




Finance for domestic decarbonisation-led retrofit

How homeowners can fund the decarbonisation of their property

August 2022

Barry Malone

Active Building Centre Research Programme
Bay Campus
Swansea University
Swansea
SA1 8EN

 info@abc-rp.com

 [@BuildingActive](https://twitter.com/BuildingActive)

 www.abc-rp.com

Contents

INTRODUCTION 3
RETROFIT COSTS 4
BARRIERS 5
FINANCIAL INCENTIVES 6
 Energy Company Obligation (ECO) 6
 Grants 7
 Green Home Grants 7
 Domestic Renewable Heat Incentive 7
 Boiler Upgrade Scheme 7
 Loans 8
DISCUSSION 9
CONCLUSION 12
REFERENCES 13



Introduction

In the UK, the operation of buildings accounts for approximately 30% of anthropogenic GHG emissions while energy use in UK homes accounts for 14%, from the use of fossil fuels for heating, cooling, and electricity use ([Climate Change Committee, 2019](#)). Compounding this is the fact that the UK has some of the oldest building stock in Europe and consequently, one of the most energy inefficient ([Maclean et al., 2016](#)).

The retrofitting of energy efficiency measures into existing residential properties can significantly reduce household energy consumption ([Berretta et al., 2021](#)) ([Coyne & Denny, 2021](#)). In a 2019 report, the Climate Change Committee ([2019](#)) called for the retrofitting of the twenty-nine million existing homes across the UK to make them low-carbon, low-energy and resilient to a changing climate. An estimated £360bn of investment will be required to decarbonise the UK housing stock to meet this target ([Green Finance Institute, 2021a](#)).

On a per home basis, the cost of retrofitting in the UK can be over £10,000 ([Energy Saving Trust, 2021](#)), while the conversion of each UK home to a low carbon heating system has been calculated at an average cost of £26,000 ([Climate Change Committee, 2019](#)). Energiesprong, a private enterprise who take a whole house retrofit approach, operate at the top end of this price range, and can cost up to £60,000 ([CIBSE, 2018](#)).

For progress to be made in decarbonising the UK's current housing stock, mechanisms for homeowners to access funding to retrofit their properties need to be designed and launched.

The aim of this paper is to identify the different Financial Incentives that are currently available to homeowners to access capital to manage the upfront costs of carrying out renovations aimed at decarbonising their properties. The focus is on the financial and non-financial implications of these measures, the technical appropriateness of the measures is not discussed. The high-level criteria residential property owners must meet to access such mechanisms is also examined.



Retrofit costs

Homeowners looking to decarbonise their property face significant costs which can build up depending on what is required. In what is a change from the current home energy payment model where upfront installation costs are low while running costs are high, the homeowner will be responsible for high initial capital costs to fund the retrofit process. This is proving to be a barrier to owner-occupier decarbonising their property ([Miu et al., 2018](#)).

Table 1 gives a breakdown of the different costs associated with the different retrofit measures. There are many different factors that can influence the costs, type and size of home, access, materials, space limitations, planning restrictions ([Palmer et al., 2017](#)) and the type of measures required to retrofit the home.

Measure	Lowest cost per home	Mean cost per home	Highest cost per home
Internal wall insulation	£6,800	£7,900	£8,900
External wall insulation	£7,100	£11,800	£15,000
Cavity wall insulation	£480	£750	£1,400 (£2,500 for Hard-to-treat (HTT))
Party wall insulation	£300	£325	£350
Loft insulation	£185	£450	£670 (£2,000 HTT)
Underfloor insulation	£3,500	£5,800	£8,300
Solid floor insulation	£1,300	£5,700	£9,800
Replacement double glazing (panes and frames)	£3,900	£6,400	£10,700
Gas boiler replacement	£1,600	£2,000	£2,400
Heating controls	£-	£450	£-
Hot water cylinder insulation (jacket)	£13	£22	£40
LEDs	£4.20/bulb	£7/bulb	£9.80/bulb
Draught-stripping	£85	£180	£275

Table 1 - Costs of Retrofitting Homes ([Palmer et al., 2017](#)).

The balanced pathway set out in the 6th Carbon Budget from the Climate Change Committee ([2020](#)) prioritises the thermal efficiency of homes before the installation of low-carbon heating, such as heat pumps, in reaching net-zero. Compared to the costs outlined in Table 1, the CCC estimate that, on average, the total investment required per household for these thermal efficiency measures will be less than



£10,000 on average over the next 30 years, while 63% of homes will need to spend less than £1,000 on retrofitting energy efficiency measures ([Climate Change Committee, 2020](#)).

Barriers

As well as financial barriers to energy efficiency retrofit there are non-financial barriers to consider. Table 1 gives a clear breakdown of the barriers that homeowners encounter when they are considering decarbonising their property. Non-financial barriers need to be addressed through education, awareness, and support. A change in mindset is also required from the homeowner, to one where they accept that reducing carbon emission will require compromise.

