HOMES FOR HEROES

Solving the energy efficiency crisis in England's interwar suburbs

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Foreword

England's interwar suburbs are in urgent need of updating if we are to meet the UK's net zero carbon target

The latest assessment report from the Intergovernmental Panel on Climate Change has provided the starkest warning yet that immediate action at scale is needed to mitigate against the most extreme impacts of climate change. Without reducing our domestic operational energy consumption, the UK will miss its net zero carbon target.

48% of emissions from the UK built environment are produced by energy usage within the existing housing stock. This represents 16% of total UK domestic emissions. Of this, 62% are produced by heating, predominantly via fossil fuel boilers. This situation is incompatible with the UK's 2050 net zero target, and so improving domestic energy efficiency and enabling a transition away from fossil fuel heating must form a fundamental element of the UK's net zero pathway. There can be no further delay in embarking on a national programme of home retrofitting, which will transform UK housing, creating warm and cheaper to heat homes while bringing health and wider societal benefits. This process will drastically reduce fuel poverty, create half a million green jobs, and positively contribute to the national levelling up agenda.

In England, we are installing only 6% of heat pumps compared to projections for annual installations needed in 2028, 9% of the cavity wall insulation needed, and less than 2% of solid wall insulation. Up to 85% of England's existing housing stock will still be occupied in 2050.

A programme of wide-scale energy efficiency retrofit is therefore crucial to meeting the Government's target to reduce greenhouse gas emission to net zero by 2050.

Retrofit also offers benefits to both residents and communities. Implementing decarbonisation measures across homes in an area can catalyse wider change in community engagement and employment programmes. These interventions can make lasting positive changes across England. In light of recent gas price increases, moving to low-carbon heating such as heat pumps could make a significant difference to residents of interwar homes.

It is critical that the Government commits to and supports retrofitting efforts with a long-term policy framework and sufficient investment to build market confidence, incentivise and protect consumers, and unlock private investment. A range of policy levers and interventions will be required, including incentives and enablers prioritising building fabric upgrades to ensure effective deployment of domestic heat pumps. The approach must be fully coordinated with local authorities, consumers, communities and other relevant stakeholders, and must not disadvantage lower-income households.

With the UK economy having suffered the worst recession since records began, the case for public investment to stimulate economic growth and create jobs has rarely been stronger.

The Government must act now to support the residents of these homes and follow through on their net zero target.

— Simon Allford, RIBA President

Executive summary

The UK Government has committed to reaching net zero greenhouse gas (GHG) emissions by the year 2050

If this target is to be met, the almost total elimination of emissions from the UK's housing stock will be required. This will include addressing England's hard-to-treat homes. Energy use in homes accounts for about 16% of the UK's greenhouse gas emissions,[1] producing a total of 77 million tonnes of CO_2 every year in England alone.[2] 12% of these are produced by England's interwar suburbs.[3]

This report focuses on the challenges and benefits that come from retrofitting England's interwar housing stock. Through retrofitting these homes, England's total carbon emissions would be reduced by 4%.[4] This would have the same impact as completely decarbonising England's waste and recycling sector.[5]

The opportunity for retrofitting interwar homes is immense: there are 3.3 million in need of decarbonising across England, a large proportion of them have solid wall construction, and they are some of England's worst performing homes in terms of gas energy use intensity. Installing the upgrades suggested in this report would also save the residents of the interwar homes an average of £511 per year in energy costs, accelerating our progress towards statutory fuel poverty targets.

647,000 interwar homes were fuel poor in 2021. This is equal to 17% of interwar households, higher than the overall national rate of 13%.[6] Poor energy efficiency is a driver of fuel poverty, leaving households unable to adequately heat and light their homes. It is essential that the Government's ambition to eliminate fuel poverty 'as far as reasonably practical' includes a plan to insulate solid wall properties. Achieving net zero will require widespread improvements to homes, such as insulation in lofts and walls; draught proofing doors, windows and floors; double or triple glazing; smarter appliances; as well as changes to heating systems. However, the Government must also enforce a fabric-first approach to retrofit. It is essential to improve the building fabric and thermal envelope prior to upgrades of heating systems to non-fossil fuel heating. This can help to reduce operational costs, improve energy efficiency and reduce carbon emissions whilst reducing ongoing maintenance costs.

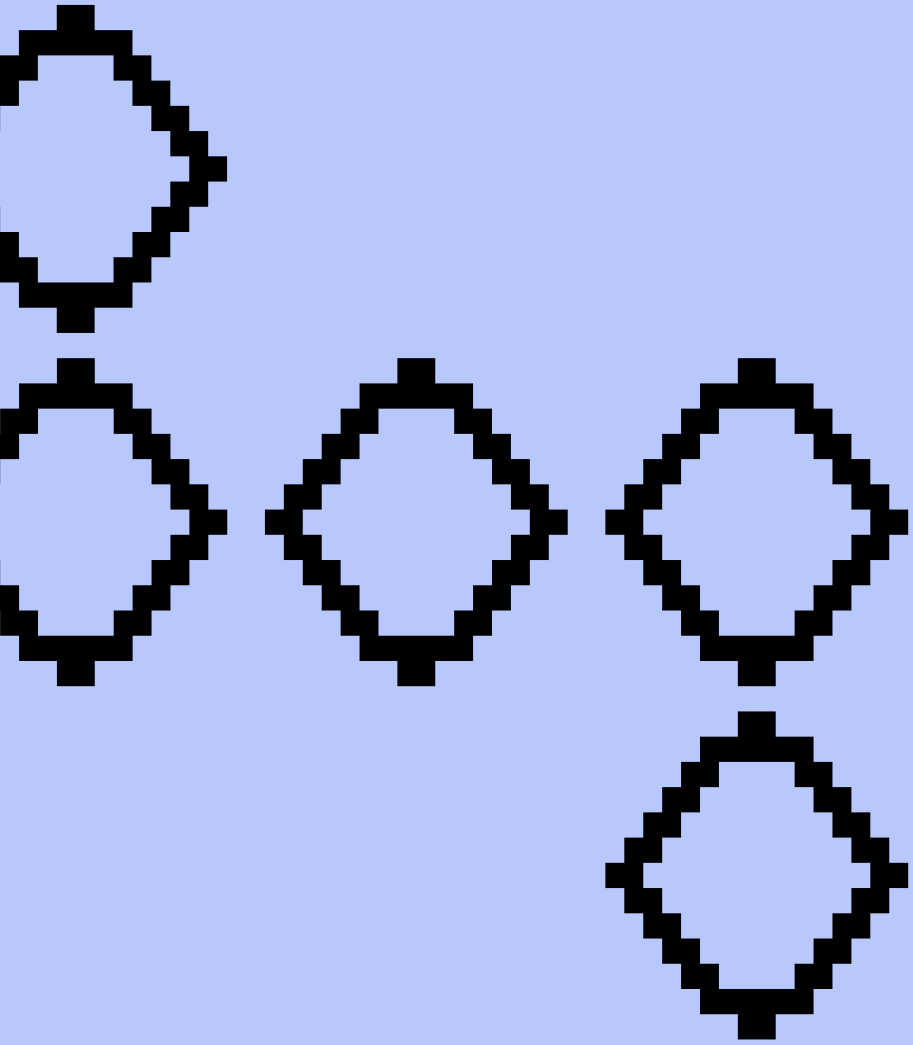
The benefits of a retrofit programme are substantial, yet the decarbonisation of the UK's housing stock has repeatedly stalled. Financial barriers, industry challenges, and consumer confidence are issues that must be addressed in order to meet the UK's net zero target and realise the extended health and social benefits that come with retro-fitting our homes. Without financial support there is a serious risk of increasing inequality – where lower bills and warmer homes are only accessible to the small proportion of households that can afford it – while bills increase for the majority, including resident who are already fuel poor.

Home retrofit can create jobs and provide training opportunities for local people, as well as supporting economic development. Upskilling workers to deliver the retrofit solutions laid out in this report presents a huge opportunity and challenge. For example, installing external insulation to the solid wall properties will generate an equivalent of nearly 10 million full time equivalent workdays. This is equal to 5,000 full time equivalent jobs every year for the next ten years to insulate all the solid wall interwar properties in England.

Improving the energy efficiency of the housing stock is fundamental to reaching net zero by 2050. The Government can no longer afford to side-line the decarbonisation of our existing homes. Following on from the Net Zero Strategy published in 2021, it is essential that the Government brings forth an ambitious and thorough National Retrofit Strategy, that concentrates in part on England's interwar homes.

1

RECOMMENDATIONS



The recommendations laid out are intended to inform a whole Government, cross-departmental approach to retrofitting England's existing housing stock. Enabling a large proportion to be improved to EPC band C or above, helping the UK to reach its 2050 net zero target.

Financial

— **Develop a National Retrofit Strategy** to unify the existing fragmented, stop-start policy approach and provide a clear signal of Government ambition and intent in the medium and long-term that ensures the UK stays on track to reach net zero and meets commitments to existing carbon budgets.

— **Implement a differential that ties Stamp Duty Land Tax to the energy efficiency of the home being sold**, such as a sliding scale of 3 per cent change to Stamp Duty Land Tax liability per Standard Assessment Procedure point from the median. This could be designed to be revenue-raising.

— Make clear its intention to **extend the principle of embedding energy efficiency across the tax system**, including incentives for those paying Inheritance Tax, Capital Gains Tax and Council Tax on domestic properties.

— **Direct government grants for low-income households** to support both energy efficiency improvements and the installation of low carbon heating.

— **Adjust the gas and electricity tax regime** (which currently strongly favours gas) for domestic customers, to incentivise the shift to heat pump technology, whilst mitigating risks to those in fuel poverty.

— **Re-introduce the Landlord's Energy Savings Allowance** to allow landlords in the private-rented sector to claim for part of their energy efficiency measures against their income tax liabilities.

Policy

— **Broaden overall policy on to the actual, real-world 'as-built' energy performance of buildings.** Shifting to a performance-based culture will allow tenants and householders to choose energy efficient buildings and enable the market to accelerate their uptake.

— **Use planning reforms to prioritise reuse of existing buildings and assets**, and disincentivise demolition and new build.

— **Set actual energy performance targets** for buildings in Building Regulations measured in energy use intensity.

— A clear trajectory and regulatory framework to **introduce mandatory minimum EPC rating of C (or equivalent under updated EPC methodology), for owner-occupied homes** at the point of sale (with suitable caveats e.g., historic building considerations)

— **Tightening of Building Regulations requirements for works to existing dwellings** (with suitable enforcement), with consequential improvements and clear triggers for energy improvement requirements.

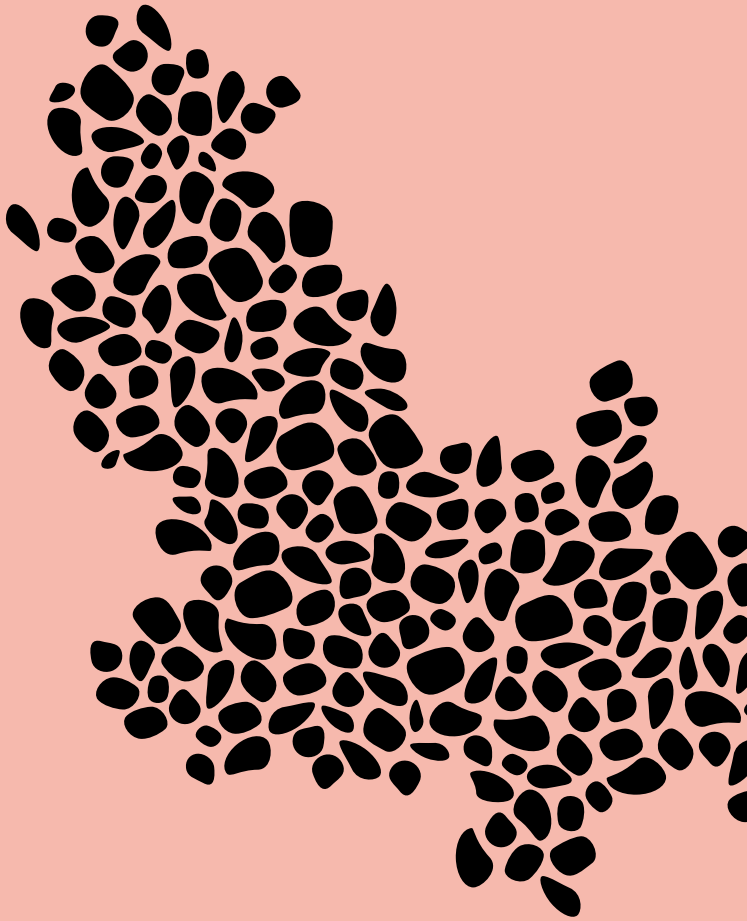
— **Reform EPCs to establish in-use energy performance as the rating metric** (as opposed to cost), reducing the performance gap and disincentivising gas usage, and enabling EPC ratings to be used as a meaningful regulatory driver in reducing emissions by 2023. Link to updated sizing and installation guidance (i.e., MCS) for heat pumps to optimise performance.

Skills and Jobs

— **Create a national retrofit training and skills strategy**, scaling up rapidly to meet emerging demand, working with trade associations within the home repair, maintenance and improvements (RMI) market, local skills partnerships, and will be informed by the Government's Green Jobs Taskforce and the CITB work on Building Skills for Net Zero.

2

WHY RETROFIT INTERWAR HOUSING?



Retrofitting interwar housing is essential if we are to reach net zero

Energy use in homes accounts for about 16% of the England's greenhouse gas emissions,[7] producing a total of produce a total of 58.5 million tonnes of CO_2 every year. These emissions need to fall by at least 24% by 2030 from 1990 levels for the UK to be on track for it's carbon budget, yet housing is one of the only sectors where the implementation of measures to reduce emissions has stalled (Figure 1).

Around 3.8 million homes built between the end of the First World War and Second World War, known as the interwar period, remain in use today. This makes up over 15% of England's housing stock.[8] [9]

The Government's 2017 Clean Growth Strategy, the central document laying out policy towards achieving emissions targets, is central to laying out England's current policies to reduce emissions. On average, existing homes are rated within Energy Performance Certificate (EPC) band D[10], and for houses built between the wars, 90% are EPC band D or below.[11]

Typically, interwar housing was built with solid walls between 1919 and 1930, and cavity walls from 1930 to 1945. A very large proportion of these have not had changes made to the walls since construction, meaning that they do not have any insulation. Since neighbourhoods tended to be built all at once, the type of walls seen tend to be uniform in each cluster of homes.

