the same block—are given heavier weightings in this process. Now that 3DStock is being rolled out to all properties in England and Wales it should be possible to have either a virtual or surveyor-based EPC for every property in England and Wales in the next two years. However, further work will still be required to determine the accuracy of the approach prior to virtual EPCs being used.
- **MyEPC and a LivingEPC:** maximising the usefulness of data collected as part of generating an EPC. Working with government (BEIS and DLUCH), UCL is investigating linking all the data collected by a surveyor to generate an EPC, to all the other 3DStock data. This would enable an EPC to be updated automatically (LivingEPC) if a certified improvement to a building had been undertaken, e.g. new windows or boiler. In addition, UCL is researching the best model to use EPC input data to predict actual energy use. This would enable an EPC to be tailored to a particular household's energy use patterns (MyEPC) helping to make better predictions of potential energy savings with a particular occupancy.
- **Reducing the performance gap.** One of the key determinants of a building's energy consumption is the building's heat loss. This is normally determined by a surveyor inspecting the property and trying to determine the construction. Alternatively, there can be attempts to measure this. Historically this has been expensive and intrusive

15 GLA London Building Stock Model:

<https://www.ucl.ac.uk/bartlett/energy/research-projects/2021/sep/london-building-stock-model>

16 UCL Solar Opportunity Map:

<https://www.ucl.ac.uk/bartlett/energy/research-projects/2021/sep/london-solar-opportunity-map>

for the occupants. UCL has been working with BEIS to help develop a new method of measurement using smart meter data. This technique is called Smart Meter Enabled Thermal Rating (SMETER) and UCL co-hosted a workshop¹⁷ with BEIS to help develop this technique which has many potential applications, for example, it could improve the accuracy of an EPC certificate. It could also check the effectiveness of improvements to the building's energy efficiency refurbishment, thereby encouraging the development of performance based contracting and helping to develop better site practices, which in turn could help reduce the performance gap. To support the development of SMETER, UCL is helping BEIS evaluate the thermal effectiveness of the Green Homes Grant (GHG) using consented smart meter data collected via SERL and analysing the data before and after the GHG interventions

Carbon Laces is an observer of PCAF UK, whose work seeks to enable cities, corporates, and communities to bring new financing to adapt to climate change through a results-based climate finance marketplace. It has aligned the UK's climate targets at a granular level with machine learning, cloud computing and real-time geospatial data to show consumption by multiple aggregations. Its dynamic models accelerate system-wide decarbonisation and abatement in scope 1-3 emissions. It analyses residential and commercial building energy with real building performance to inform innovative business models. The company is creating open data under a charity structure for 'data for good' which allows easy access and innovation. This is currently in the early testing phase with several partners.

Drawing on these insights into innovation to improve data quality, the UKRLWG has set out a number of recommendations in section 7.

5.3 Whole life carbon

Understanding whole life carbon emissions is the focus of many built environment professionals, such as the UK Green Building Council's work on the 'Net Zero Whole Life Carbon Roadmap'. The Global Standard accounts for annual operational carbon emissions arising from the building occupants' scope 1 and 2 emissions and does not include other emissions such as those from construction, renovation and maintenance.

¹⁷ SMETER: <https://www.ucl.ac.uk/bartlett/energy/news/2021/apr/smeter-workshop-explores-requirements-effective-uk-system-use-thermal-performance>

6. Coalition for the Energy Efficiency of Buildings

Measuring and reporting carbon emissions is an essential first step to inform decarbonisation plans. PCAF UK has benefitted from the Coalition for the Energy Efficiency of Buildings (CEEB) as an observer, with a common goal of decarbonising the building stock.

The CEEB was established in 2019 by the Green Finance Institute, with support from E3G, to catalyse new markets for financing the decarbonisation of buildings, promote the enabling conditions for market growth, and deliver a scalable model for stimulating financial innovation.¹⁸ The Coalition, which includes several UKRLWG members, identifies the barriers to investment into net zero homes, and actively develops the financial solutions and data tools needed to unlock these barriers and support widescale investment into greening the building stock. By anticipating and exploiting market developments, the CEEB co-creates and accelerates these solutions from inception, through the pre-commercial and pilot phases, to launch and then scale. The Coalition also provides a crucial bridge between the finance sector, business and government to ensure the latest thinking and experience is shared.