The lack of information available to the homeowner to decide on how best to retrofit their property can lead to them making the wrong decision, a costly mistake, or to them deciding not to proceed with the installation. This is recognised by the Climate Change Committee in their 2022 Progress Report where they recommended setting up an online portal to provide high-level and trusted information for the public to make better informed decision ([Climate Change Committee, 2022](#))

From a financial perspective the inability to access private capital can have a major impact on the uptake of retrofit interventions ([Schleich et al., 2019](#)). Homeowners who own their property either outright or through a mortgage fall under the tenure of owner-occupier and hence in the ‘able-to-pay’ bracket when it comes to financing energy efficiency retrofit installation to their property ([Kerr & Winskel, 2020](#)).

The owner-occupier tenure makes up 62% of UK households which is the largest potential market for financing home decarbonisation ([Christiansen & Lewis, 2019](#)). For those in this bracket, private capital will deliver most of the investment to allow energy efficiency improvements to be carried out ([Green Finance Institute, 2020b](#)). Financial Incentives (FI) are an important tool to allow homeowners to access to this type of funding ([Kerr & Winskel, 2020](#)). They are available in various guises; soft loans, tax incentives, mortgages, grants ([UKGBC, 2013](#)) and they can assist in reducing financial barriers to the installation of retrofit interventions in UK properties ([De la Rue du Can et al, 2014](#)) ([Harmelink et al, 2008](#)).

Financial Barriers	Non-Financial Barriers
High upfront costs for improvements.	Low awareness among homeowners, and disconnect between a genuine concern about climate change and the energy efficiency of their property
Lack of access to capital	Professional influencers fail to inform and educate homeowners of benefits
Low confidence in energy bill savings: A barrier for homeowners seeking full repayment via energy savings.	Lack of good quality information and support on products, choices, and suppliers. to embark on a renovation ‘journey’.



Duration of tenancy: Energy bill savings may not accrue to the original homeowner if they move property.	Duration, hassle, and complexity (i.e., supply chain, installation, finances) of retrofit projects.
Property value-add: Efficiency improvements not considered to increase and/or protect property values.	Lack of confidence in the supply chain
Availability and accessibility of products: Low penetration and availability of attractive financial offers for efficiency measures.	Leaseholders gaining permission: Getting collective agreement amongst groups of share-of-freeholders.

Table 2: Financial and non-financial barriers to retrofit projects in the owner-occupied sector ([Green Finance Institute, 2020a, p24](#))

Financial Incentives

Financial Incentives (FI) are funding mechanisms to encourage homeowners to invest the capital required to retrofit their homes. They have been used successfully as a policy tool to accelerate the use of renewable energy in Germany, Spain ([IEA, 2021](#)) and USA ([Gouchoe et al., 2002](#)). There are currently a range of FI available to encourage retrofit activity in owner-occupied residential properties in the UK ([Kerr & Winskel, 2020](#)). These include Energy Company Obligation (ECO), Green Home Grants, Domestic Renewable Heat Incentive, Boiler Upgrade Scheme and Loans.

Energy Company Obligation (ECO)

The ECO is currently the main scheme for supporting energy efficiency improvements in British homes ([OGFEM, 2022](#)). Under the scheme, energy providers are required to meet a certain number of ECO points through the retrofitting of energy efficient measures ([Miu et al., 2018](#)). Unlike other schemes, the ECO is not a government grant, it is an obligation placed on the largest energy suppliers to provide energy efficiency support to low income and vulnerable households. A knock-on effect from this is the costs spent by the energy providers is passed onto the customers through their energy bills ([Simple Energy Advice, 2022](#)).

In 2019 the ECO was worth £380 million, with most of this focused on insulation and the replacement of efficient gas boilers ([BEIS, 2019](#)). There has been significant success in retrofitting energy saving measures through the ECO with 78,000 owner-occupied homes benefitting in 2019-22 ([BEIS, 2019](#)). While the fact that the energy providers can choose which energy-saving measures they provide potentially limits its agility, the scheme has been criticised for being short-sighted by focusing on the more cost-effective measures over the more expensive long-term measures that have more impact ([Kerr & Winskel, 2020](#)).

The focus for the ECO is on lowering heating costs for low income and vulnerable households across all tenures meaning that the scheme is accessible by those in the owner-occupier tenure.

To be eligible for ECO support, the beneficiary needs to receive at least one of several required benefits, and satisfy some income requirements ([OGFEM, 2021](#)). For example, to qualify for the ECO under the Child Benefit scenario, a household's relevant income must not exceed specified amounts, less than



£18,000 for a single income home with one child up to less than £39,000 combined income for four plus children.

Grants

The simplicity of grants for the retrofit of residential properties makes them an appealing method of accessing finance and explains their popularity in the green finance sector ([Kerr & Winskel, 2020](#)).