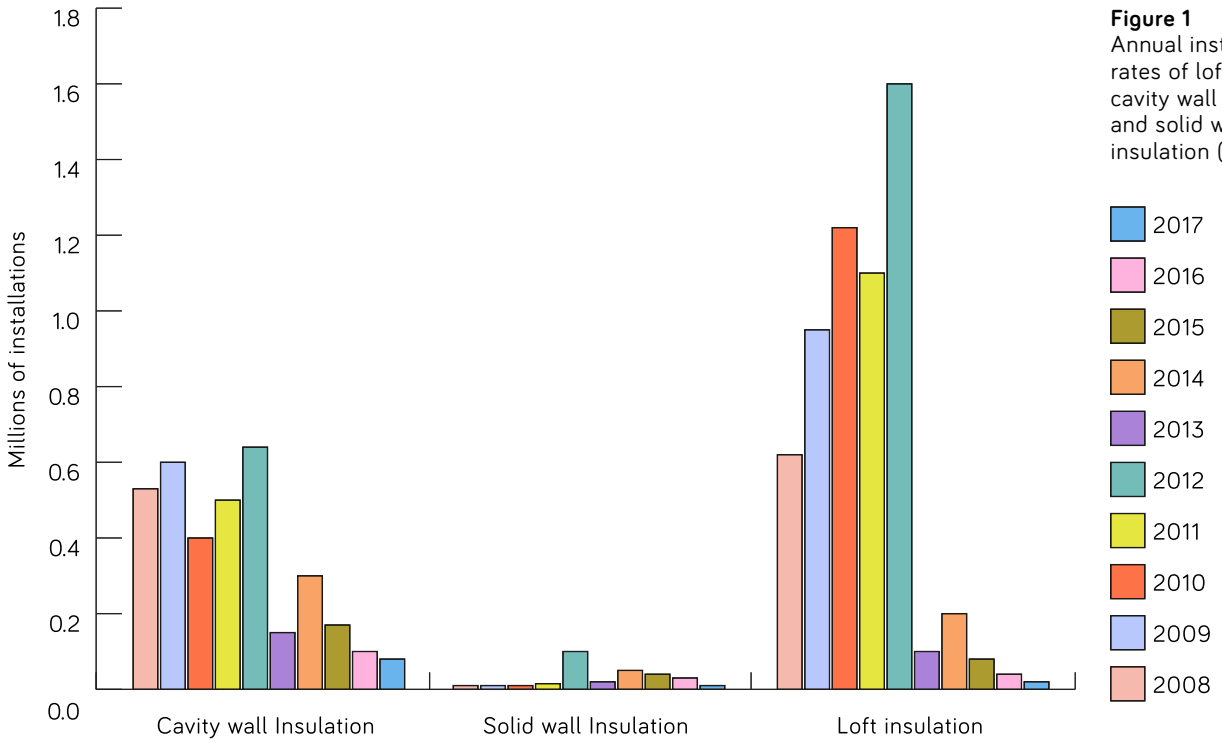
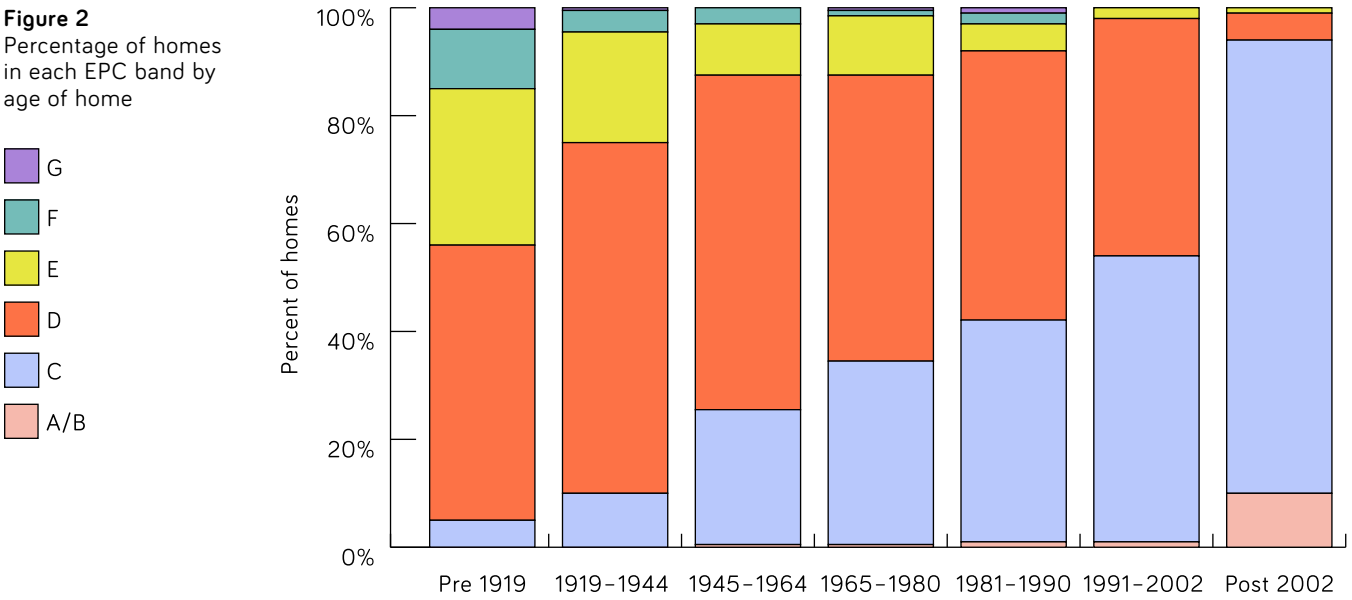


Figure 1
Annual installation rates of loft insulation, cavity wall insulation and solid wall insulation (2008-2017)

Source: BEIS (2008) Household Energy Efficiency National Statistics; previous DECC publications.
Notes: Installations under Government schemes.

Figure 2
Percentage of homes in each EPC band by age of home



Source: English Housing Stock Survey 2018

To date only 10% of the interwar homes in the UK have an EPC rating above band C (Figure 2). Therefore, over 3.4 million homes, with very similar decarbonisation needs will, have to be retrofitted within the next 15 years to fulfil the Government's 2035 target.

By retrofitting all interwar homes in England to be EPC band C or better, dependent on their potential improvement, there could be an energy saving of over 15 billion kilowatts per hour (kWh). This equates to a CO_2 emissions reduction of 8.5 million tonnes annually. This would eliminate 9% of England's total residential CO_2 emissions and reduce the total CO_2 emissions across all sectors in England by 2.6%

Savings by retrofitting all interwar homes in England to be EPC band C or better

15 billion
kilowatts per hour (kWh) energy

8.5 million
tonnes CO_2 emission reduction annually

9%
of England's total residential CO_2 emissions

The technology needed to decarbonise hard-to-treat houses already exists

Insulating hard-to-treat homes will be central to decarbonising housing. Unlike other sectors where technologies need to be developed to facilitate carbon reduction on scale, energy efficient housing can be undertaken immediately.

In England, close to 30% of dwellings are of solid wall construction – and make up 50% of interwar homes.[12] Solid wall dwellings are responsible for 36% of all the housing stock carbon emissions, with approximately 96% of solid wall properties in UK having no wall insulation.[13] In homes without wall insulation, walls account for up to 45% of the total heat loss. Therefore, these homes represent an area of significant retrofit potential, and addressing this challenge will be essential to decarbonising England's housing stock.[14]

The uniformity of interwar housing favours mass customisation

Traditional homes as well as interwar homes have poor energy efficiency. However, retrofitting traditional homes can present complex and unpredictable issues, with pre-1919 buildings varying in both style, size and structure. Interwar housing has been criticised for its repetitive architecture, however when considering mass retrofit options, this uniformity makes the perfect property type.

Focusing on interwar housing will decarbonise some of the worst performing homes in England

Using the floor areas that can be found in individual EPC certificates, the gas use intensity of different age bands of the housing stock can be compared. Looking at Figure 3, gas consumption is highest in properties from the interwar period. Aside from the interwar period there is a general decline across subsequent age brackets. This is likely to be the result of improved energy efficiency in the construction methods used, such as cavity walls and insulation.

One reason that the homes from the interwar period have low energy efficiency is that solid wall construction continued for a large proportion of this time period. Alongside this, the solid walls that were being built at this time had lower energy efficiency than solid walls build pre-1919, likely due to construction factors such as using lower quality materials, and the speed and volume of interwar build programmes. This suggests that, compared with other solid brick wall houses, the interwar properties would benefit most from energy efficiency interventions.

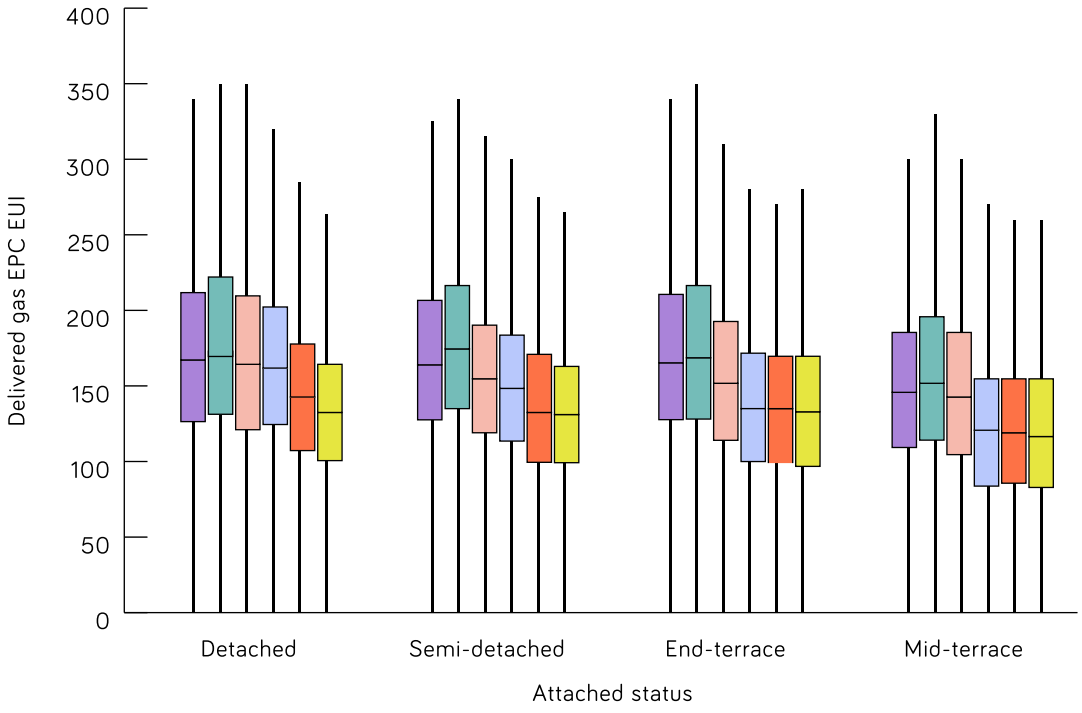
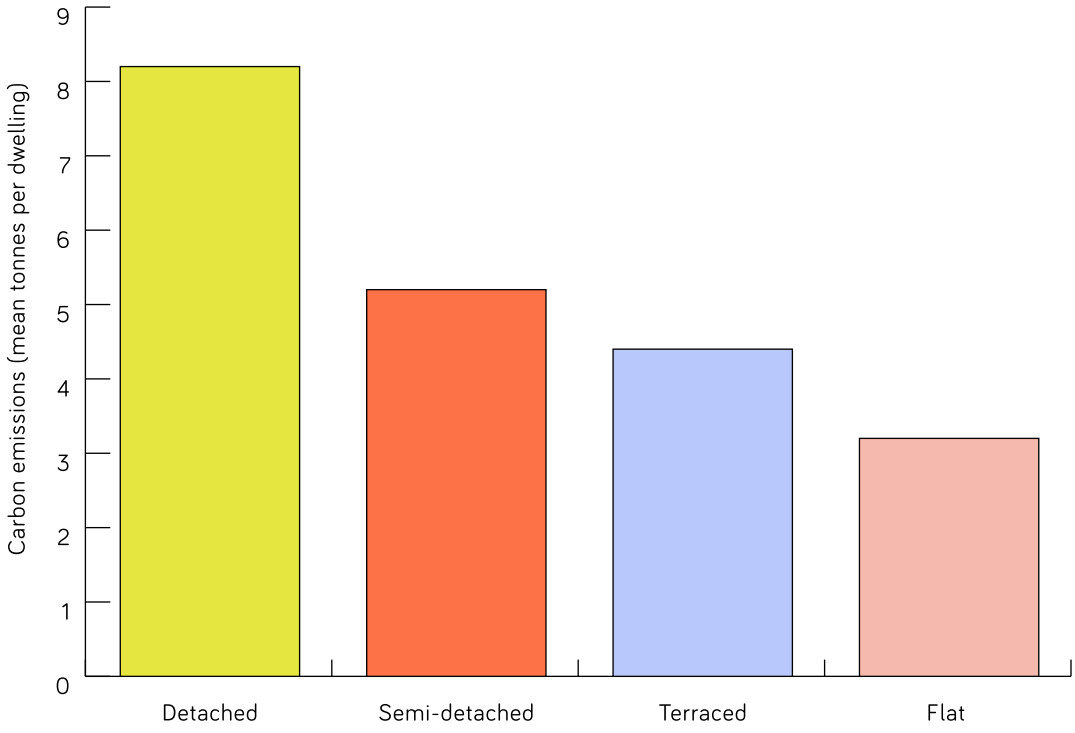


Figure 3
Delivered gas energy use intensity (EUI:kWh/m/yr), based on EPC floor areas, per age band and attached status

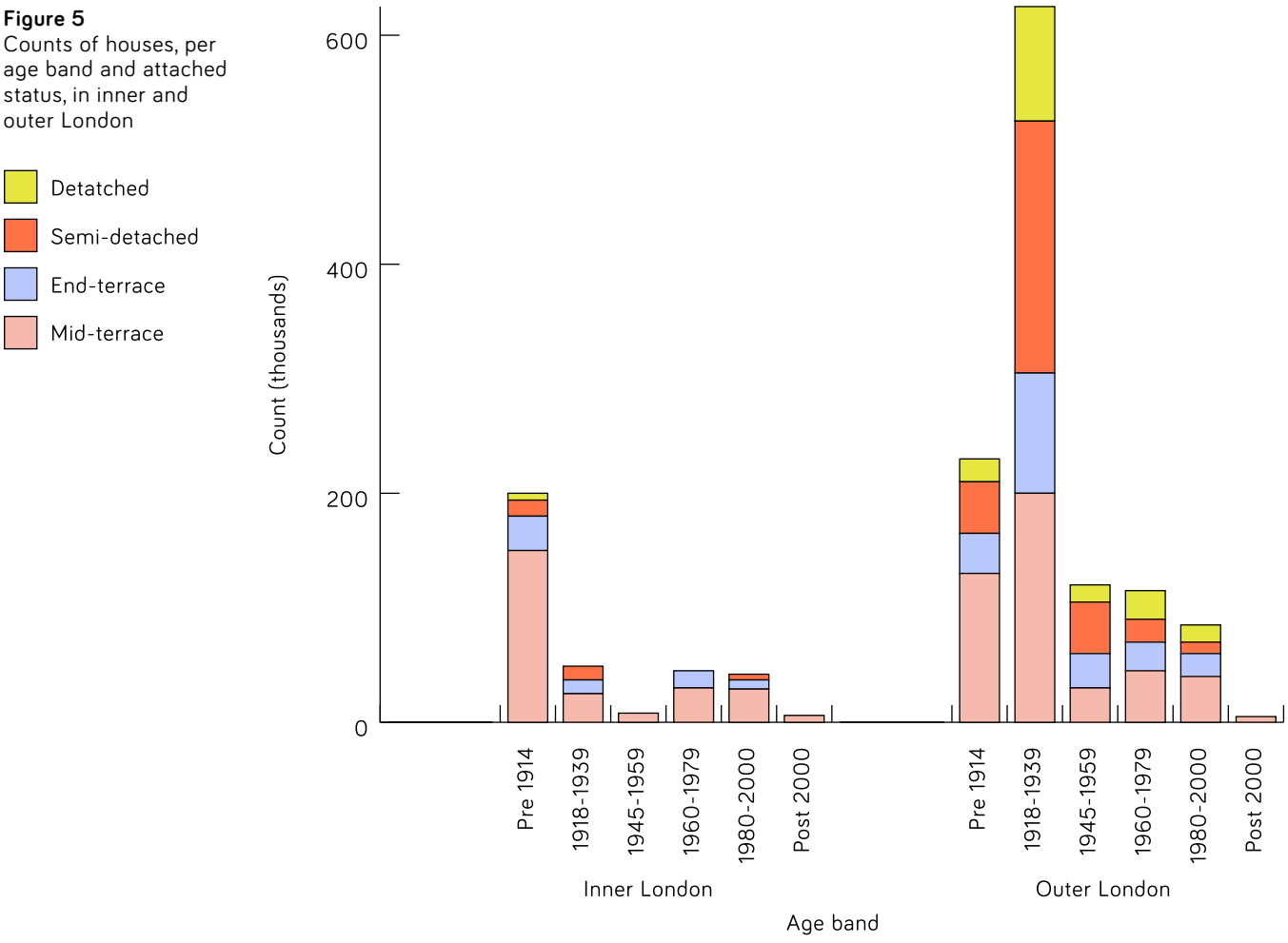
Source: Liddiard, R., Godoy-Shimizu, D., Ruyssevelt, P., Steadman, P., Evans, S., Humphrey, D., & Azhari, R. (2021). *Energy use intensities in London houses. Buildings and Cities*, 2(1) [15]

Figure 4
Carbon emissions by dwelling type, 2012 (mean tonnes per dwelling). Detached houses emit more than twice as much carbon than flats



Source: English Housing Survey, 2012

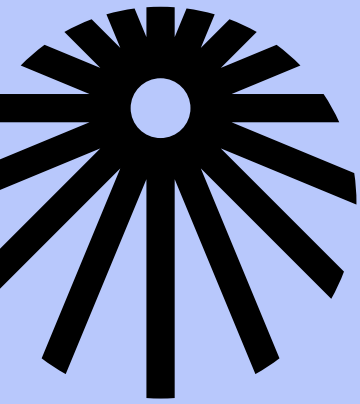
Figure 5
Counts of houses, per age band and attached status, in inner and outer London

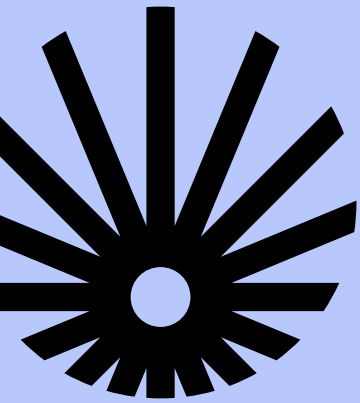


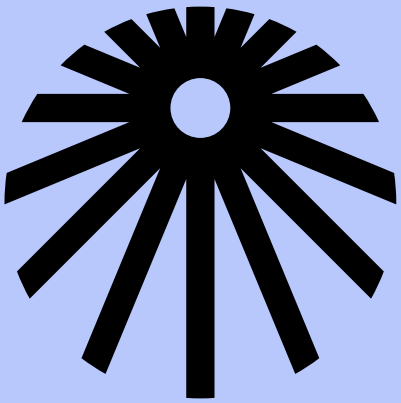
Source: Liddard et al. *Buildings and Cities* DOI. B105334/bc.79

3

WHY WE NEED TO RETROFIT HOUSING







Retrofitting housing is crucial to reaching net zero

In May 2019, at the request of the UK Government, the Committee on Climate Change (CCC) set out a roadmap for how the UK could become a net zero economy by 2050.[16] The 2050 target is seen by many countries as the key target if they are to restrict global warming to no more than 1.5°C above pre-industrial levels, in line with the 2015 Paris Agreement. In June 2019, the UK Parliament made this net zero ambition law. This commitment means that the UK must reduce greenhouse gas emissions by at least 100% when compared to 1990 emissions levels. In the CCC's recommendations to Government, they laid out certain measures that will be central to achieving this net zero target. Of these, decarbonising housing was highlighted as needing to be central to the national effort to reach net zero emissions by 2050.