The CEEB has delivered a breadth of financial products, enabling tools and market insights, including:

- **Green Home Finance Principles:** Developed in collaboration with the Loan Market Association, the Principles promote integrity in the green mortgage market by providing financial institutions with a consistent and transparent methodology for the allocation of finance towards decarbonising the UK's domestic buildings.¹⁹ Within one year of launching, 11 financial institutions - representing one-third of the UK mortgage market by balance sheet - publicly aligned, or committed to align, at least one financial product with the Principles.
- **Building Renovation Plans:** Building Renovation Plans (BRPs) are digital tools to help property owners access decision-useful information to retrofit their home.²⁰ They provide information on the current energy performance of a property, past renovations; and a long-term retrofit roadmap that identifies future decarbonisation measures, along with links to contractors and finance options. Following extensive engagement with 50+ industry pioneers, in October 2021 the CEEB published a framework that outlines good practice considerations and recommendations for organisations developing BRP propositions, as well as those that seek to support their introduction.
- **Lender's handbook on green home retrofit and technologies:** In October 2021, the CEEB published a practical guide to help financial institutions and others understand the key energy efficiency, heating, microgeneration and resiliency technologies available to homeowners.²¹ The Handbook offers users a snapshot of each technology, including the current costs, carbon savings and benefits, as well as profiling the main funding options, quality assurances and guarantees to protect customers.

¹⁸ <https://www.greenfinanceinstitute.co.uk/ceeb>

¹⁹ <https://www.greenfinanceinstitute.co.uk/ghfp/>

²⁰ <https://www.greenfinanceinstitute.co.uk/building-renovation-plans/>

²¹ <https://www.greenfinanceinstitute.co.uk/lenders-handbook/>

Building on its early successes, the CEEB is exploring opportunities to test, demonstrate feasibility, and rapidly scale up its portfolio of financial solutions and data tools. Through a series of place-based partnerships, the Coalition will leverage local knowledge, skills and networks to mobilise public and private investment at pace and scale.

UKRLWG has benefitted from CEEB's shared insights and in turn, seeks to support the work of CEEB by increasing the ability of financial institutions to understand in detail the energy and carbon performance of their residential lending books.

7. Recommendations

The UKRLWG has prepared recommendations arising from its activity over the last year:

- I. To facilitate financial institutions using the PCAF methodology to prepare accurate carbon accounts for their residential property portfolios using EPC data:

We recognise that EPCs are a valuable resource, resulting from considerable professional input over many years, including the property assessments carried out by professional assessors and the ongoing development of the Standard Assessment Procedure model.

We welcome measures to:

- Redefine the main purpose of SAP to improve energy efficiency and reduce energy demand.
- Improve the SAP methodology to provide a more accurate assessment of energy use.
- Increase the coverage of EPCs and actively explore ways of developing a consistent approach to fill gaps, which could include options such as virtual EPCs or other innovations.
- Ensure EPCs are regularly updated to reflect improvements that are made to the fabric and heating system of a property, rather than static documents that capture a moment in time. A centralised data source would be helpful.
- Provide more information and data on the building performance gap, between modelled and real energy use, and help to standardise the approach to dealing with the gap in reported carbon emissions.
- Make more data used as part of the SAP calculation available in the public release of the EPC dataset. This would enable the outputs of EPCs to be more useful to those providing advice and support to homeowners.
- Reassess the basis for recommendations on energy efficiency measures in EPCs, so that they are helpful to homeowners and lenders seeking to reduce carbon emissions.

II. To facilitate financial institutions to enhance their carbon accounts for their residential property portfolios using real energy usage data:

We recognise the immense value provided by access to data on real energy use. We welcome measures to:

- Enable financial institutions to access real energy use for their residential property portfolio, based on metered gas and metered electricity.
- Enable access to data as close to real-time as possible, so that carbon emissions can be based on the most to up to date information. A centralised data source would be helpful.