Currently, there are several government schemes available to homeowners to access green finance for retrofitting of their property. Government schemes come and go depending on the political situation at the time. This everchanging landscape can make it confusing for homeowners to know how to access funding.

Green Home Grants

In September 2020 the Green Homes Grant (GHG) was introduced by the Department for Business, Energy & Industrial Strategy. It was a £1.5bn scheme designed to assist in allowing homeowners to access funding for energy-efficient home improvements set to run until March 2022 ([Hinson & Adcock, 2021](#)) However, the scheme was cancelled as of March 2021 having reached just 10% of the 600,000 homes promised at the outset. The failure of the scheme has been attributed to it being poorly designed and implemented, with a portion of the blame being attributed to the scheme administration contractor, ICF Consulting Services Ltd ([The Committee of Public Accounts, 2021](#)). The scheme was criticised by the National Audit Office ([2021](#)) for being overly complex, resulting in a scheme that failed in its objectives and was a poor experience for both the consumer and the installers. There is a risk that this outcome of the scheme can be a detriment to the promotion of energy efficiency.

Domestic Renewable Heat Incentive

The scheme, available in England, Scotland and Wales, to support the installation of renewable heating systems in domestic housing is called the Domestic Renewable Heat Incentive (DRHI) ([OGFEM, 2022](#)). Rather than get assistance with the initial capital costs of the installation, the DRHI makes a payment for every unit of renewable heat that is produce for several years. The value is dependent on the type of renewable energy source, the amount of energy used and the financial situation of the customer. The scheme is currently available to homeowners in England, Scotland, and Wales. The DRHI closed to new applicants on 31 March 2022 ([OGFEM, 2022](#)).

Boiler Upgrade Scheme

With the premature closure of the GHG and the ending of the DRHI, the government has announced the introduction of the Boiler Upgrade Scheme (BUS). This is a £450 million scheme, set to start in April 2022, which will aim to provide upfront capital grants of up to £6,000 to households to decarbonise domestic heating as part of the £3.9bn Heat and Buildings Strategy ([BEIS, 2021b](#)).

£5,000 is available for the purchase of air source heat pumps (ASHP) and biomass boilers, with £6,000 available towards ground source heat pumps (GSHP), homeowners will have to meet the remaining cost of the installation.



The scheme is set to run until April 2025, with all homeowners in England and Wales able to access the BUS, apart from social housing and new-build properties. All applicants must have a valid Energy Performance Certificate (EPC) issued in the previous 10 years that has no outstanding recommendations for loft or cavity wall insulation. 30,000 installations per year for three years are permitted, and will operate on a first come, first served basis.

Application is through a voucher system where the homeowner applies for a voucher, engages with a certified installer, who, upon completion of the install, certifies the heat pump through the microgeneration certification process and then apply to Ofgem to redeem the voucher. The installer is paid directly with the customer billed for the remaining amount.

In Scotland, the Home Energy Efficiency Program in Scotland (HEEPS) offers homeowners interest-free loans of up to £10,000 for implementing energy efficiency measures ([Schleich et al., 2019](#)).

Loans

For those households classified in the 'able-to-pay' bracket, services offered through the UK's leading bank and building societies provide an option for them to finance decarbonisation of their homes.

Financing through the private equity markets is essential to the UK achieving its net-zero target ([Grantham Research Institute on Climate Change and the Environment, 2020](#)). These services are offered under the title of 'Green Finance' that offer preferential rates to customers to carry out measures to decarbonise their homes (Green Finance Institute, 2021b). In Germany, loans of up to €100,000 with favourable interest rates, are available through the Energy-Efficient Refurbishment program for homeowners to carry out retrofit measures ([Schleich et al., 2019](#)).

In the UK several lenders have recently made commitments to support homeowners in improving the energy efficiency of their homes ([BEIS, 2021a](#)). Currently NatWest, Barclays and HSBC offer green loans to businesses while personal green loans are still in their infancy.

As part of this commitment there has been an increase in the number of lenders offering green mortgages to their customers in recent years ([Green Finance Institute, 2021b](#)). Currently, a preferential interest rate is offered to the homeowner on their mortgage if they are purchasing a property with an EPC rating of A or B. This type of financial incentive has the potential to revolutionise energy efficiency in UK home by unlocking additional finance for homeowners ([World Green Building Council, 2018](#)).

Green Finance has been identified as a priority by the UK Government for the availability of additional capital for homeowners to increase the energy efficiency in their homes ([HM Government, 2021](#)). Previously, the private sector has been encouraged by the UK Government to develop green finance products ([BEIS, 2017](#)). While green mortgages were first introduced in the UK in 2006 by Ecology Building Society, they were the only lender that provided this type of service until 2018 when Barclays Bank introduced their own green mortgage ([Green Finance Institute, 2021b](#)). Since then, the number of lenders has grown to the point where there are now 31 lenders providing green mortgage services in the UK (see appendix A for a detailed list) ([Green Finance Institute, 2022](#)).