However, we are already falling behind the emissions reductions that will be required if it is to reach those targets. Although the UK is on track to meet the reductions required to deliver the third carbon budget (2018 to 2022), it is set to miss later carbon budgets, with the fourth (2023 to 2027) and fifth (2028 to 2032) set to be missed by 5.6% and 9.6% respectively. With these carbon budgets reflecting the 80% reduction in emissions that was mandated by the Climate Change Act 2008 rather than the 100% necessary to meet our net zero target, something must change for UK to meet net zero by 2050, especially following the new commitment to reducing emissions by 78% by 2035.[17]

Recovering from the effects of the pandemic must include a focus on decarbonising our housing

The lasting changes in society wrought by the coronavirus pandemic ought to bring this challenge into clearer focus. The pandemic has triggered a culture change, with home working becoming a norm that is likely to continue for many years to come.

The main source of potential energy savings from the shift to home working is from the reduced carbon emissions from commuting, and potentially from lower office energy consumption. However, hybrid working practices may result in worse of both worlds: with energy for heat and light still required for offices, even with a lower head count, and increased energy required for a section of the staff to work remotely from home. Additionally, the carbon footprint from the increase in data and video conference streaming may (viewed at the national scale) negate carbon emissions savings gained from reduction in travel. Some studies concluded a net worsening of total emissions as result of the pandemic-related changes to behaviour.[18]

The evidence suggests the extent to which any reductions in emissions as a result of reduced office working will depend on the energy efficiency of the housing stock.

Meeting the Government's fuel poverty targets

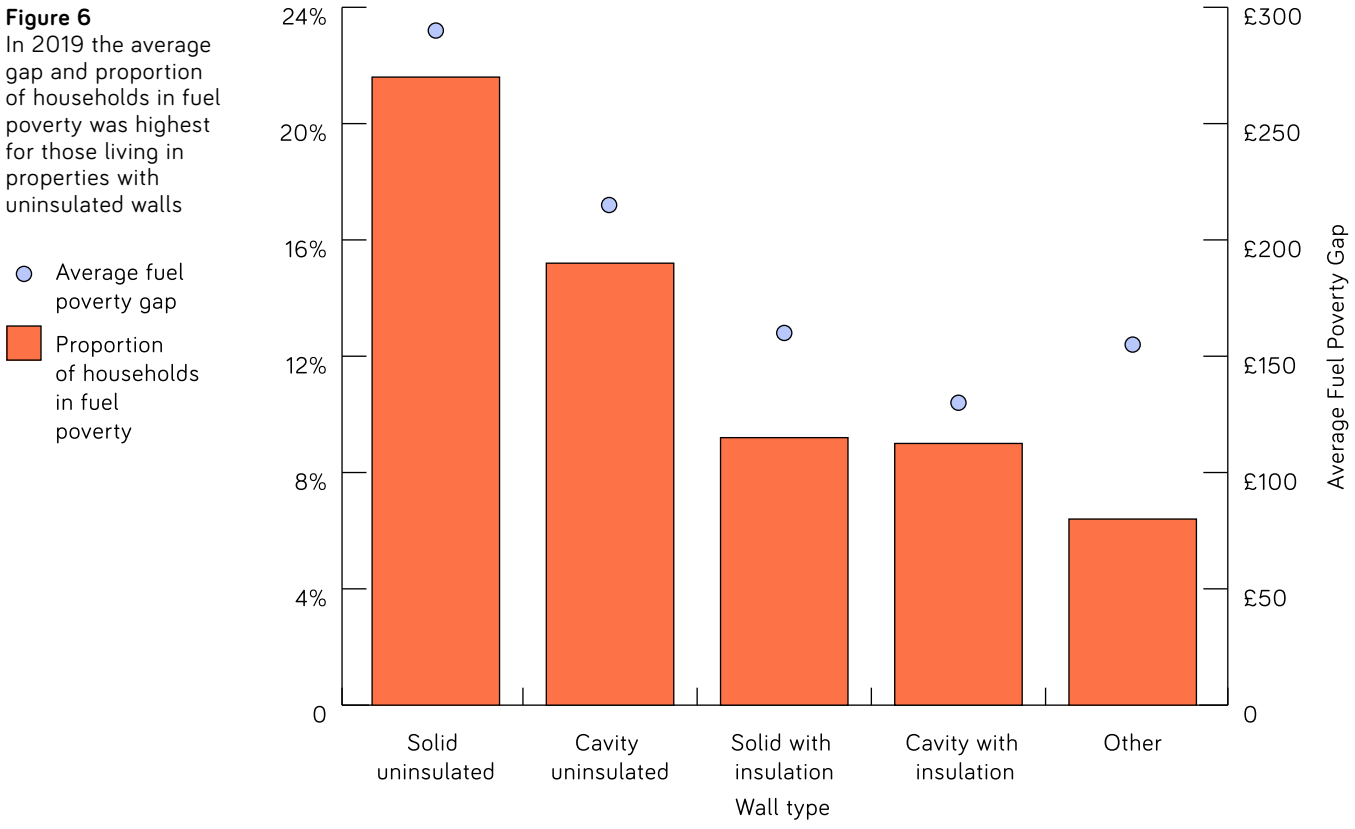
The fuel poverty target commits the Government to ensure that as many fuel poor homes as is reasonably practicable achieve a minimum energy efficiency rating of band C, by 2030.[19]

Tackling fuel poverty has a wide range of social benefits. Cold homes are recognised as a source of both physical and mental ill health.[20] Transforming England's housing stock so that homes are warm, healthy and fit for the future will help protect the health of those most vulnerable and reduce the strain on the NHS.[21]

The fuel poverty status of a households depends on the interaction between three key drivers. The Government measures both how many households there are in fuel poverty and also the depth of fuel poverty, meaning how effected each household is. The depth of fuel poverty is calculated by taking account of the fuel poverty gap. This is a measure of the additional fuel costs faced by fuel poor households to compared with the required fuel costs at the threshold that would make them non-fuel poor.

Properties with uninsulated solid walls have the highest rate of fuel poverty (21% of households) with an average gap of £291, whereas those with insulated solid walls are less than half as likely to be fuel poor (9%) with an average gap of £165. With interwar homes making up 50% of the solid wall houses in England, and with 18% of interwar households living in fuel poverty, retrofitting these would drive down the number of fuel poor households dramatically.

Figure 6
In 2019 the average gap and proportion of households in fuel poverty was highest for those living in properties with uninsulated walls



Source: Annual Fuel Poverty Statistics in England, 2019 (2017 data)

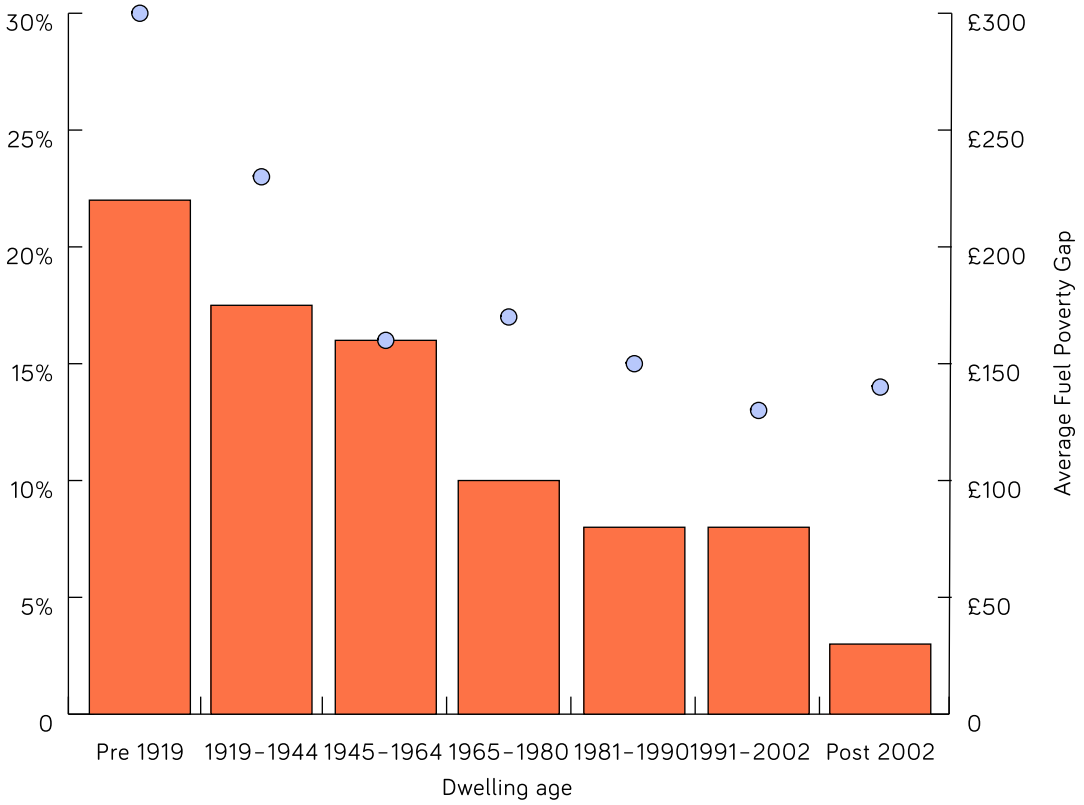


Figure 7
Households living in properties built before 1919 have the highest share of fuel poverty and highest average gap at £298, more than double the average gap properties built after 2002

Source: Annual Fuel Poverty Statistics in England, 2019 (2017 data)

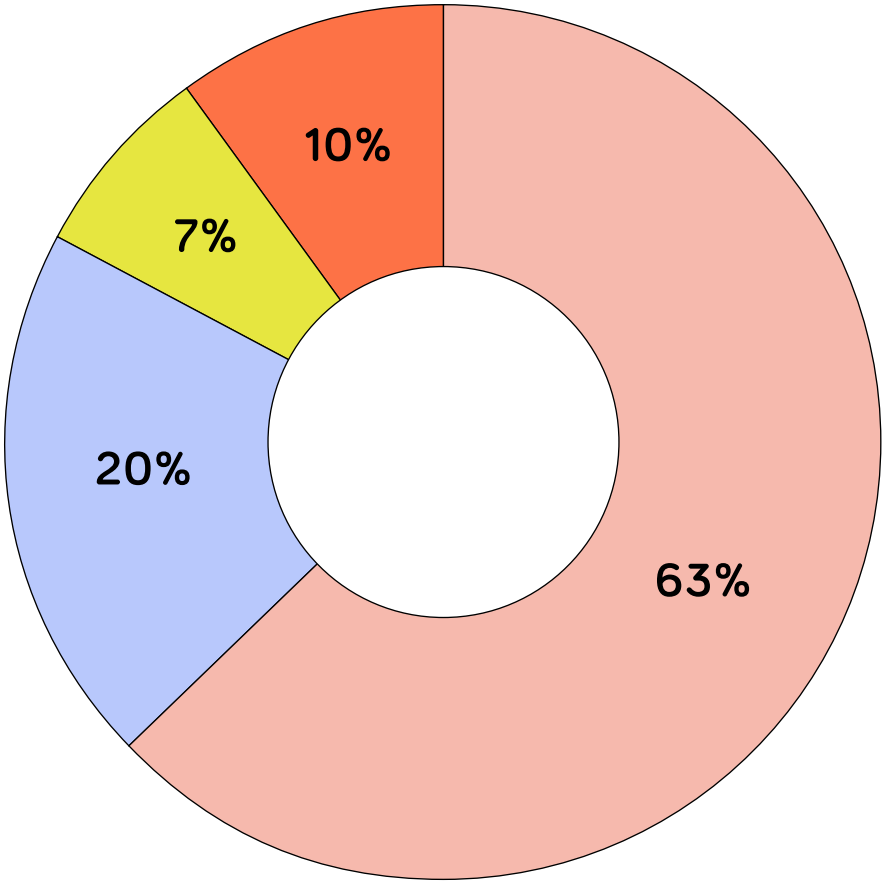


Figure 8
Dwellings by tenure in England, 2018

Source: Department for Levelling Up, Housing and Communities, Number of dwellings by tenure and district, England, 2018

In general, the greatest potential energy savings can take place in areas with the lowest average annual salaries for residents. For example, in Harlow retrofitting a home from the interwar period leads to an average energy saving of 55%. This has the potential to alleviate the financial pressures of fuel poverty for some of England's most deprived areas.