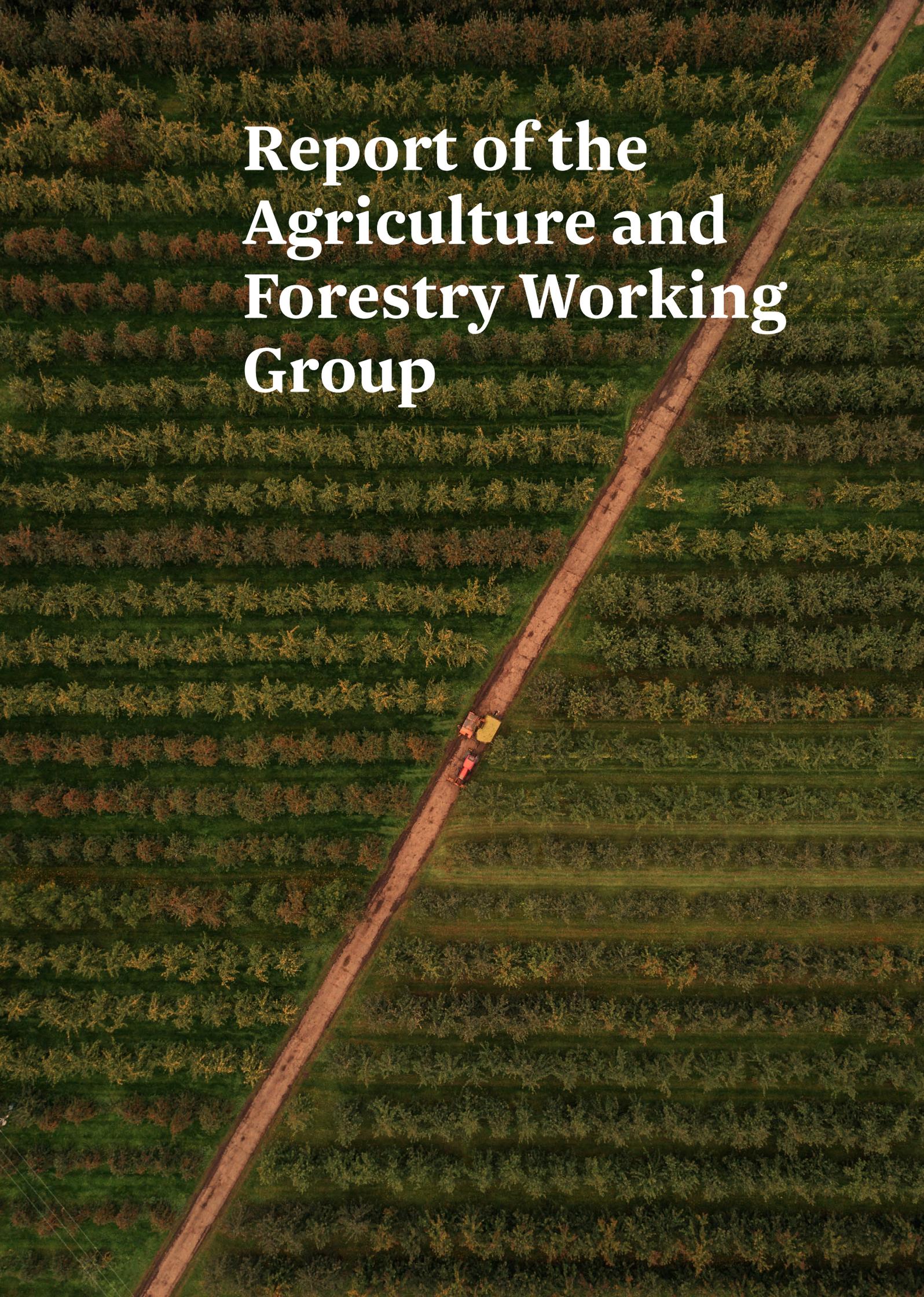
III. To improve plans and incentives for decarbonisation of residential property:

Decarbonisation of residential property will require installation of energy efficiency measures and low carbon heating, together with the decarbonisation of the energy supply. In order to evaluate how the property emissions will change over time and to ensure that adequate change occurs, we welcome measures to:

- Provide information on the trajectory for carbon intensity of the energy supply and increased availability and understandability of information relating to home energy efficiency and/or upcoming regulatory change.
- Increase government incentives for homeowners to take the measures required to improve the energy efficiency of their properties.

IV. To facilitate financial institutions' implementing effective climate change mitigation strategies:

The UKRLWG recommends all financial institutions to embark on their carbon accounting journeys, using the Global Standard and collaborating within the community.

An aerial photograph of a vast agricultural field, likely a vineyard or orchard, showing neat rows of plants. A wide dirt road runs diagonally across the field. A tractor is visible on the road, and the overall scene is bathed in the warm, golden light of late afternoon or early morning.