The eligibility criteria for green mortgages are similar to those of regular mortgages and vary from lender to lender. Typically, a lender will be looking at the following criteria when making a decision on lending on a green mortgage ([Wait, 2021](#)):



- EPC level of the property
- Size of the loan
- Size of the deposit offered
- Type of property being purchased
- Employment status
- Credit rating
- Affordability

The EPC rating of a property is the only criteria that is specific to the requirements of a Green Mortgage. Here the lender will be looking for energy efficiency rating of 81 or above, or in energy efficiency bands A or B in a property ([Green Finance Institute, 2021b](#)).

For those with an existing mortgage looking to access additional funding to decarbonise their home the eligibility criteria are based around the energy efficiency of the property. In 2021 Santander, in partnership with Countrywide Surveying Services, launched [EnergyFact](#) ([Santander, 2021](#)). This report is open to existing Santander customers, it is a free, practical home energy report for the homeowner to understand what changes could be made to the property to make it more energy efficient. While not directly linked to accessing finance from the lender, it provides the homeowner with an idea of how much additional funds they will need.

Halifax Building Society provide a similar online service through its website called [Home Energy Saving Tool](#) ([Halifax Building Society, 2022](#)). This tool gathers information regarding the property and creates an 'Action Plan' that includes estimated costs required to make the property more energy efficient. Like the [EnergyFact](#) report, it does not give the homeowner direct access to funding, only an estimate of how much is required. To access additional funding on an existing mortgage, the homeowner will have to go through the specific eligibility criteria for the specific lender.

Discussion

None of the funding mechanisms available to homeowners to manage the upfront costs of carrying out retrofit renovations to decarbonise their properties can be said to be without fault, out of the mechanisms discussed, green mortgages appear to be the most accessible to homeowners. While they do not overcome all barriers, they perform better than the other funding mechanisms.

The focus of the ECO is on supporting those in fuel poverty to make their homes more energy-efficient and thus reducing the running costs of the property. Access to the ECO is limited and subject to strict criteria, detailed earlier in the paper. While many homeowners may qualify, this mechanism excludes a significant portion of the population through its qualifying criteria.

The delivery of the ECO schemes has been fragmented, with the focus on the delivery of lower cost retrofit measures. As a result, it fails to address the funding barrier for the more expensive measures such as solar panels and heat pump installations. These types of measures are necessary as they can actively reduce a household's use of carbon emissions and help reduce grid carbon intensity.

Grants are the most popular form of funding mechanism among the public. The fact that the capital received is non-repayable overcomes the financial barriers to retrofit. The issue arises when addressing non-financial barriers. As a policy tool, grants frequently change their structure and can end suddenly, as



seen with the Green Homes Grant. Application for the various grants can be long and unduly complicated and are reliant on current government policy. These issues raise non-financial barriers that can make them unappealing or even unsuitable as a funding mechanism for homeowners. To overcome these issues government would need to maintain a stable, long-term plan, to renew the confidence of industry and consumers, an attempt has been made by the government to achieve this through the introduction of the heat strategy and the Energy security strategy ([The Committee of Public Accounts, 2021](#)).

In recent years there has been a significant investment in the retrofitting of energy efficiency measures in social housing in the UK. The Social Housing Decarbonisation Fund (SHDF) was set up in 2021 targeting social rented homes to increase their energy efficiency with the aims to “deliver warm, energy-efficient homes, reduce carbon emissions and fuel bills, tackle fuel poverty, and support green jobs” ([BEIS, 2021c, pg8](#)). In Wales, the Optimised Retrofit Programme (ORP) is financing a number of projects to determine the most efficient and cost-effective method of retro-fitting social housing ([Welsh Government, 2022](#)). These path finding projects will help to establish an evidence base of effective measures, as well as stimulate the supply chains needed for retrofit at scale, enabling growth in green finance products and transition to private stock.

As part of the BUS, the UK government has committed to Air Source Heat Pumps as a primary intervention to decarbonise the heating in domestic housing. Last year they pledged to install 600,000 heat pumps in homes per year by 2028, 27,000 were installed as of 2019 ([Energy Saving Trust, 2021](#)). The Climate Change Committee estimates that there is a requirement for one million heat pump installations per year by 2030 to meet decarbonisation targets ([Element Energy, 2021](#)). The number required and the number of installations currently taking place requires a significant increase. This in itself provides a non-financial barrier for homeowners, as demand grows for the installation of heat pumps and this is not met with an increase in installers in the short-term, there will be difficulty getting them installed and potentially driving up the short-term costs. This compounds with a lack of knowledge for homeowners in being sure about the right solution and investment for their home.