Cracking the owner-occupier market will be key to unlocking private sector finance

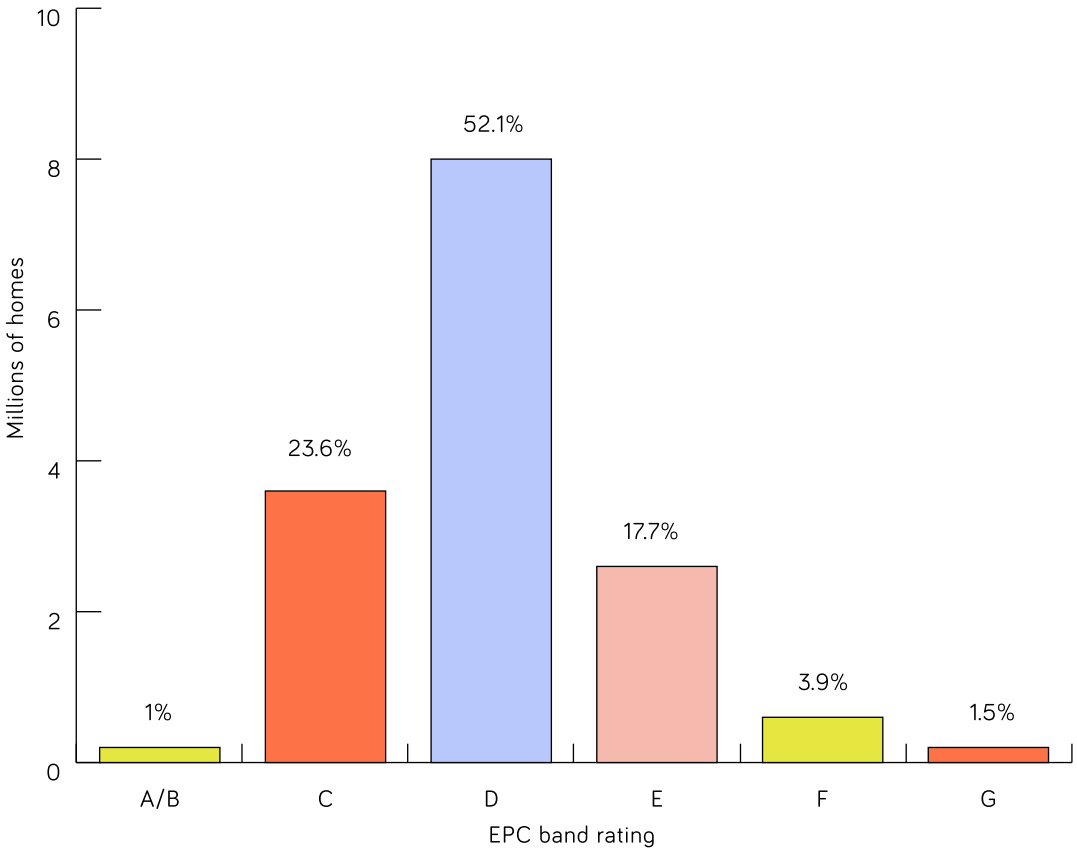
At 63% of England's housing stock, or over 15 million homes, owner-occupiers comprise the largest housing tenure, and therefore the largest potential market for financing home decarbonisation.[22] The number of new entrants to the sector has been declining steadily, with the share of household with a mortgage down from 37% in 2007 to 28% in 2017.[23] This decline has been mirrored by growth in the share of households renting privately. The incidence of fuel poverty amongst owner-occupiers is lower than the other housing tenures, at 8%, although given the percentage of homes in this sector the number of fuel poor households – 1.2 million in England – is the largest.[24]

There are significant variations across the owner-occupier sector, ranging from highly mortgaged first-time buyers to those who own a property outright; and there are wide differences in purchasing power within these groups. For example, in England the outright owners are typically older and evenly distributed across the income quintiles.[25] Owner-occupiers use

1.2 million
owner-occupiers in England are fuel poor

55%
average energy saved in Harlow by retrofitting interwar homes

Figure 9
Distribution of EPC ratings in the owner-occupied sector, England 2016/17



Source: Department for Levelling Up, Housing and Communities, English Housing Survey, 2016/17

a variety of different finance sources for retrofit and renovation purposes, including housing-related finance such as advances on an existing mortgage or equity release. The variation in circumstances creates different challenges, opportunities and motivations for homeowners to improve the energy efficiency of their property.

For those who choose to retrofit their home lowering their energy bills is a key motivator, but owner-occupiers may also choose energy efficiency improvements when pursuing other goals, such as increased comfort and a healthier home, for aesthetic reasons, or to protect the value of their property. Major renovations to homes (e.g. extensions, kitchen or bathroom refurbishments) or general maintenance and repair (e.g. roofs or façades) create valuable opportunities to undertake concurrent work to improve energy and emissions performance.

Incentivising private landlords will benefit both renters, themselves and the environment

The private-rented sector has grown rapidly in recent years, Just over 4.4 million households live in the private-rented sector in England, 19% of all households.[26] This growth has been mirrored by a decline in the percentage of households that purchase a property, and it overtook social housing as the second-largest tenure in 2014.

Owing to a combination of lower energy performance and housing quality, compared to other tenures, and with a high proportion of low income households, the sector has the highest incidence of fuel poverty at 19.4% in England, equivalent to 900,000 households.

As of April 2020, the Minimum Energy Efficiency Standard (MEES) mandated all private rental properties to have an EPC rating of E or above in England and Wales, and we responded to a Department of Business, Energy and Industrial Strategy (BEIS) consultation to increase this to an EPC rating of C by 2030 in 2021. In 2019, the Energy Company Obligation (ECO) funded energy improvements for 14,500 low income and vulnerable private-renting households across Britain.[27]

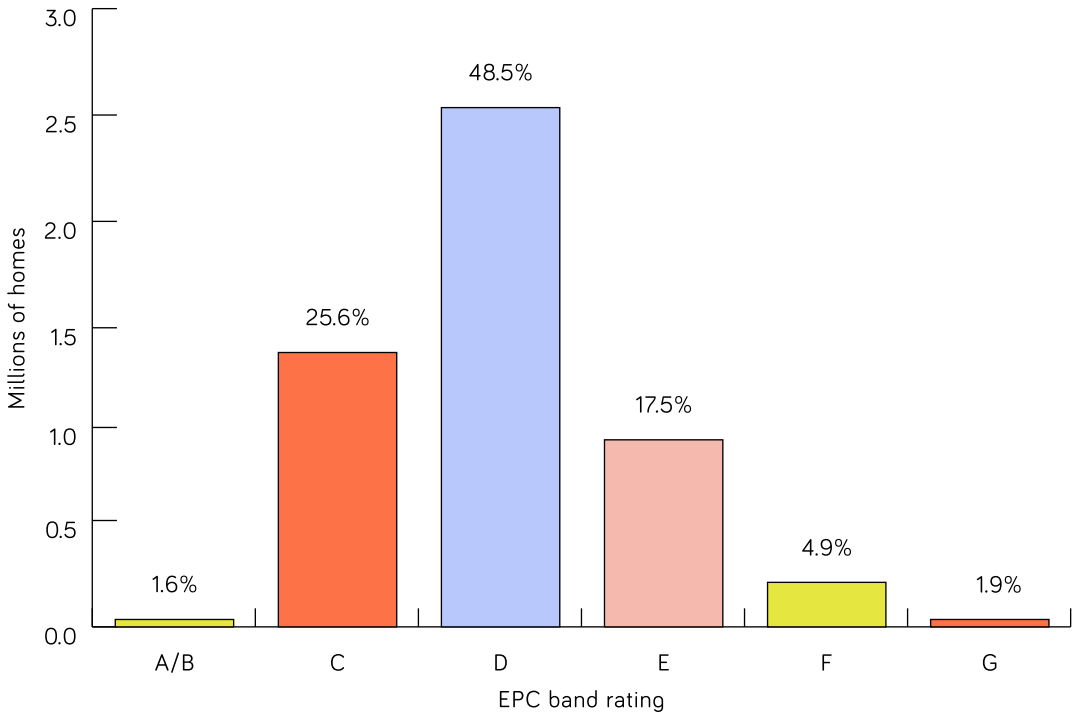
The profile of landlords is wide-ranging: from small landlords with portfolios of one or two homes, through to corporate landlords, institutional investors and asset managers.

94% of landlords are individuals, and almost half of landlords own just one property. However, the top 17% of landlords by portfolio size account for approximately half of all tenancies in England.[28]

On average, landlords report a gross rental income of £15,000 per year and the median borrowing value of mortgages to purchase a rental property is £180,000.[29] With the notable exception of students in purpose-built accommodation, tenants are typically responsible for paying the energy bills. Private-rental tenants tend to be younger than households in other tenures and stay in properties for a shorter time than owner-occupiers, with an average duration of four and 18 years, respectively.

An estimated 64% of private renters have no significant savings, and one in five receive Housing Benefit.[30] These factors mean that, despite tenants possibly benefiting from energy bill savings, the capacity of tenants to directly contribute towards the cost of retrofits – as is common in France, Germany and the Netherlands – is limited and leaves landlords as the principal investors and decision makers. At 42%, awareness and understanding amongst landlords and agents of MEES is low, but steadily rising.[31]

Figure 10
Distribution of EPC ratings in the private-rented sector, England 2016/17



Source: Department for Levelling Up, Housing and Communities, English Housing Survey, 2018

Tenants' awareness of, and willingness to act on, their rights in respect of MEES is expected to increase over time. More broadly, renovation works in the sector are usually driven by the need for repairs (e.g. heating system replacement) especially amongst small landlords.

Property improvement works are usually undertaken during void periods, due to the reduced complexity and potential to recoup a portion of the improvement costs through higher rental rates on the new tenancy. Given the regulatory and fiscal changes to landlords' circumstances in recent years, coupled with short-term uncertainty caused by the coronavirus health crisis, the landlord community is likely to favour longer-term clarity on the technologies and timelines for energy efficiency improvements. And the professional network of letting and management agents, sustainability advisors, asset managers and larger landlords – as well as tenants – has significant potential to influence the energy renovation decisions of landlords.

Retrofitting social housing can make it an exemplar for energy efficiency standards

The number of homes rented from registered social landlords in England has declined steadily over the past 40 years, from a peak of nearly seven million around 1980 to just under five million homes in 2017.[32] This is attributed to the fact that provision of new social housing cannot keep pace with the depletion of existing stock through the Right to Buy scheme. Over the same period, the number of homes rented from councils has fallen dramatically, whilst the number of homes provided by housing associations has grown, primarily via stock transfers.

There is renewed pressure on local authorities to provide more social housing, as austerity measures of the past decade impact low-income households and homelessness rises.

The removal of the Housing Revenue Account borrowing caps is expected to enable councils to increase construction by 10,000 homes per year, however there will still be a shortfall between social housing demand and in supply.

The energy performance of social-rented homes is significantly better than in private housing, owing to a combination of a newer stock, a higher proportion of flats, regulatory requirements and the typically proactive and planned approach to renovation.

Decision makers in the social housing sector are property owners, managers and tenants. Landlords encompass housing associations, who have the largest and growing share of social housing stock, local authorities own a declining share, with significant geographic variations in available resources for low-carbon renovations. Reduced void periods and rent arrears are important goals for social housing providers, who acknowledge that improved energy efficiency is linked to achieving both.[33]

Numerous councils have ambition, yet are poorly informed on the options for climate action and how these can be financed.

With government committed to net zero emissions by 2050, there is a responsibility for councils to incorporate this into local planning policy, which many are failing to do.[34] Nevertheless, the policies and ambitions of individual councils and housing associations on energy, emissions and fuel poverty are a major driver of renovation activity. Many that have declared a climate emergency own social housing – often the first port of call for local authorities' efforts to tackle carbon emissions, frequently combined with efforts to reduce fuel poverty.

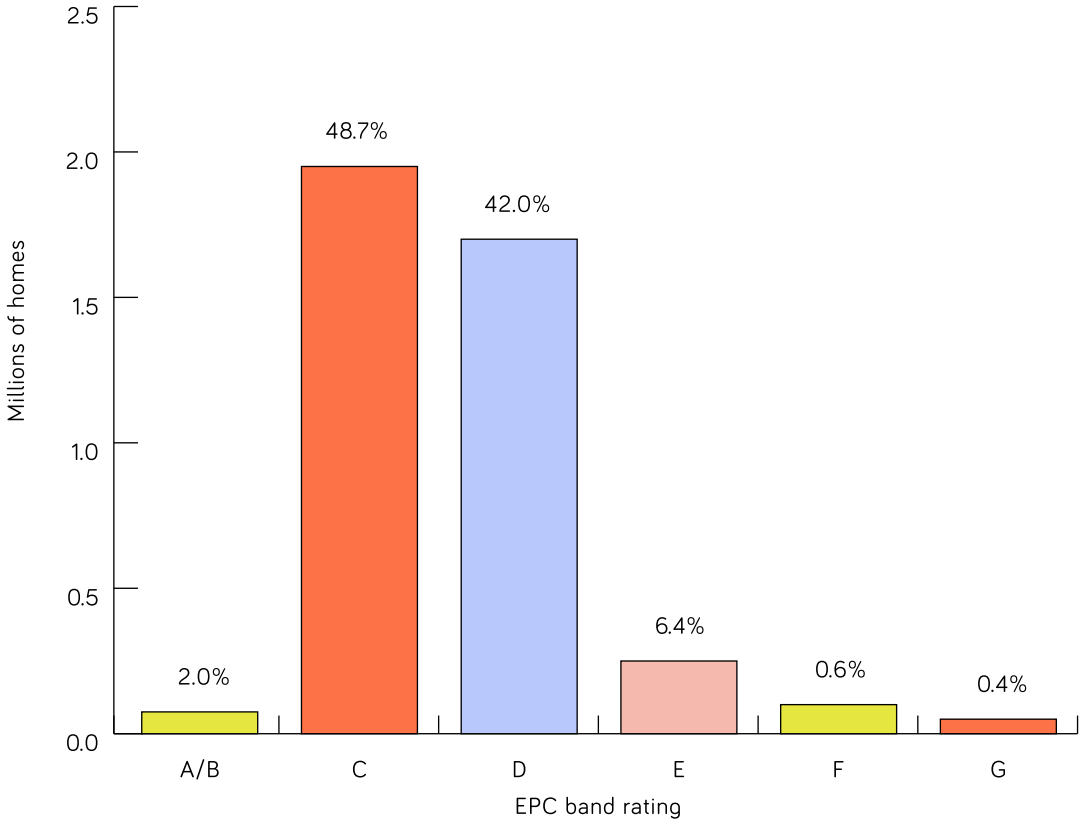
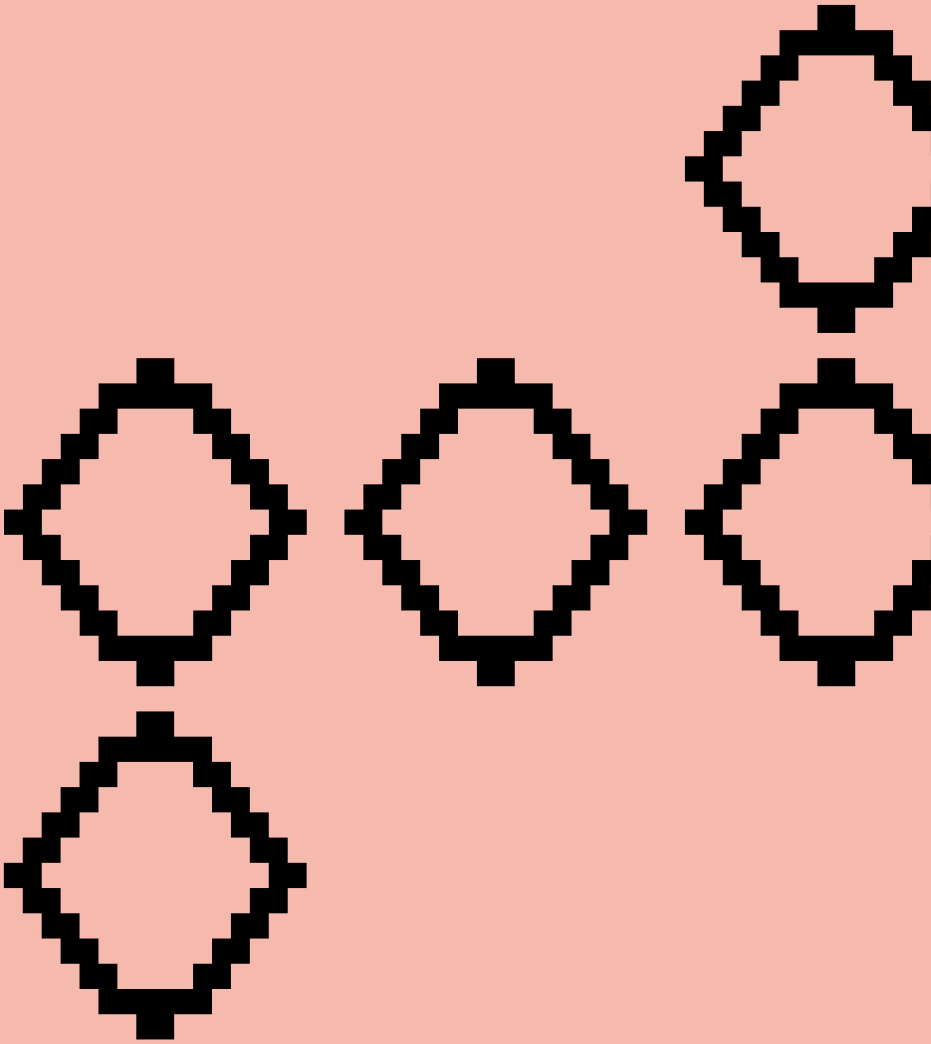


Figure 11
Distribution of EPC ratings in the social-rented sector, England 2016/17

Source: Department for Levelling Up, Housing and Communities, English Housing Survey, 2018

4

RETROFIT METHODS



Retrofit methods

The importance of place

Interwar housing provides communities with a very distinctive character, and it is important that retrofitting these buildings should retain and/or enhance this character. Traditional buildings are vital to our heritage and sense of place. Retrofitting our homes isn't just about technical measures, it's about upgrading the feel of individual homes and whole neighbourhoods.