Report of the Agriculture and Forestry Working Group

1. About the PCAF UK Agriculture and Forestry Working Group

The PCAF UK Agriculture and Forestry Working Group (UKAFWG) was formed in 2021 and chaired by Robert Hall (Federated Hermes). The purpose of the UKAFWG is to act as an action-oriented forum for identifying and sharing lessons learned on the practical, institutional and technical processes required to disclose financed emissions in the agriculture and forestry sectors.

2. Progress to date and key findings

Carbon accounting for financed emissions requires financial institutions to access emissions data relating to the underlying asset; if the FI is unable to estimate the total emissions associated with the financed asset then it is unable to calculate the proportion of these total emissions which its financing enables. However, standardised carbon accounting methodologies for woodland and agricultural land (foremost among which are soil and woodland carbon accounting) are less mature than those that exist to account for emissions arising from the built environment. Early discussions of the UKAFWG were principally focused on a 'market review' of existing methodologies and tools for estimating the carbon footprint of underlying agricultural and/or forestry assets. Whilst the UKAFWG as a whole did not move forward on these topics, individual members are exploring broader industry collaborations beyond PCAF UK that can help to develop solutions to more accurately measure the emissions of agricultural and/or forestry assets.

3. Update on PCAF Global Core Group activity

It is important to note that forestry and agricultural activities can act as both a sink and source of GHG emissions (in particular carbon dioxide, nitrous oxide and methane) depending upon the nature of the woodland management scheme and/or agricultural practice. A key goal of the PCAF Global Core Team is to develop a global PCAF standard for financed 'negative emissions technologies' – i.e. a standard for accounting for and attributing emission removals. A number of UKAFWG members are also members of the PCAF Global Core Team, through which this work is being undertaken. A summary update on the development of a global standard for accounting for financed carbon removals by the PCAF Global Core Team is provided below.

PCAF GHG EMISSION REMOVALS METHODOLOGY DEVELOPMENT

Reporting emission removals is a way to quantify positive contribution towards net zero. Recognising the importance and the relevance for the financial sector to report on emission removals, the PCAF Global Core Team formed the GHG emission removals working group which consists of twelve PCAF Global participants. This working group is chaired by FMO and has been developing content on the following topics:

- General guidance on net-zero financed emissions accounting
- Detailed guidance on measurement and reporting of emission removals for listed equity & corporate bonds, business loans & unlisted equity and project finance
- Clear explanation on the use and reporting of purchased and/or sold carbon credits

The working group has consulted materials from the Intergovernmental Panel on Climate Change (IPCC) and the Oxford Principles for Net Zero Aligned Carbon Offsetting. In addition, tools to calculate emission removals have been reviewed. Public consultation on the proposed accounting and reporting guidance by PCAF's emission removals working group will take place in November and December 2021.

Glossary

Absolute emissions	Emissions attributed to a financial institution's lending and investing activity. Expressed in tonnes CO ₂ e.
Attribution factor	The share of total greenhouse gas (GHG) emissions of the borrower or investee that are allocated to the loan or investments.
Borrower	A person or company that borrows money from a bank.
Climate impact	In the context of this report, climate impact refers to the emissions financed by loans and investments.
CO₂-equivalent (CO₂e)	The amount of CO ₂ that would cause the same integrated radiative forcing (a measure for the strength of climate change drivers) over a given time horizon as an emitted amount of another GHG or mixture of GHGs. Conversion factors vary based on the underlying assumptions and as the science advances. As a baseline, PCAF recommends using 100-year Global Warming Potentials without climate-carbon feedback from the most recent IPCC Assessment report.
Direct emissions	Emissions from sources that are owned or controlled by the reporting entity or the borrower or investee.
Embodied emissions in buildings	The GHG emissions associated with the non-operational phase of the project. This includes emissions cause by extraction, manufacture, transportation, assembly, maintenance, replacement, deconstruction, disposal and end of life aspects of the materials and systems that make up a building.
Emission intensity metric	Emissions per a specific unit, for example: tCO ₂ e/€M invested or tCO ₂ e/MWh
Emission removal	The action of removing GHG emissions from the atmosphere and storing it through various means, such as in soils, trees, underground reservoirs, rocks, the ocean, and even products like concrete and carbon fibre.
Emission scopes	The GHG Protocol Corporate Accounting and Reporting Standard classifies an organisation's GHG emissions into three scopes. Scope 1 emissions are direct emissions from owned or controlled sources. Scope 2 emissions are indirect emissions from the generation of purchased energy. Scope 3 emissions are all indirect emissions (not included in scope 2) that occur in the value chain of the reporting organisation, including both upstream and downstream emissions.
Energy Performance Certificate (EPC)	Energy performance certificates (EPCs) are a rating scheme to summarise the energy efficiency of buildings. The building is given a rating between A (Very efficient) - G (Inefficient). The EPC presents the most cost effective ways to improve the energy rating. Similar energy performance certificates are used in many countries.
Financed emissions	Absolute emissions that banks and investors finance through their loans and investments.
Financial institutions	A company engaged in the business of dealing with financial and monetary transactions such as deposits, loans, investments, and currency exchange. Financial institutions encompass a broad range of business operations within the financial services sector including: commercial banks, investment banks, development banks, asset owners/managers (mutual funds, pension funds, close-end funds, investment trusts), and insurance companies.
Greenhouse gas (GHG) emissions	The seven gases mandated under the Kyoto Protocol and to be included in national inventories under the United Nations Framework Convention on Climate Change (UNFCCC)—carbon dioxide (CO ₂), methane (CH ₄), nitrous oxide (N ₂ O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF ₆), and nitrogen trifluoride (NF ₃).
GHG accounting	A means of measuring the direct and indirect emissions to the Earth's biosphere of CO ₂ and its equivalent gases from industrial activities.