The BUS scheme is limited to England and Wales, excluding a large chunk of the UK population. With the upfront cost of installing a low carbon heating source a major barrier to uptake, a grant of up to £5,000 does not meet the estimated cost of £10,000 to £12,000 on average to install a heat pump. This leaves homeowners to raise a significant portion of the initial capital costs and, while reducing the impact of the cost barrier, still leaves it in place. With the costs for the installation of heat pumps not showing decreasing trends ([Renaldi et al., 2021](#)) the cost barrier will remain of significant without an increase in the funding to homeowners or a reduction in the cost per £/kW.

Another issue with the BUS is that it is not accessible to those homeowners that have an outstanding requirement for cavity or floor installation on their EPC. This leaves the homeowner with more capital costs to fund before they can access funding for a low carbon heating system. This begs the question should the focus from the UK Government be on funding increasing efficiency through insulation rather than on the installation of heat pumps.

To provide initial capital for the homeowners, the private equity sector is playing an increasingly prominent role in the financing of the decarbonisation of the domestic housing sector ([BEIS, 2021a](#)). Loans are seen as less attractive to homeowners than non-repayment incentives even though they are less likely to generate lower leverage ratios ([Kerr & Winskel, 2020](#)). While the current offering of green mortgage products from the domestic banking sector are focused on homes with existing high-level EPC ratings,



there is an increased recognition from the sector of the need to provide funding to homes to improve their EPC rating ([Green Finance Institute, 2020b](#)). Currently only 3% of UK homes have an EPC rating that satisfies the requirement for a green mortgage.

In 2021 Lloyds, RBS, and Nationwide all made commitments to support homeowners to improve the energy efficiency of their homes ([BEIS, 2021a](#)). With an existing network of funding the current process of providing mortgages has the potential to be the most successful at funding green improvements as it is building on an existing structure and processes that homeowners are familiar with. The issues arise, as for regular mortgages, with accessing mortgage finance. Lenders have strict requirements when it comes to lending, and these have become stricter since the financial crisis of 2008.

There is also the potential for this method of lending to push homeowners further into debt by adding to their initial borrowing. With the latest rise in UK interest rates bringing them to a thirteen-year high ([Bank of England, 2022](#)), this adds further risk of default for homeowners with mortgages ([Linn & Lyons, 2019](#)). The counter to this is that the homeowner is expected to save on energy costs over the long term to offset the increase in borrowing, there is a potential to save up to £905 per annum ([Energy Saving Trust, 2022](#)). This may be more significant recently given the large increase in UK energy bills.

The green mortgage market in the UK continues to grow based on increased public demand for financial products that satisfy their requirements to be more environmentally friendly ([Harvey, 2022](#)). With the green mortgage still in its infancy as a financial product the Green Home Finance Principles (GHFP) by the Green Finance Institute provide a level of consistency that the homeowner can relate to. A homeowner knows that a lender aligning themselves with these principles is trustworthy about the product that they are providing. This moves to alleviate the non-financial barrier of lack of support and understanding for the homeowner about green finance.

The strict eligibility criteria required by lenders to access a mortgage raises a financial barrier for homeowners. With the rise in house prices, those without mortgages are finding it more difficult to meet the income criteria to access this funding mechanism ([McMullan et al., 2021](#)). Another barrier is debt aversion among homeowners which has been found to negatively impact on the adoption of retrofit measures ([Schleich et al., 2019](#)). This may deter homeowners from accessing a green mortgage or adding to their existing mortgage for fear of incurring large debts.

The UK government can play a positive role in this sector by working with the private sector on how to improve the take-up of green mortgages. An option for achieving this is through the development of innovative green finance products for homeowners that target different of different income levels and EPC ratings.

The EPC is an important document as it allows homeowners to identify where they can make energy efficiency improvements to their home, and it gives lenders the energy efficiency rating of a property. However, the reliance of the lenders on the EPC when determining what properties are entitled for a green mortgage or additional financing carries a risk ([Kerr & Winskel, 2020](#)). There are a number of issues with the EPC process, the quality is strongly influenced by the qualification of the assessor ([Arcipowska et al, 2014](#)), this can result in a variation of the results depending on who carries out the assessment ([Li et al, 2019](#)). In its current format the EPC is ill suited to being a decision tool to determine access to funding. Changes can and should be implemented to the process to be ensure it is a more robust and accurate tool better able to support the decarbonisation of UK homes on the journey to net zero by 2050.



Conclusion

In the current system, green mortgages are the most transparently accessible and familiar way for homeowners to access funding to decarbonise their properties. Green mortgages overcome some of the financial and non-financial barriers that are present with accessing green finance. A significant number of homeowners that have an existing mortgage will be able to access to additional funding for renovations that focus on reducing the carbon emissions of their home. Mortgages are an existing funding mechanism that the public are familiar with. The banks also have an interest in making the process as straightforward as possible. Alternative funding mechanisms have been proposed, it is a matter of time to determine if these will prove successful and an alternative to green mortgages.