Initiatives so far

The Green Deal energy efficiency scheme, which ran from 2013 to 2015, assumed there would be high consumer interest in low-cost insulation measures. But just 14,000 households (0.05 per cent of target properties) took advantage of Green Deal loans during the scheme's existence, even though they were well publicised.

The primary reason The Green Deal model fell short was because home-owners were put off by the perceived risks and costs of deep retrofit. By contrast, people purchase double glazing regularly: it is estimated that 20% of homeowners are considering it for the future. This is even though, at £250-390 per tCO_2 saved, it can cost up to four times more than Green Deal measures to achieve the same level of warmth.

Currently, England's key energy efficiency improvement scheme is the Energy Company Obligation (ECO). ECO and its predecessor schemes, the Carbon Emissions Reduction Target (CERT) and the Community Energy Savings Programme (CESP) have targeted low cost measures, such as cavity wall and loft insulation. As the number of households who are able to benefit from low cost measures shrinks, harder to treat homes needing more expensive improvements will be required to upgrade our interwar homes. In addition, ECO funding is only available if a household meets certain requirements, and therefore excludes many homes in England.

There is no available policy currently to support able-to-pay households in retrofitting their homes. The Green Homes Grant would have helped to bridge this gap, however its failure has lowered confidence of those interested in retrofitting.[35] Incentivising energy efficiency improvements for owner-occupiers who are able-to-pay for the cost of retrofitting is vital to reaching our climate commitments. Incentives will need to be coupled with access to private sector funding. The Government has a key role to play in ensuring private sector finance comes to market.

For large scale retrofits to be a desirable choice, they must be seen as simple to do and enhance a home's appearance, as well as being affordable. The current policy approach does not take this into account.

Prioritising fabric-first and whole-house retrofit approaches

A fabric first approach is key to ensuring that energy efficiency works actually improve the energy efficiency of a property and do not add additional costs to the building occupier. For example, it is important that heat pumps are installed in well-insulated homes. This is because the lower the flow temperature of the heat pump, the higher it's efficiency. In a home without adequate insulation, the heat pump will require a higher flow temperature, which will cost more to run and have higher carbon emissions.

It is important, therefore, that a "whole house" retrofit plan, which includes considered individual measures that are installed at the right time and work together, is undertaken for successful energy efficiency works.[36]

Embodied carbon is the total greenhouse gas emissions generated in producing the heating system.

20%
of the heating bills are due to drafts in poorly insulated homes

40%
reduction in embodied carbon in heating systems with good building fabric

Solid wall insulation

There are two ways to insulate solid walls – internal wall insulation or external wall insulation. There are pros and cons to both options, and in most cases owner-occupier's preference will be the deciding factor in the approach taken. In some cases, such as when properties are in conservation areas, internal wall insulation is the best option to take as this does not affect the façade of the building. Both methods of insulation reduce total house emissions by around 35%.[37]

External wall insulation

External wall insulation involves adding insulation boards to the outside of a property. External wall insulation improves ability of the wall to withstanding the elements as it protects the brickwork underneath and prevents against damp. It also helps to prevent noise pollution inside the house by adding another barrier between the street and residents inside. External wall insulation also provides an opportunity to improve the external appearance of the house by covering existing cracks and imperfections. However, some owners will not want to alter the original façade of the building so internal insulation will be preferable.

External wall insulation systems are installed on the outside and require scaffolding. While there is minimal disruption inside the house for this form of insulation by itself, adopting a whole-house approach is likely to require other measures including draft proofing and double glazing and so some internal works will still be needed.

External wall insulation alters the external appearance of a house. Depending on the way this is done, these changes can be either positive or negative, not only for the house being insulated but also for the houses next to it and indeed the whole street or area. Most external insulation is finished with render. The appearance and performance of different insulation materials and render systems can vary considerably.

Internal wall insulation

Internal wall insulation preserves the external appearance of a house, but can change its internal appearance, reduce room sizes and may require changes to fitting and furnishings. Again, changes in appearance can be either positive or negative depending on how the works are designed and installed. This often is unappealing to residents and can restrict the volume of insulation that they are willing to install therefore preventing the maximum potential of insulation.

It is essential that insulation of walls is considered as part of a whole-house approach. Consideration needs to be given to insulating window and door surrounds, improving the windows themselves, detailing at 'junctions' where floors and roofs meet the external walls, and in particular ventilation systems. All of these measures will work alongside the wall insulation to reduce heat loss from the homes.

While internal wall insulation is being installed, there can be considerable disruption to the daily routines of the people living in the house, but with careful planning and efficient installation this can be minimised. No scaffolding is required, and the work can be phased, allowing for different parts of the house to be accessible at different stages.

Cavity wall insulation

Cavity walls have a gap between the inner and outer brickwork. An installer can fill this cavity with insulating material by drilling small holes in the brickwork, which are then repaired afterwards. According to the Energy Saving Trust, an installer can do this in around two hours for a regular-sized home with easy access and it will not create any mess.[38]

Cavity wall insulation is the single most cost-effective, low risk energy efficiency measure available for the existing housing stock, after roof insulation.

It can be installed without major disruption to occupants and it needs no maintenance. Cavity wall insulation can reduce the heat loss through cavity walls by up to 40%.

Interwar homes built after 1930, which is approximately half of all interwar homes, have uninsulated cavity walls. These cause a huge amount of energy to be lost through the walls. When incorporated into a whole-house retrofit approach, cavity wall insulation is an inexpensive way to reduce the carbon emissions of the whole home.

Roof insulation

Interwar housing typically has pitched roofing. Roof insulation is the most straightforward and cost effective way to improve roof energy efficiency, improving roof energy efficiency.

It is essential that any ineffective roof insulation is removed and replaced. Roof insulation must maintain eaves ventilation to avoid damp accumulation which will cause rot, whilst also making sure that the insulation is tight fitting to reduce heat loss.

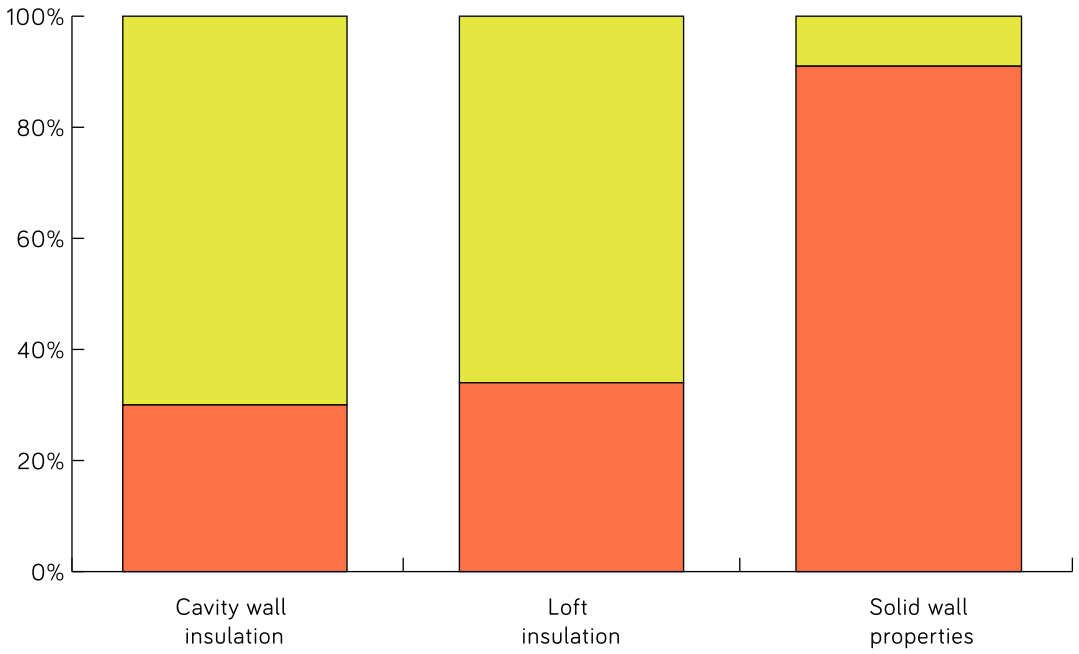


Figure 12
Most homes left to insulate will need more expensive measures

Source: Department for Business, Energy & Industrial Strategy, Household Energy Efficiency detailed release: Great Britain Data to December 2020

Windows

A typical house loses 10% of its heat through the windows.[39] Both double and triple glazing can decrease energy loss and save money on bills.

Ventilation

Traditionally, many older homes have relied on natural air infiltration to provide ventilation, through gaps in the fabric and around windows and doors. This can result in excessive and uncontrollable ventilation rates, significantly increasing the energy used to heat the home adequately and creating cold drafts and discomfort.

Heat losses from drafts can account for around 20% of a heating bill. Draft proofing is therefore key to improving the energy efficiency of our housing stock. Once insulation is installed, drafts become the dominant cause of heat loss in a home, accounting for around half of overall heat loss.

Draft proofing is a fairly simple measure that can be easily applied alongside insulation to increase the energy efficiency of the home.

By dealing with drafts and heat loss, this will also reduce the demand for heating and cooling. This means that heating systems will be used less.

Low carbon heating and cooling

The transition from a dependence on fossil fuel domestic heating to zero carbon technologies is one of the fundamental challenges the UK faces in its path to net zero by 2050, with a significant role for heat pump technologies.

The main heating solutions currently in use are:

— Gas boilers burning natural gas (primarily methane) supplied through the national gas grid (made up of the National Transmission System and eight gas distribution networks).

— Low-efficiency direct electric heating, such as economy-seven or plug-in space heaters, provides less than one unit of heat for every unit of electricity consumed.

— High-carbon oil and liquefied petroleum gas (LPG) boilers, with large storage tanks, used by many homes that are not connected to the gas grid.

— Solid fuel, either biomass (wood, wood chippings or pellets) or coal.[40]

Alternative options are:

— Air source heat pump
— Ground source heat pump
— Solar thermal hot water
— Biomass boilers

Boiler replacement

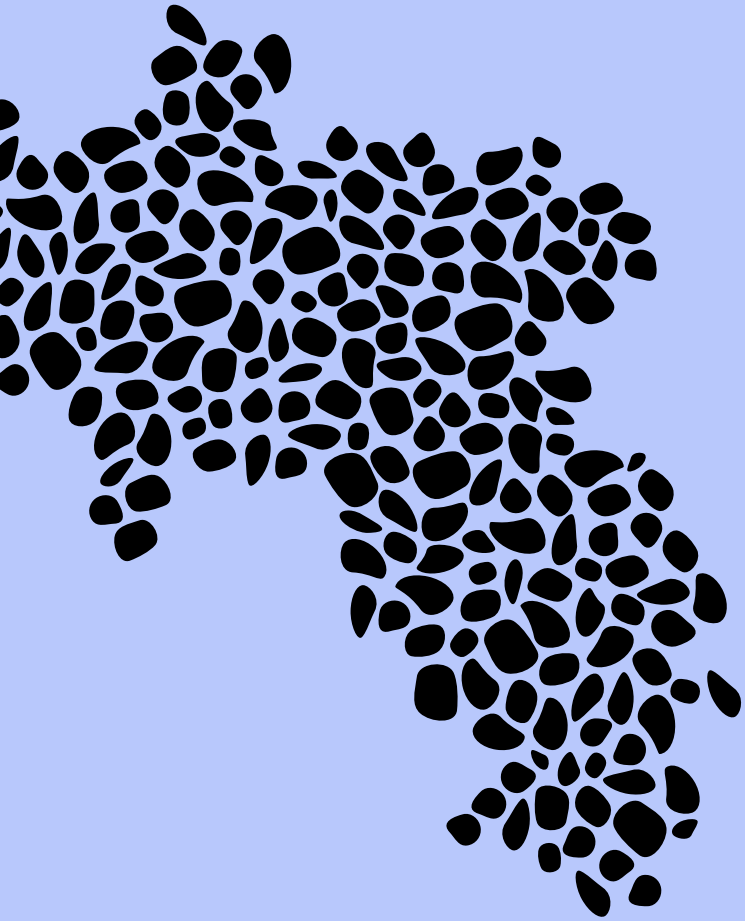
The Department for Business, Energy & Industrial Strategy (BEIS) consultation – 'Future Support for Low Carbon Heat' – identifies that heat pumps could enable the UK to almost completely decarbonise heat alongside the decarbonisation of electricity generation.[41] This is supported by the CCC which forecasts that 19 million heat pumps will be needed by 2050.[42]

To deliver the CCC's 2050 forecast for heat pumps, around 633,000 heat pumps need to be installed each year, (based on a straight-line trajectory from 2020). This is an ambitious goal but put in context this is equivalent to only 38% of the 1.67 million gas boilers sold in the UK in 2019.[43]

Where gas boilers are present still in interwar homes, they must be replaced by heat pumps as part of a whole-house retrofit approach. Installing a low-carbon heating system after other building energy performance improvements is key to ensuring high efficiencies and lower running costs.

5

MEASURING ENERGY EFFICIENCY



The energy efficiency of a building means its ability to use less energy to perform a certain task

Typical interventions to improve the energy efficiency of buildings include insulation in lofts and walls, both cavity and solid; draught proofing doors, windows and floors; and superior glazing systems, as well as changes to method of heating, such as the installation of a heat pump and energy efficient appliances. A significant challenge for retrofit fabric upgrades is access to and around existing junctions as insulation needs to be contiguous, such that cold bridges are minimised.

The performance of these combined measurements is documented in an EPC, graded on a scale from G (least efficient) to A (most efficient). EPCs are based on two different metrics, a rating related to CO_2 emissions and a fuel cost-based energy efficiency rating. The energy efficiency rating is based on a Standard Assessment Procedure (SAP) – which is the methodology used by the Government to assess the energy performance of homes. The SAP assesses how much energy a home will consume, based on standard assumptions for occupancy and behaviour. Broadly, the higher the SAP score the lower the running costs of the home in question. As Figure 13 shows, the annual running costs of a band C rated home are £270 lower than the average band D rated home and £650 less than the average band E rated home.[44]

However, EPCs are an imprecise way to measure energy efficiency. Real in-use performance data shows the disparity between predicted energy found in SAP calculations and actual energy used. Furthermore, SAP does not include unregulated energy sources, which is a primary cause of the performance gap between the design and the actual operations of a building. There is a real case for SAP to be revised to better reflect actual energy performance and include unregulated energy sources. This could then be reviewed a year after the property has been occupied with Post Occupancy Evaluation, measuring actual energy usage.