GHG Protocol	Comprehensive global standardised frameworks to measure and manage GHG emissions from private and public sector operations, value chains, and mitigation actions. The GHG Protocol supplies the world’s most widely used GHG accounting standards. The Corporate Accounting and Reporting Standard provides the accounting platform for virtually every corporate GHG reporting program in the world.
Investment	The term investment (unless explicitly stated otherwise) is used in the broad sense: “Putting money into activities or organisations’ with the expectation of making a profit.” Most forms of investment involve some form of risk taking, such as investment in equities, debt, property, projects, and even fixed interest securities which are subject to inflation risk, among other risks.
Mortgage	This asset class includes on-balance sheet loans for specific consumer purposes—namely the purchase and refinance of residential property, including individual homes and multi-family housing with a small number of units. This definition implies that the property is used only for residential purposes and not to conduct income-generating activities.
Net zero	Net zero carbon dioxide (CO ₂) emissions are achieved when anthropogenic CO ₂ emissions are balanced globally by anthropogenic CO ₂ removals over a specified period.
Paris Agreement	The Paris Agreement, adopted within the UNFCCC in December 2015, commits participating countries to limit global temperature rise to well-below 2°C above preindustrial levels and pursue efforts to limit warming to 1.5°C, adapt to changes already occurring, and regularly increase efforts over time.
Standard Assessment Procedure (SAP)	The Standard Assessment Procedure (SAP) is the UK government’s recommended methodology to assess and compare the energy and environmental performance of dwellings. Its purpose is to provide accurate and reliable assessments that are needed to underpin energy and environmental policy initiatives. SAP is used to calculate the information included in the Energy Performance Certificates.
Scope 1 emissions	Direct GHG emissions that occur from sources owned or controlled by the reporting company—i.e., emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.
Scope 2 emissions	Indirect GHG emissions from the generation of purchased or acquired electricity, steam, heating, or cooling consumed by the reporting company. Scope 2 emissions physically occur at the facility where the electricity, steam, heating, or cooling is generated.
Scope 3 emissions	All other indirect GHG emissions (not included in Scope 2) that occur in the value chain of the reporting company. Scope 3 can be broken down into upstream emissions that occur in the supply chain (for example, from production or extraction of purchased materials) and downstream emissions that occur as a consequence of using the organisation’s products or services.

Annex

Further information on carbon accounting activities of UKRLWG members:

Ecology Building Society

<https://www.ecology.co.uk/wp-content/uploads/2021/03/Ecology-Annual-Report-Accounts-2020.pdf>

In March 2021, Ecology Building Society published its annual emissions from its mortgage portfolio, in its Annual Report and Accounts. All Ecology mortgages aim to generate an ecological benefit, in terms of saving energy and other scarce resources. Annual operational carbon emissions were assessed for each property, using CO₂ emissions from the property EPC, together with an estimate of CO₂ emissions from unregulated energy (based on average energy use of appliances in UK households from Energy Saving Trust). New build properties still under construction were not included. 48% of properties did not have a valid EPC. Using EPCs available for the mortgage portfolio, averages were derived for existing properties and new properties, which were then used to estimate emissions for properties where EPCs were not available. The majority of Ecology mortgages involve the release of funds as the property is built or renovated and its valuation increases, in which case the attribution factor was calculated for based on the latest physical valuation for the property, rather than the valuation at origination. Once the property works have been completed, the completed valuation in the carbon accounting database is fixed.