References

- Arcipowska, A. Anagnostopoulos, F. Mariottini, F. and Kunkel, S. (2014) *Energy performance certificates across the EU A mapping of the national approaches*. Brussels: Buildings Performance Institute Europe.
- Hinson, S. and Adcock, A. (2021) *Green Homes Grant*. (HC, CBP 9235). (Online) London: HMSO. Available from: <[@www.parliament.uk/commons-library/intranet.parliament.uk/commons-library/papers@parliament.uk](http://www.parliament.uk/commons-library/intranet.parliament.uk/commons-library/papers@parliament.uk)> [Accessed 03 July 2022].
- Bank of England (2022) *Why have interest rates gone up?* [Online] Available from: <<https://www.bankofengland.co.uk/knowledgebank/why-are-interest-rates-in-the-uk-going-up>> [Accessed 03 August 2022].
- BEIS (2017) *The Clean Growth Strategy Leading the Way to a Low Carbon Future*. London: HMSO.
- BEIS (2019) *Green Finance Strategy Transforming Finance for a Greener Future*. London: HMSO.
- BEIS (2021a) *Heat and Buildings Strategy*. London: HMSO
- BEIS (2021b) *Plan to Drive down the Cost of Clean Heat*. London: HMSO
- BEIS (2021c) *Social Housing Decarbonisation Fund Competition Guidance Notes*. London: HMSO.
- Berretta, M. Furgeson, J. Yue, |, Wu, N. Zamawe, | Collins, Hamilton, I. & Evers, J. (2021) *Residential Energy Efficiency Interventions: A Meta-Analysis of Effectiveness Studies*. [Online]. Campbell Systematic Reviews, 17 (4) December, pp. 1206. Available from: <<https://doi.org/10.1002/cl2.1206>> [Accessed 22 May 2022].
- Christiansen, K. and Lewis, R. (2019) *UK Private Rented Sector*. London: Office for National Statistics.
- CIBSE (2018) *Energiesprong – the Dutch system that could rescue Britain’s social housing*. [Online] London: CIBSE Journal. Available From: <<https://www.cibsejournal.com/>> [Accessed 22 July 2022].
- Climate Change Committee (2019) *Net Zero The UK’s Contribution to Stopping Global Warming*. London: Committee on Climate Change.
- Climate Change Committee (2020) *The Sixth Carbon Budget*. London: Committee on Climate Change.
- Climate Change Committee (2022) *Progress in reducing emissions 2022 Report to Parliament*. London: Committee on Climate Change.
- Coyne, B. and Denny, E. (2021) *Retrofit Effectiveness: Evidence from a Nationwide Residential Energy Efficiency Programme*. Energy Policy, 159 (112576) December, pp. 1-15.



De la Rue du Can, S. Leventis, G. Phadke, A. and Gopal, A. (2014) *Design of incentive programs for accelerating penetration of energy-efficient appliances*. Energy Policy 72 May, pp. 56–66.

Element Energy (2021) *Development of trajectories for residential heat decarbonisation to inform the Sixth Carbon Budget*. Cambridge: Element Energy.

Energy Saving Trust (2021) *Future Heating in the UK: Heat Pumps and Hydrogen - Energy Saving Trust*. [Online] London: Energy Saving Trust. Available from: <<https://energysavingtrust.org.uk/the-future-of-heating-in-the-uk-heat-pumps-or-hydrogen/>> [Accessed 25 January 2022].

Energy Saving Trust (2022) *Steps to Save Hundreds on Home Energy Bills - Energy Saving Trust*. [Online] London: Energy Saving Trust. Available from: <<https://energysavingtrust.org.uk/energy-saving-trust-outlines-steps-to-save-hundreds-on-home-energy-bills-as-costs-set-to-increase-by-50/>> [Accessed 5 June 2022].

Gouchoe, S. Everette, V. and Haynes, R. (2002) *Case Studies on the Effectiveness of State Financial Incentives for Renewable Energy*. [Online] Golden: National Renewable Energy Laboratory. Available from: <<http://www.osti.gov/bridge>> [Accessed 21 February 2022].

Grantham Research Institute on Climate Change and the Environment (2020) *Financing a Just Transition to Net-Zero Emissions in the UK Housing Sector*. London: London School of Economics and Political Science.

Green Finance Institute (2020a) *Financing Energy Efficient Buildings: The Path to Retrofit at Scale*. [Online] London: Green Finance Institute. Available from: <<https://www.greenfinanceinstitute.co.uk/wp-content/uploads/2020/06/Financing-energy-efficient-buildings-the-path-to-retrofit-at-scale.pdf>> [Accessed 30 January 2022].

Green Finance Institute (2020b) *Green Home Finance Principles*. London: Green Finance Institute.