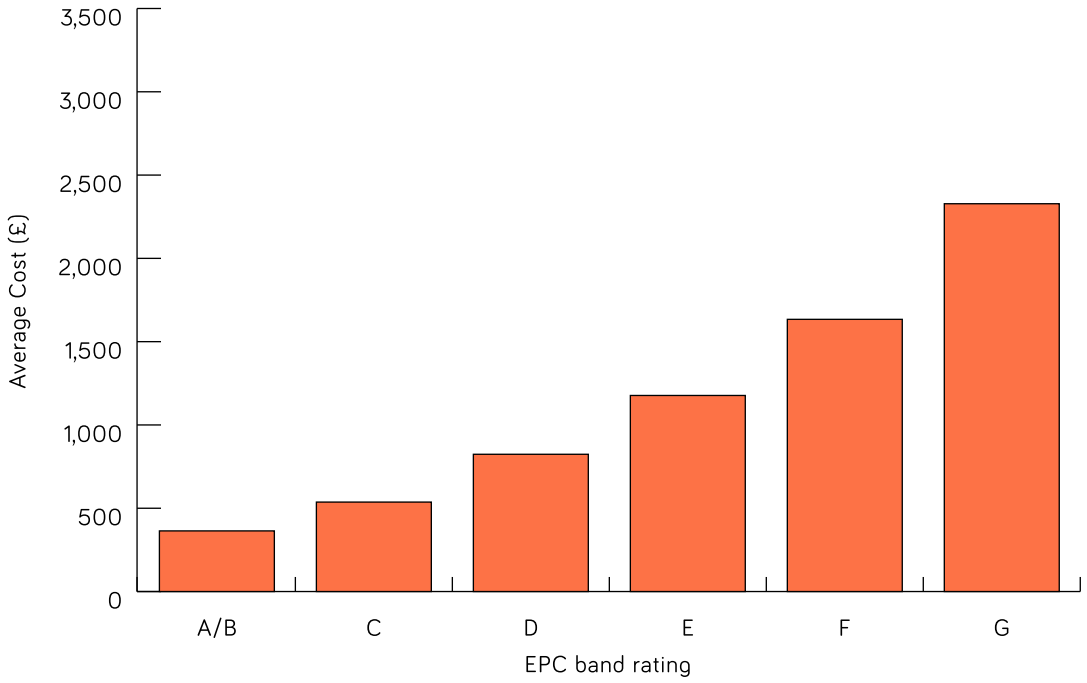


Figure 13
Average annual cost of energy in homes by energy efficiency rating, 2021

Source: Valuation Office Agency – Council Tax: stock of properties, 2020

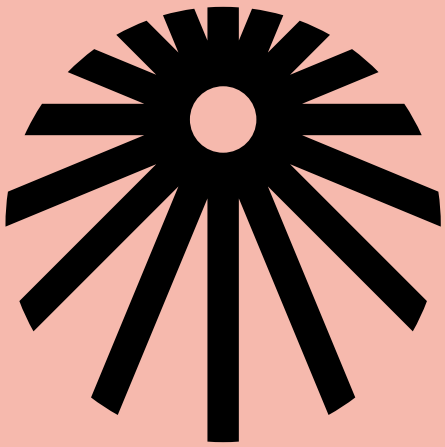
Post Occupancy Evaluation (POE) is the process of obtaining feedback on a building's performance in use after it has been built and occupied. By accurately measuring factors such as building use, energy consumption, water usage, maintenance costs and user satisfaction, POE allows for a process of continuous improvement in the construction industry.

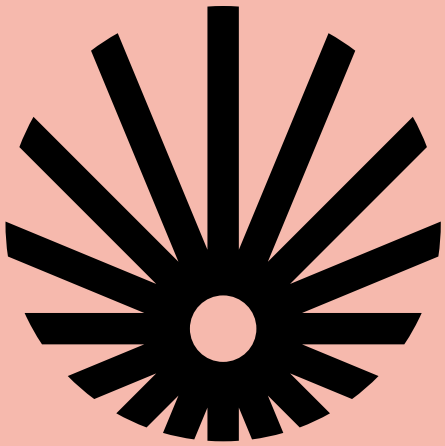
With these problems in mind, and with EPCs coming to be used across many different aspects of Government policy with regards to both retrofitting and new homes, the Government consulted on the continued use of EPCs in July 2018.[45] The Government's response to this consultation was published on 30 September 2020.[46] It is a step in the right direction on EPCs by acknowledging that they must better reflect real world performance. It sets the correct direction of travel that EPCs ought to eventually be a more accurate measurement.

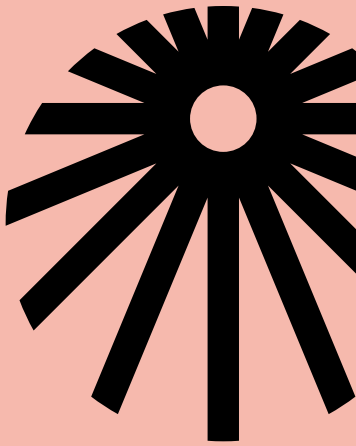
Despite the obvious shortcoming of the EPC and SAP system detailed here, and the recognition from the Government that EPCs fall short in some areas, we would caution against hasty changes to the system. The most recent wave of the Department for Business, Energy, and Industrial Strategy (BEIS)'s Public Attitudes Tracker published in 2019 found that six in ten people were aware of EPCs.[47]

6

HOUSING IN THE INTERWAR PERIOD







Community spirit drove the building of interwar homes

The First World War (WW1) permanently altered England's social and political landscape. It accelerated the changing attitudes towards class and gender and brought far reaching changes to the behaviours of British people and the lives that they led. These changes included the huge expansion of England's suburbs, a greater reliance on cars and debate around the way that England should look as it recovered from the effects of the War.

In the period between the wars, England went through intense suburbanisation.

Council housing grew from less than 1% of England's housing stock in 1914 to nearly 10% by 1938.[48]

Of the 1.1 million new interwar council houses, 90% were located within suburban estates.[49] It was not only the number of homes that dramatically grew during this period, with subsidised housing prices, home ownership quickly became a realistic possibility for a much larger number of English people. In 1915, 10% of England's housing stock was owner-occupied, by 1938 this has increased to 32%.[50] Most of these new owner-occupiers bought the new homes that were being built, and so a large proportion of England's owner-occupiers lived on these new suburban estates.[51]

The difference a home can make

Prior to the War, the living conditions in England's cities were very poor. When WW1 occurred, it coincided with the industrial expansion of cities. These conditions had been identified as a problem since the Victorian era, and several ineffective attempts had been made to revolutionise the problem of poor-quality housing and the accompanying poor health and quality of life for the English working class. These included the redistribution of residents from the most overpopulated areas. The War acted as a catalyst for the emergence of housing as a highly political issue, with the resulting suburbs being the first effective measure taken by the Government to remedy the problem.

Inner city slums arose initially as a result of the rapid urbanisation and industrialisation that was taking place. They were notorious for unsanitary and squalid living conditions, as well as extreme overcrowding. In the second half of the nineteenth century, London slums attracted the attention of journalists and social researchers, who described them as areas of extreme poverty, degradation, crime and violence, and called for an immediate public action to improve the living and sanitary conditions of the working classes.[52]

"Slums ceased to be regarded as a disease in themselves and gradually came to be viewed as a symptom of a much larger social ill."[53]

A number of contemporary accounts about life in the slums aroused public concern. Some of these reports helped prepare for the subsequent slum reform and clearance legislations. The War had also revealed that young, urban recruits were in poor physical health due to the dangerous living conditions in England's inner cities. This added to the impact that reporting of the state of inner-city housing had initiated publicly, and further increased the sense that housing was an urgent political issue. As peace returned, there was huge demand for working class housing. These factors led to a national campaign, spear-headed by the Prime Minister, David Lloyd George, who promised 'homes fit for heroes' to the soldiers returning from battle.

RIBA Collections – Terraced houses, Fretherne Road, Welwyn Garden City, Hertfordshire

The Tudor Walter's model for housing revolutionised the design of the British family home

In response to the vast array of necessary changes that English society demanded, the Government created a Ministry of Reconstruction in 1917. The aim of the Ministry was that it was to be "charged with overseeing the task of rebuilding the national life on a better and more durable foundation".

The main impact on post-WW1 housing was to create a Ministry of Health under which social housing and slum clearance were managed, with a housing department and local commissioners being in control. The Government also appointed architect and Member of Parliament Sir John Tudor Walters to report on the condition of housing. The result was the "Report of the Committee Appointed to Consider Questions of Building Construction in Connection with the Provision of Dwellings for the Working Classes", or "The Tudor Walters report" of 1918.

This influential report made recommendations for the design of housing and housing estates, stating its aim was to 'profoundly influence the general standard of housing in this country and to encourage the building of houses of such quality that they would remain above the acceptable minimum standards for at least sixty years'.[54]

The Tudor Walters Report was an extremely important step in the evolution of housing standards. The new suburban estates were distinguished from their urban counterparts both by their location and the character of their housing. The Tudor Walters Committee set out a new blueprint, drawing on contemporary planning ideas, pioneered in garden cities, that sought to improve economic and social conditions by creating

healthier and better-designed housing and communities. The Committee proposed housing specifications well in advance of current standards, including a minimum of three ground floor rooms, three bedrooms, plus a bathroom.

Houses were to be built at a density of no more than 12 per acre, semidetached or in short terraces, with wide frontages to increase natural daylight and a cottage appearance enhanced by front and rear gardens.[55] These homes remain sought after family homes to this day.

RIBA Collections –
Slum housing London

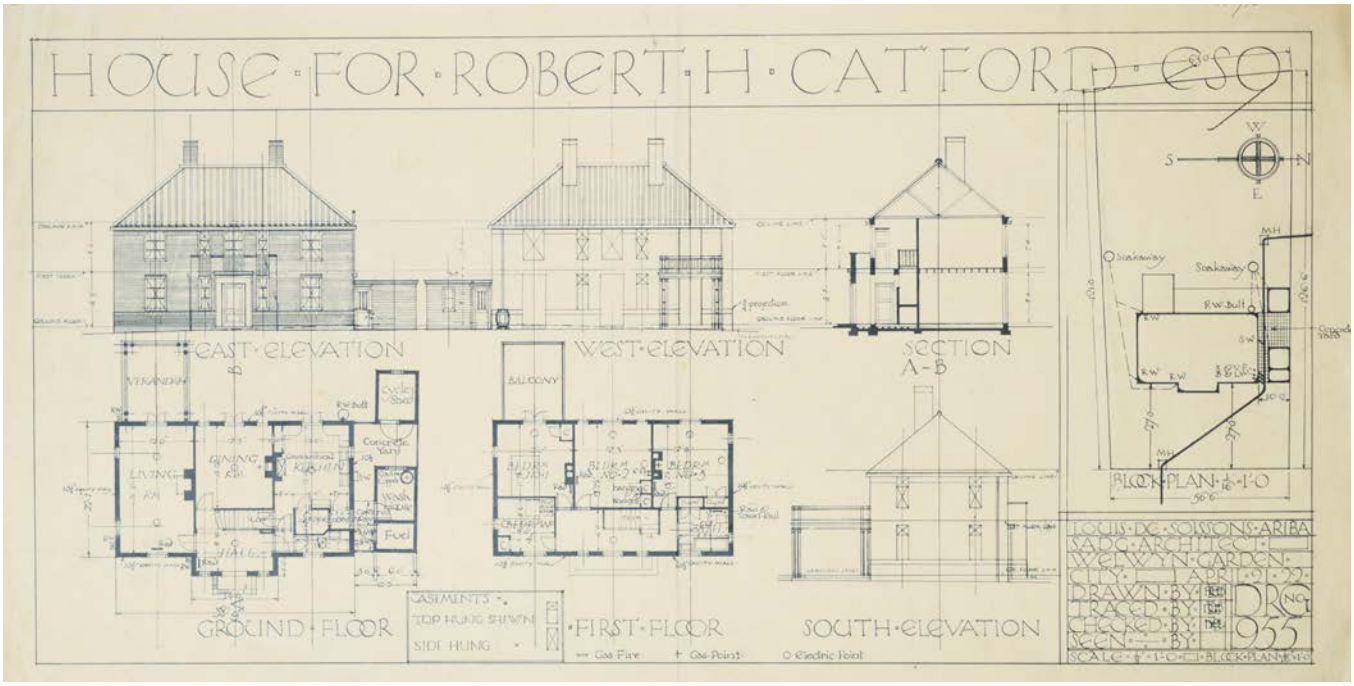
Critical reception to the interwar suburbs carried the same message as the NIMBYism of today

The London interwar suburbs have consistently suffered a tirade of critical disapproval. As the suburbs were being built, contemporary writers savaged the architecture, the destruction of large swathes of countryside and the submersion of small villages into the vast English cities. They feared the draining effect suburbanisation would have on city centres in terms of population and job losses and the impact this would have on the lives of the people left behind.

One of the consequences of this critical view has been the prolonged neglect of the suburbs as an issue for town planning. By concentrating on spatial development policies which emphasise the linkage of economic and social forces to improve the quality of urban landscapes, regeneration has become an essential tool in attracting investment. As a result, attempts to improve cities have generally emphasised the centre of cities rather than the suburbs surrounding them.[56] This polarisation of inward investment in favour of the city centres, at the expense of the aging suburbs has led to these areas having declining quality of life for the residents. One issue that is starting to emerge is the decline of the suburbs built in the 1920s and 1930s.

Over time, there has been increasing levels of deprivation in the interwar suburbs.

RIBA Collections – Design for a house for Robert H Catford, Welwyn Garden City, Hertfordshire



RIBA Collections – 'London Going out of Town – or – The March of Bricks and Mortar!' etching by George Cruikshank, Scraps and Sketches, 1829

On the one hand this can be attributed to concentrations of capital investment elsewhere but equally significantly as Peter Hall commented in 1989:

"The suburbs will not last forever. Not all were well built; not all have been well maintained. The cost of maintaining them will surely rise, and their owners will not be able to meet it. Some may well degenerate into slums, and the question of clearance and rebuilding will then loom large." [57]

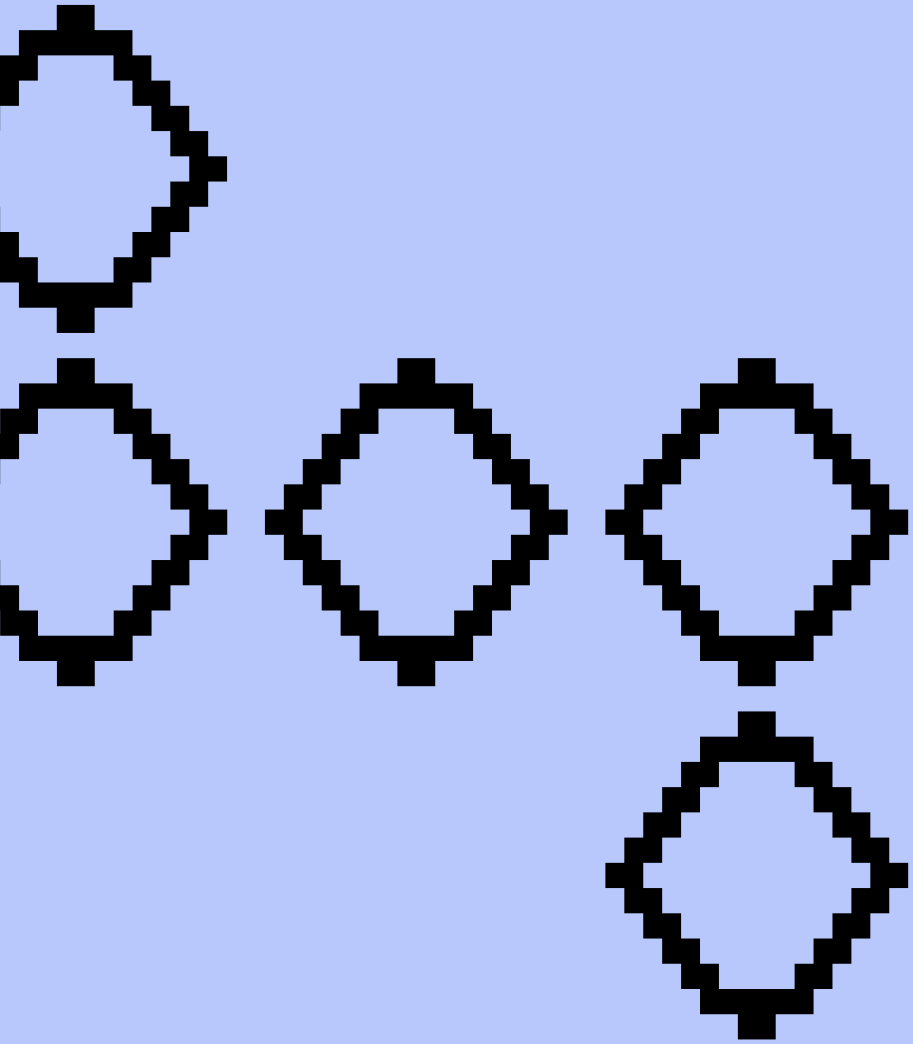
The view that these suburbs are fated to demolition will be fulfilled unless action is taken to revitalise and align them with the net zero ambitions that English homes must begin to move towards.

The future of the interwar estates

Despite the profound legacy of the interwar estates, these homes are falling behind in terms of energy efficiency performance. Most interwar homes have not been renovated since building, and therefore require both maintenance and retrofit adaptations in order for the UK to achieve its net zero commitment.

7

INTERWAR HOUSING — WHERE ARE THEY LOCATED?