Nationwide Building Society

<https://www.nationwide.co.uk/-/assets/nationwidecouk/documents/about/how-we-are-run/results-and-accounts/2020-2021/climate-related-financial-disclosures-2021.pdf>

In May 2021, Nationwide published its enhanced climate-related financial disclosures, aligned to the recommendations of the Taskforce on Climate-related Financial Disclosures. To calculate the carbon emissions for their mortgages (scope 3), Nationwide developed an innovative model to interpolate publicly available EPC data and to provide EPC ratings for the roughly half of the mortgage portfolio that does not have a valid EPC. The model uses a combination of artificial intelligence and machine learning techniques to match similar property features in order to best estimate EPC's. The EPC data was then used to calculate the CO₂ emissions associated with space and water heating, and lighting for each property. Nationwide used the Partnership for Carbon Accounting Financials' Global Standard to calculate its financed emissions, weighted by the ratio of loan amount to property value, as well as a data score for its scope 1, 2 and 3 emissions.

Lloyds Banking Group

<https://www.lloydsbankinggroup.com/assets/pdfs/who-we-are/responsible-business/downloads/lbg-esg-interactive-210223.pdf>

In February 2021, Lloyds Banking Group published its initial estimated view of its 2018 financed emissions baseline across the Group's own lending activity. We selected 2018 as there was more comprehensive company emissions reporting and UK Government Office of National Statistics (ONS) emissions data available at that time. We used the emerging industry standard for calculating financed emissions developed by the Partnership for Carbon Accounting Financials

(PCAF). Given this is a new discipline that will continue to develop and evolve, it is expected that our baseline will change in the future (perhaps materially), which may require restatement. Our mortgages financed emissions excluded non-UK mortgages. We used EPC emissions estimates for 45% of properties and average emission intensity profiles of EPC C to G properties to calculate emissions for the balance of properties where EPCs were not available. Property index value as at end 2018 was used for current property value in the PCAF emission attribution calculations.

Natwest Group

<https://investors.natwestgroup.com/~media/Files/R/RBS-IR-V2/results-center/19022021/2020-climate-related-disclosure-report.pdf>

During 2020, NatWest Group worked on developing capabilities to estimate our financed emissions to enable us to: (i) Identify, assess and manage climate-related risks and opportunities, (ii) understand the drivers of climate-related transition risks and opportunities in our business, (iii) set and navigate emissions reduction goals, (iv) act to reduce our climate impact. We focused on estimating financed emissions and emissions intensities for four sectors: residential mortgages, agriculture (primary farming), automotive manufacturers and oil and gas extractors, and published initial estimates of financed emissions and emissions intensity in our 2020 climate related disclosures report in February 2021. To estimate financed emissions on residential mortgages, we used EPC data as an estimate of the underlying climate impact. As EPC ratings only need to be updated every ten years or after significant retrofits, point of sale or lease, not all properties have current EPC ratings. As at December 2019, EPC data was available for just under half of the residential mortgage portfolio. To estimate EPC ratings for properties which did not have publicly available EPC data, we used average emissions profile of properties for which EPC data was available. This is based on the assumption that properties without EPC ratings have the same emissions intensity profile as those with available EPC ratings.

TSB Bank Plc

<https://www.tsb.co.uk/do-what-matters>

TSB launched the Do What Matters plan in July 2020, its very first responsible business plan aligning business strategy with TSB's social and environmental footprint. Led by the Board and driven by members of the Executive Committee it forms a key part of TSB's corporate strategy and targets. Within this overarching plan, transitioning to net zero is a key objective for the environmental pillar and in January 2021 TSB announced its commitment to achieve net-zero from their own operations by 2030. In parallel, TSB also signed up to the Science Based Targets initiative. In July 2021 TSB joined PCAF, and participation in the Residential Mortgages Working Group supports baselining and target setting for Scope 3 emissions, including TSB's mortgage portfolio.

For more information please contact
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PCAF

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Financials

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