Green Finance Institute (2021a) *Supercharging Green Home Finance This Autumn through the Spending Review and Heat & Buildings Strategy*. [Online] London: Green Finance Institute. Available from: <<https://www.greenfinanceinstitute.co.uk/news-and-insights/supercharging-green-home-finance-this-autumn-through-the-spending-review-and-heat-buildings-strategy/>> [Accessed 19 February 2022].

Green Finance Institute (2021b) *The Way Ahead for the UK's Green Mortgage Market*. London: Green Finance Institute.

Green Finance Institute (2022) *Green Mortgages*. [Online] London: The Green Finance Institute. Available from: <<https://www.greenfinanceinstitute.co.uk/programmes/ceeb/green-mortgages/>> [Accessed 17 August 2022].



Halifax Building Society (2022) *Funding Green Living Improvements*. [Online] Halifax: Halifax Building Society. Available from: <<https://www.halifax.co.uk/mortgages/help-and-advice/green-living/funding-green-living-improvements.html>> [Accessed 20 February 2022].

Harmelink, M. Nilsson, L. and Harmsen, R. (2008) *Theory-based policy evaluation of 20 energy efficiency instruments*. *Energy Efficiency*, 1 July, pp. 131–148.

Harvey, E. (2022) *Finance Sector Mobilises on Climate Change*. [Online] London: The Building Societies Association. Available from: <<https://www.bsa.org.uk/media-centre/bsa-blog/january-2022/guest-blog-finance-sector-mobilises-on-climate-cha>> [Accessed 20 February 2022].

HM Government (2021) *Net Zero Strategy: Build Back Greener*. London: HMSO.

IEA (2021) *Energy Policy Review Spain 2021*. [Online] Paris: International Energy Agency. Available from: <www.iea.org/t&c/> [Accessed 21 February 2022].

Kerr, N. and Winskel, M. (2020) Household Investment in Home Energy Retrofit: A Review of the Evidence on Effective Public Policy Design for Privately Owned Homes. *Renewable and Sustainable Energy Reviews*, 123 (109778) May, pp. 1-10.

Li, Y. Kubicki, S. Guerriero, A. and Rezgui, Y. (2019) Review of building energy performance certification schemes towards future improvement. *Renewable and Sustainable Energy Reviews*, 113 (109244) June, pp. 1-13.

Linn, A. and Lyons, R. (2019). *Staff Working Paper No. 812 Three triggers? Negative equity, income shocks and institutions as determinants of mortgage default*. London: Bank of England.

Maclean, K. Sansom, R. Watson, T. and Gross, R. (2016) *Managing Heat System Decarbonisation: Comparing the Impacts and Costs of Transitions in Heat Infrastructure*. London: Imperial College London.

McMullan, L. Osborne, H. Blight, G. and Duncan, P. (2021) UK Housing Crisis: How Did Owning a Home Become Unaffordable? *The Guardian* [Online], 31 March. Available from: <<https://www.theguardian.com/business/ng-interactive/2021/mar/31/uk-housing-crisis-how-did-owning-a-home-become-unaffordable>> [Accessed 21 February 2022].

Miu, L. M. Wisniewska, N. Mazur, C. Hardy, J. and Hawkes, A. (2018) A Simple Assessment of Housing Retrofit Policies for the UK: What Should Succeed the Energy Company Obligation. *Energies*, 11 (2070) August, pp. 1-22.

National Audit Office (2021) *Green Homes Grant Voucher Scheme*. (HC302, 2021-22). London: HMSO.

OGFEM (2021) *Energy Company Obligation (ECO3) Guidance*. OFGEM, London.



OGFEM (2022) *Energy Company Obligation (ECO)*. [Online] London: Ofgem. Available from: <<https://www.ofgem.gov.uk/environmental-and-social-schemes/energy-company-obligation-eco/support-improving-your-home>>. [Accessed 28 March 2022].

Palmer, J. Livingstone, M. and Adams, A. (2017) *What does it cost to retrofit homes?* London: Department for Business, Energy and Industrial Strategy.

Renaldi, R. Hall, R. Jamasb, T. and Roskilly, A. P. (2021) Experience Rates of Low-Carbon Domestic Heating Technologies in the United Kingdom. *Energy Policy*, 156 (112387) September, pp 1-9.

Santander (2021) *Santander Launches EnergyFact – Helping Homeowners Understand How to Improve Energy Efficiency and Save Money*. [Online] London: Santander. Available from: <<https://www.santander.com/en/press-room/press-releases/2021/03/santander-launches-energyfact-helping-homeowners-understand-how-to-improve-energy-efficiency-and-save-money>> [Accessed 20 February 2022].