Homes were built outside of city centres to provide a better quality of life

The largest proportion of interwar homes are found just outside the centre of major cities. The growth in suburbia led to the term 'metro-land', which referred to the new suburbs in Hertfordshire, Buckinghamshire and other areas just outside London. With the growth of London's borders, it is unsurprising that Greater London has the largest stock of interwar properties in England, with around 850,000. London also has the highest proportion of interwar properties when compared to other property ages and types, with around 23% being from this period.

850,000
interwar properties in Greater London

23%
of all housing stock in London is interwar

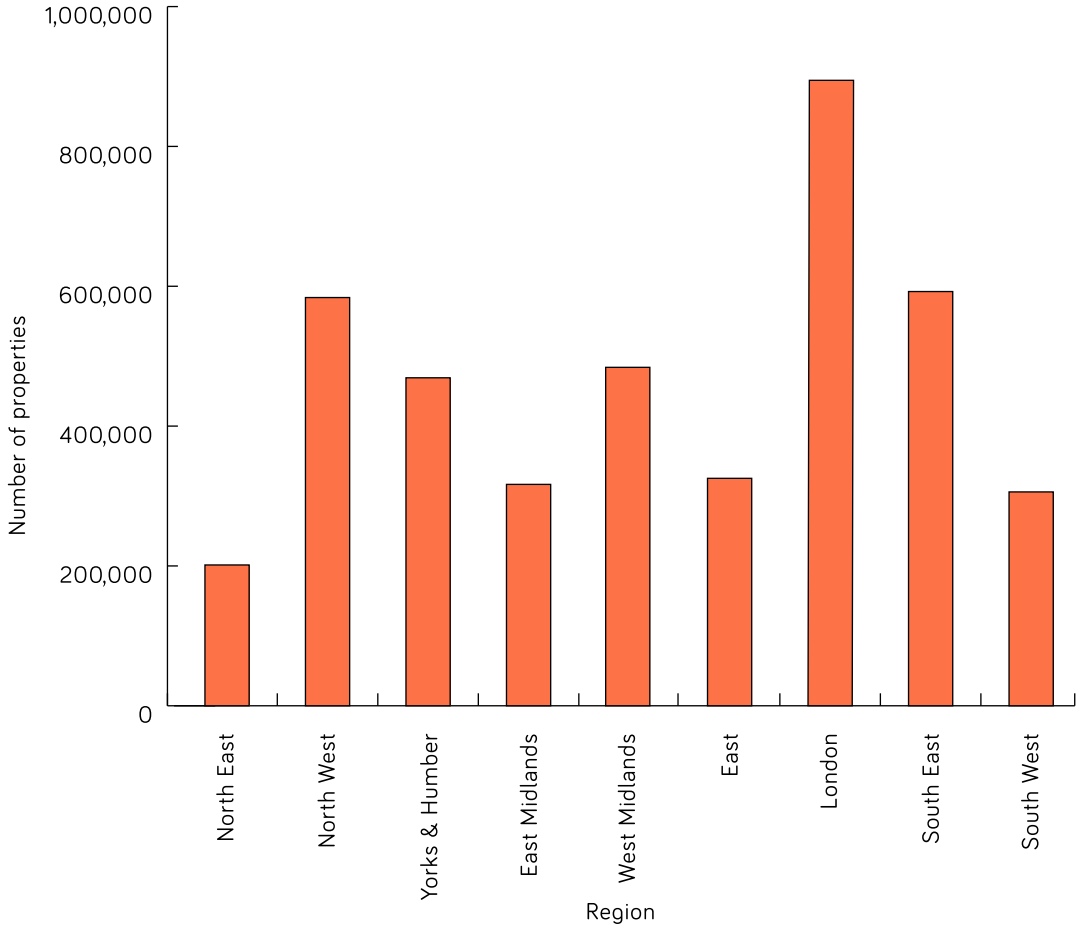


Figure 14
Number of inter-war homes by area

Source: Valuation Office Agency – Council Tax: stock of properties, 2020

Figure 15
Number of LSOA's with 100% inter-war houses by area

Local authority	Number of 100% LSOAs
Birmingham	7
Brent	7
Barking & Dagenham	5
Bexley	4
Nottingham	4
Sheffield	4
Newcastle upon Tyne	3
Barnet	2
Kingston upon Thames	2
Liverpool	2

Source: Valuation Office Agency – Council Tax: stock of properties, 2020

Local distribution

Eight out of the ten local authorities with the highest proportion of interwar housing are in Greater London. Only one is located away from the capital – Blackpool – of which 36% are interwar homes. The local authority with the highest proportion of interwar housing is Harrow. Though scattered throughout local areas, there are certain postcodes that have a much higher proportion of these homes.

In fact, there are over 50 Lower Layer Super Output Areas (LSOAs) that comprise only interwar housing. Each distinct postcode area in England represents one LSOA. These are distributed throughout England, however certain local authorities have a much higher number. Both Birmingham and Brent have seven LSOAs that only contain houses built between the wars.

8 of 10
local authorities with the highest proportion of interwar housing are in Greater London

50
Lower Layer Super Output Areas (LSOAs) that comprise only interwar housing

Kingstanding, Birmingham

Impact of retrofitting Birmingham

In total, Birmingham has 125,690 inter-war homes. Through retrofitting these homes that are able to be improved to EPC band C and above, the residents would save a total over £42 million annually, or on average £376 per property. Birmingham has one of the highest rates of fuel poverty in the country, with one in five households in the area pushed into poverty by the cost of adequately heating and lighting their homes. On average in Birmingham, the fuel poverty gap is £332 each year. By retrofitting some of Birmingham's most energy inefficient homes, the instances of fuel poverty in the area will be drastically reduced.

As well as this, retrofitting Birmingham's interwar homes to EPC band C or above would reduce the carbon emissions for the area by 317,426 tonnes of CO_2 each year. This is equal to eliminating 8% of the total CO_2 emissions in Birmingham, and 23% of the total residential emissions in Birmingham.[58] Birmingham has an ambitious target of a 60% reduction in total CO_2 emissions by 2027, against 1990 levels.[59] Retrofitting inter-war housing would contribute greatly to achieving this target.

£42m
saved on energy bills annually

£376
per property on their energy bills

317,426 tonnes
annual CO_2 emissions reduction

Property types

There are a number of postcodes in the Kingstanding area of Birmingham that are comprised almost entirely of interwar housing. We analysed EPC ratings for 37 postcodes from the area, which contain a total of 347 homes and 414 EPC ratings, with some homes divided into flats. Other than a few outliers, most of the homes in this area are built between the wars.

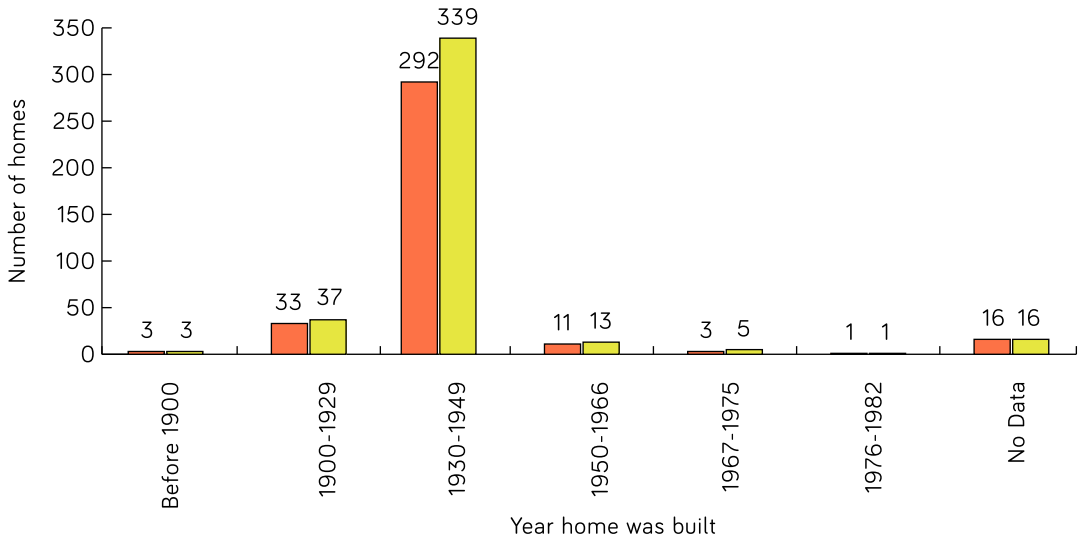


Figure 16
Number of interwar homes in a sample area area of Kingstanding by age band

Source: Department for Levelling Up, Housing & Communities, Energy Performance of Buildings Data: England and Wales, 2020

Figure 17
Numbers of homes by wall description

Wall descriptions	
Solid brick, with internal insulation	1
Solid brick, as built, no insulation (assumed)	275
Cavity wall, filled cavity	1
Cavity wall, as built, insulated (assumed)	2
Cavity wall, as built, no insulation (assumed)	8

Source: Department for Levelling Up, Housing & Communities, Energy Performance of Buildings Data: England and Wales, 2020

The current state of the housing stock

85% of the properties are owner-occupied, with the others mostly privately rented. This means that the houses are owned, occupied and will be retrofitted by the people who live in them. Due to this, many of the more common and easier decarbonisation measures, such as double glazed windows, have already been installed.

96% of the homes in the area have solid walls with no insulation, and 94% of the homes rely on a gas boiler for heating and hot water. Together these factors are the most detrimental to the energy efficiency of these buildings. In the June 2021 report to parliament, the CCC highlighted that:

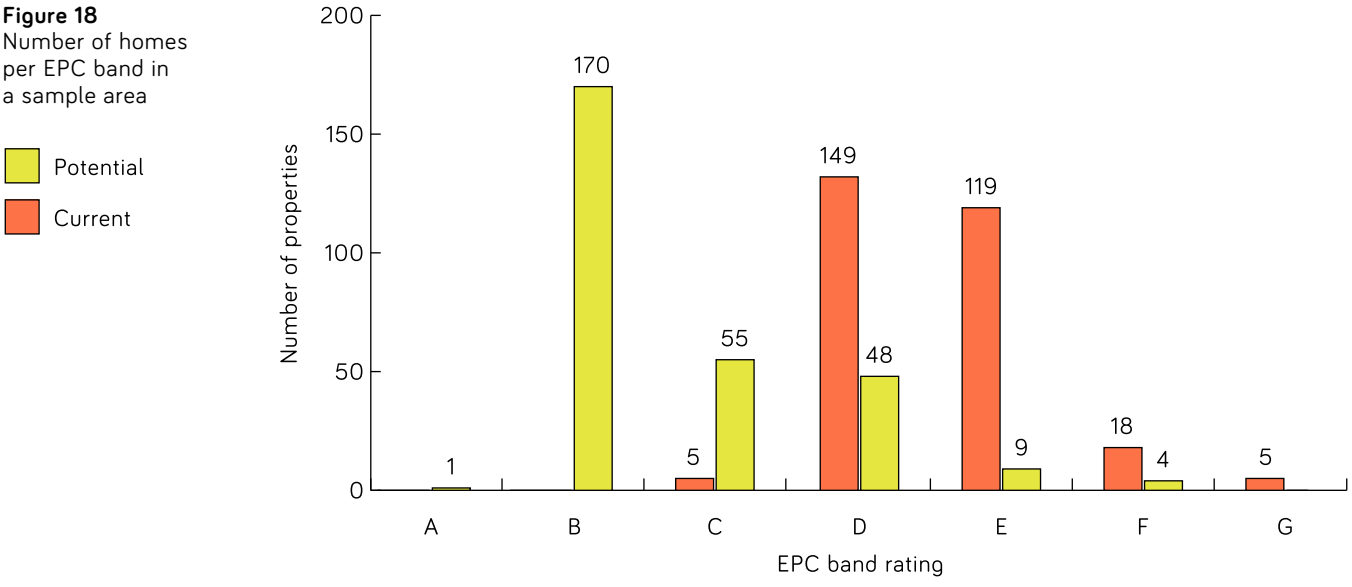
"there is an urgent need for well designed, fully-funded policy that works for deployment of energy efficiency improvements and low-carbon heat."[60]

Realising potential

Figure 18 shows the current EPC ratings of the homes in the area, alongside their potential. Most of the homes are EPC band D and E and so must be retrofitted to align with the Government's commitment to bring all homes to EPC band C or above by 2035. , as specified under the Government's Clean Growth Strategy.

The main interventions that will need to take place with these homes in order to increase the EPC ratings to reflect the potential in Figure 17 are solid wall insulation, replacing the gas boilers with heat pumps, improving the roof energy efficiency.

Figure 18
Number of homes per EPC band in a sample area



Source: Department for Levelling Up, Housing & Communities, Energy Performance of Buildings Data: England and Wales, 2020

Becontree, Barking and Dagenham

Interwar retrofit will improve the lives of those in the most fuel poor borough in England

Barking and Dagenham has the worst rate of fuel poverty in England. 23% of households in the borough cannot afford to heat their homes, compared to the national average of 13%. By retrofitting the interwar homes in Barking and Dagenham, the communities that live there will collectively save over £10 million annually on their energy bills. The average fuel poverty gap in England is £216, meaning that not only will retrofitting bring many homes out of fuel poverty but residents will also benefit from savings on their energy bills.

By updating the homes to be EPC band C or above, Barking and Dagenham will also prevent 77,470 tonnes of CO_2 emissions being released. This would reduce the total residential emissions for the area by 38%, and the total emissions for Barking and Dagenham by 14%. This is equivalent to removing all of the carbon emissions that are released by industry in the borough.

23%
of households cannot afford to heat their homes

£10m
annual energy bill saving

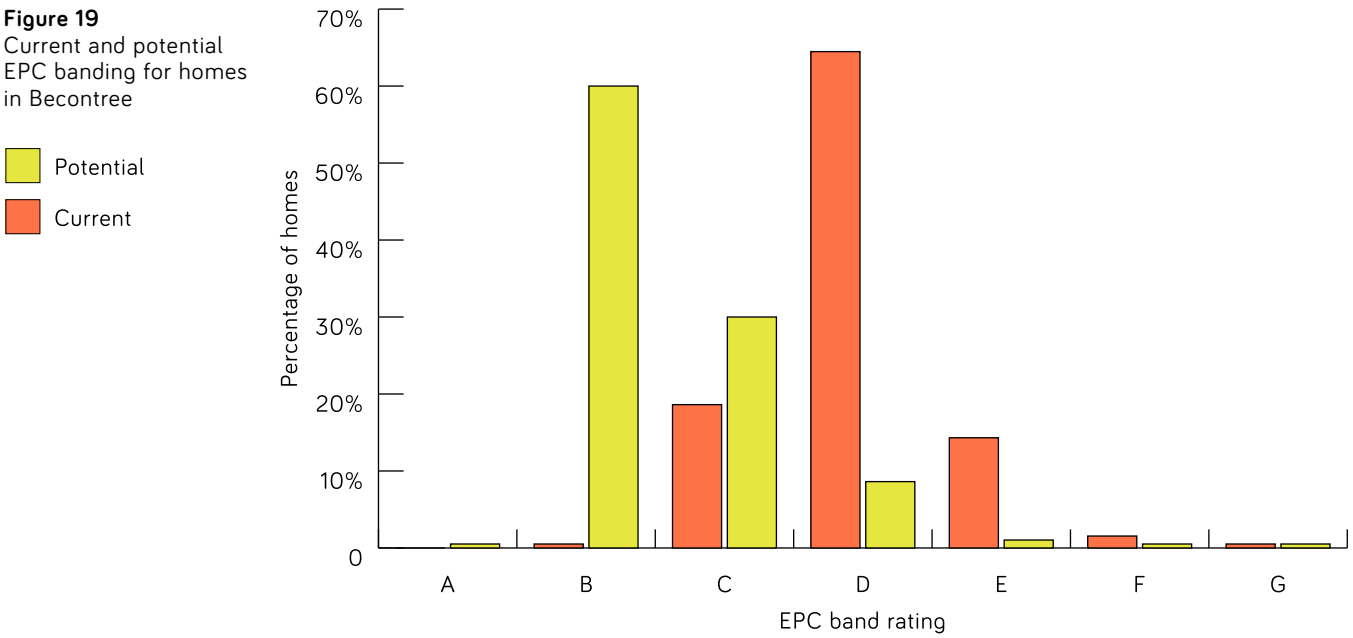
77,470
tonnes annual CO_2 emission reduction

History

The Becontree Estate was once described as the largest social housing estate in the world. Under the direction of Chief Architect George Topham Forrest, the London

RIBA Collections – Becontree housing estate, Dagenham, London, Forrest, George Topham (1872-1945) London County Council. Architects Department

Figure 19
Current and potential EPC banding for homes in Becontree



Source: Department for Levelling Up, Housing & Communities, Energy Performance of Buildings Data: England and Wales, 2020

County Council (LCC) built around 27,000 new homes on 3,000 acres of compulsorily purchased market gardens, fields and lanes in the parishes of Barking, Dagenham and Ilford in Essex. The Housing and Town Planning Act of 1919 had permitted the LCC to build housing outside of the City of London for the first time, with Becontree designed to rehouse people displaced from the East End by slum clearance.