Schleich, J. Faure, C. and Meissner, T. (2019) *Adoption of Retrofit Measures among Home-Owners in EU Countries: The Effects of Access to Capital and Debt Aversion* [Online]. Karlsruhe: Fraunhofer Institute for Systems and Innovation Research ISI. Available from: <<http://hdl.handle.net/10419/205148www.econstor.eu>> [Accessed 10 February 2022].

Simple Energy Advice (2022) *Energy Company Obligation* [Online]. London: Department for Business, Energy, and Industrial Strategy. Available from: <<https://www.simpleenergyadvice.org.uk/pages/energy-company-obligation>> [Accessed 21 February 2022].

The Committee of Public Accounts (2021) *Green Homes Grant Voucher Scheme*. (HC 635, 2021–22). London: HMSO.

UKGBC (2013) *Retrofit Incentives: Boosting take-up of energy efficiency measures in domestic properties*. London: UK Green Building Council.

Wait, R. (2021) *Mortgage Eligibility Guide* [Online]. Money Supermarket. Available from: <<https://www.moneysupermarket.com/mortgages/mortgage-eligibility/>> [Accessed 20 February 2022].

Welsh Government (2022) *Optimised Retrofit Programme: funded projects*. [Online] Cardiff. Available from: < <https://gov.wales/optimised-retrofit-programme-funded-projects.html>> [Accessed 20 June 2022].

World Green Building Council (2018) *What Are Green Mortgages & How Will They Revolutionise Home Energy Efficiency?* [Online] Washington: World Green Building Council. Available from: <<https://www.worldgbc.org/news-media/what-are-green-mortgages-how-will-they-revolutionise-home-energy-efficiency>> [Accessed 20 February 2022].



Appendix A



Green Mortgage Providers

Company Name	Product Name	Launch Year
AIB	Green Mortgage Rate	Feb-20
Barclays	Green Home Mortgages	2018
Barclays	Green Home Buy-to-Let Mortgages	Jan-22
Coventry Building Society	Green Together Reward	Sep-21
Coutts	Green Mortgage	Jun-21
Coutts	Retrofit Green Mortgage	Jun-21
Danske Bank	Danske Carbon Neutral Mortgage	Jan-22
Dudley Building Society	Two Year Fixed Energy Efficient Remortgage	Jun-21
Dudley Building Society	Three Year Fixed Rate Energy Efficient BTL Remortgage	Jun-21
Dudley Building Society	Two Year Discount Energy Efficient Further Advance	Jun-21
Dudley Building Society	Eco Self-Build Discount for Term - Advance	2020
Dudley Building Society	Eco Self-Build Discount for Term - Arrears	2020
Ecology Building Society	C-Change Discount: Sustainable Homes Discount	2006
Ecology Building Society	C-Change Discount: Retrofit Discount	2006
Ecology Building Society	C-Change Discount: Energy Improvements Discount	2006
Foundation Home Loans	Green Reward Mortgage	Feb-21
Foundation Home Loans	Green ABC+ Products	Apr-22
Gatehouse Bank	Green Home Purchase Products	Apr-22
Halifax	Green Living Reward	Feb-22
Halifax	Green Mortgage Cashback	Jul-21
Hinckley and Rugby Building Society	Green Mortgages	Jul-21
Just Group	Green Lifetime Mortgage Feature	Jul-20
Kensington Mortgages	eKo Cashback Mortgage	Feb-21
Landbay	Green Mortgage Range	Jun-21
Leeds Building Society	Green 2 Year Fixed Rate Mortgages	Sep-21
Legal & General	Energy Saver Cashback Offer	Nov-20
Lloyds Banking Group	Eco Home Reward	Feb-22
Monmouthshire Building Society	Energy Efficiency Mortgage Range	Feb-22
NatWest Group	Green Mortgages	Oct-20
Nationwide Building Society	Green Additional Borrowing	Mar-20
Nationwide Building Society	Green Reward	Apr-21
Newable Finance	EPC Loans and Mortgages	May-22
Newbury Building Society	GoGreen Further Advance Mortgage	Jul-20
Newbury Building Society	GoGreen Self-Build Mortgage Reward	Jul-20
Newbury Building Society	GoGreen Buy To Let Further Advance Mortgage	May-22
Paragon Bank	Green Mortgages	Jun-21
Paragon Bank	Green Further Advance Range	Jul-21
Quantum Mortgages	Green Range	Mar-22



Saffron Building Society	Retro Fit Mortgage	Sep-20
Shawbrook	Energy Efficiency Discount	May-22
Skipton Building Society	Green Additional Borrowing Products	Jan-22
Swansea Building Society	Green Mortgage	Mar-22
The Mortgage Works (TMW)	Green Further Advance Mortgage	Apr-21
TSB	Green Additional Borrowing Mortgage Products	Jun-21
Virgin Money	Greener New Build	May-21
West One Loans	Green Second Charge Mortgage	Apr-22

[\(Green Finance Institute, 2022\)](#)