Property types

There are 1374 distinct postcodes on the Becontree Estate. We analysed EPC ratings for the whole Becontree Estate, which contains a total of 10,851 unique EPC ratings. Other than a few outliers, most of the homes in this area are built in the interwar period.

Retrofitting Becontree

In Becontree, 46% of the housing stock is owner-occupied. 34% is social rental, with the remained of the residents privately renting their homes. Nearly all homes on the estate have double glazing, however the energy efficiency of the windows is still considered poor. Therefore, during retrofit, additional measures will need to be implemented in order to optimise the energy efficiency of the fabric of the building including draft proofing.

Just over half of the houses in Becontree have uninsulated solid walls. The other half is divided between uninsulated cavity walls and filled cavity walls. Both filled cavity walls and solid walls are considered hard-to-treat, and with 70% of the homes on the estate being this way, a large proportion of the area will require either internal or external insulation measures applied during retrofit. This is the factor that is causing the greatest energy inefficiency as all of these homes have not currently been insulated.

With only a few outliers, all of the homes in Becontree have a gas boiler as the heating source. Along with other decarbonisation measures, the boilers must be replaced with heat pumps. Heat pumps will provide a more energy efficient means of heat to the homes, however this must only be done following fabric thermal efficiency upgrades.

If these measures are implemented, Figure 19 shows the potential energy efficiency improvements to the homes. This shows that 90% of the homes in Becontree can be retrofitted with existing technology and methodologies to reach EPC band C.

Blackpool

Retrofitting Blackpool's interwar properties will close the fuel poverty gap for many households

The 2019 Indices of Multiple Deprivation revealed Blackpool was ranked the most deprived area out of 317 districts and unitary authorities in England.[61] In Blackpool, 16.3% of households were estimated to be in fuel poverty in 2019. This is the 4th highest percentage of fuel poor in Lancashire but has the largest number of households that are fuel poor. By improving Blackpool's interwar homes to EPC band C or above, households would save on average £322 per year on their energy bills. With the average fuel poverty gap at £334 annually in Blackpool, these measures could lift a large proportion of Blackpool's households out of fuel poverty.[62]

As a major tourist destination Blackpool has always had a lower-than-average rate of employee jobs in the construction sector, and therefore a much greater reliance on service sector employment. The impact of the coronavirus pandemic has acted to exacerbate the levels of employment deprivation in Blackpool. By developing a programme for retrofitting interwar homes, local jobs will be created, supporting communities in the area.

16.3%
households in fuel poverty in 2019

4th highest %
of fuel poverty in Lancashire

56,887 tonnes
annual CO_2 emissions reduction

56%
uninsulated cavity walls

Upgrading all interwar homes that can be improved to EPC band C or above would prevent 56,887 tonnes of CO_2 emissions being released. This is equal to 28% of the total housing emissions for Blackpool, and 12% of the total emissions for the area.

Retrofitting Blackpool

In the 1920s Blackpool had the most rapid expansion of any town in England.[63] This was largely fuelled by the rise in people going on holiday to resorts, in areas such as Blackpool, which began before the war and continued during the interwar period. By the 1930s, elements

Energy rating of homes built between 1930-49	Current	Potential
A	0%	0%
B	0%	29%
C	10%	56%
D	54%	13%
E	29%	2
F	5%	0%
G	2%	0%

Figure 20
Current EPC ratings of Blackpool's homes and potential EPC rating after retrofitting measures are completed

Source: Department for Levelling Up, Housing & Communities, Energy Performance of Buildings Data: England and Wales, 2020

RIBA Collections – View of Blackpool with Blackpool Tower in the centre, Adelaide Street on the left and Church Street on the right

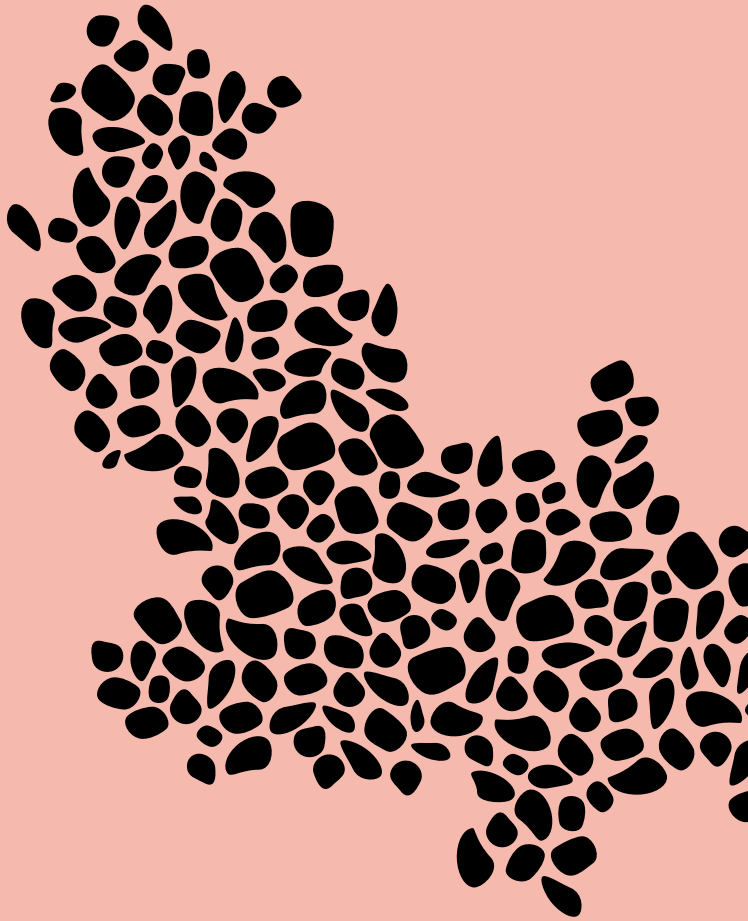
of a new garden city at Blackpool just behind the main promenade had begun to take shape. We analysed 47 distinct postcodes from this area to determine the potential for retrofit within Blackpool's interwar suburbs. This led to analysis of a total of 434 interwar homes. Blackpool's interwar housing estate came later in the interwar period than estates such as Becontree. The estate was built after cavity walls became the norm in housebuilding. Therefore, other than a few outliers, houses in this area have cavity walls. 42% of these cavity walls are a filled cavity and therefore will require internal or external insulation application, in the same way as solid wall housing. 56% of the houses in this area have uninsulated cavity walls that are unfilled. These homes will require simpler and cheaper insulation measures, with the cavity walls being filled with suitable insulation. With 56% of these homes having wall energy efficiency that is catagorised as poor wall insulation will be a significant factor in reaching the EPC potential mentioned Figure 20.

When insulating the walls of these homes, other measures such as roof and window energy efficiency must be addressed. 28% of the homes in the area analysed are catagorised as having very poor roof energy efficiency. Due to the design of interwar homes, and the loft space that was built into them, insulating the roof is an uncomplicated option. Therefore, addressing this is an easy method to improve energy efficiency within homes that have not undergone any previous modifications.

There has not been a large amount of retrofit that has occurred since the houses were built in Blackpool. This presents an opportunity to approach the homes with a standard set of measures which can then be adjusted to suit the tenants. With 94% of the homes in the case study area relying on gas boilers, these must all be retrofitted with a heat pump within the next 15 years.

8

BENEFITS OF RETROFIT



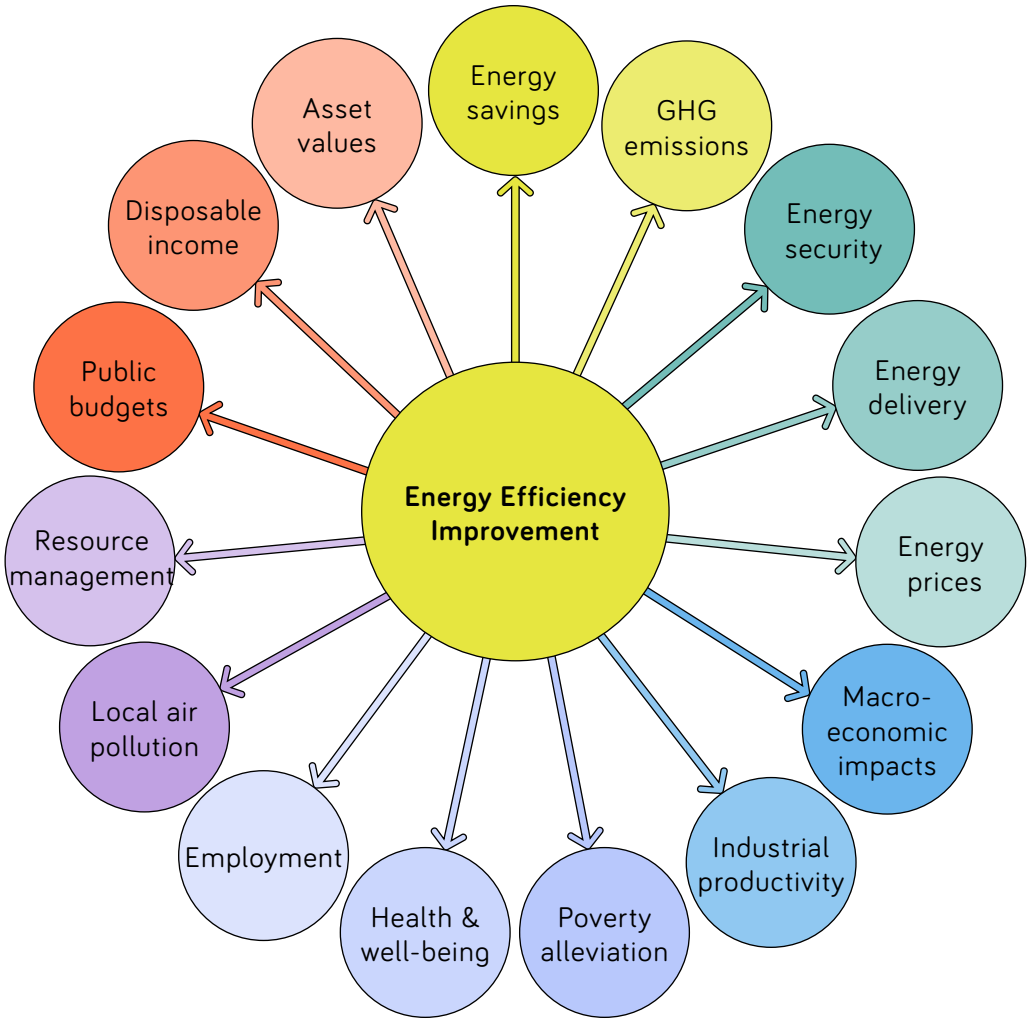


Figure 21
Capturing the multiple benefits of energy efficiency

Source: International Energy Agency

Economic

A long-term coronavirus recovery plan will be needed to support communities

Fundamental to the delivery of retrofit measures are the workers who will be manufacturing, designing, installing, and administering these solutions. This represents both a vast challenge and opportunity.

Improving the fabric energy efficiency of every building in the country is a colossal task but it must to be done. Some of the required roles, such as surveying and designing each project, require deep knowledge of building systems, considerable experience and specialised training. However, many of the installation tasks can be delivered with lower levels of training. The sheer number of interventions required to retrofit our housing stock means decades of work.

Therefore a significant ramp up of jobs is required in order to meet England's climate change target, which will provide new opportunities for local people. Moreover, doing so could see interwar

areas develop a skills base that could serve as a comparative advantage to deployment both inside and outside of the area for many years to come, providing long-term, skilled employment for people in the region.

The uptake of solid wall insulation to date has been low due to a longer payback period, higher upfront cost, and greater disruption associated with installations, compared to cavity wall insulation for example.

For every £1 million spent on energy efficiency about 23 jobs are directly supported in the energy efficiency industry.[64]

Widespread heat pump deployment will require both upskilling of the current workforce and training the next generation of low-carbon heating installers. This will ensure that the quality of heat pump installations is high, the knowledge of the benefits that the technology can bring is commonplace, and there are enough installers to scale up deployment to the levels required.

In terms of installation times, the Heat Pump Association's Heat Pump Roadmap assumed that eight working days would be needed to install a heat pump in retrofit homes. Each installer is assumed to work for 200 days per year and can therefore install 25 heat pumps per year.[65] If this is split across a ten-year period, there would need to be 13,200 heat pump installers to upgrade the heating systems of interwar homes.

Installing external insulation to the solid wall properties will generate an equivalent of nearly 10 million full time equivalent workdays. This is equal to 5,000 full time equivalent jobs every year for the next ten years to insulate all of the solid wall interwar properties in England.[66]

Upskilling and job creation can drive economic growth

With the complexity of work in some sectors, there will be an increased demand for cross-, multi- and interdisciplinary skills such as in whole-house retrofitting. This is because the move from traditional natural gas heating and present insulation solutions to low carbon energy efficient houses will mean that retrofitters will need to be able to work across multiple technologies and optimise them. At present, boilers and insulation are installed independently, but in a net zero world there will be multiple technologies that would operate in a home including solar panels, electric vehicle charge points, heat pumps, batteries, and smart systems to control these interacting technologies. This demonstrates the importance of their materials and skills supply chains working together.

According to the Construction Industry Training Board (CITB), improving the building fabric energy efficiency of every building in the country in need of retrofit will require 12,000 workers to be trained every year for about the next four years, before the need to ramp up annual recruitment by up to 30,000 workers between years 2025 and 2030. This implies an increased trained workforce of up to 230,000 by the end

Retrofitting our interwar properties means:

13,200
heat pump installers employed

12,000
workers trained every year for four years

30,000
workers recruited 2025-2030

230,000
increase trained workforce by end of decade

of the decade, and a resulting need to urgently prioritise new recruitment and retraining.[67]

Home retrofit can create jobs and provide training to local people, as well as supporting economic development.[68] Low-income areas often suffer high unemployment rates due to a lack of opportunities for residents. Employing local people to deliver the retrofit works means skills are more likely to be retained in the area, thereby enabling the rollout of retrofitting to be more efficient and allowing the development of a local maintenance network.[69] For residents in deprived areas, employment and can improve health as well as providing an income and skills training.[70]

Analysis by Frontier Economics has found that energy efficiency projects can have comparable benefits to other major infrastructure projects outside of the energy sector.[71] A review of over 20 studies found that every £1 million invested in retrofitting homes resulted in the creation of about 23 years of employment,[72] and Cambridge Economics has estimated that a national programme to improve all homes up to EPC band C would create 108,000 jobs across the country.[73]

Heat pumps tend to require 32-amp electrical supplies, and therefore an installation will require someone on site that is Part P (of the Building Regulations) qualified to be able to connect the power supply.[74]

108,000
jobs created across the country

Over 1.1. million
direct jobs in the low-carbon economy by 2050

Future-proofing England's construction industry

The Local Government Association estimates that in England by 2050 there will be over 1.1. million direct jobs in the low-carbon economy – including those related to energy efficiency and low carbon heat. The report also provides a regional breakdown of the direct jobs for all English single tier and district councils.[75] The gap between construction and other more productive sectors in England is one which deep retrofit can make steps towards tackling. Digitisation, innovative solutions and new product development will support jobs and increase productivity now and into the future.

New research from UK100 indicates that nearly half a million builders, electricians and plumbers will be needed to help meet the Government's objective of becoming net zero by 2050. It also shows that more than 3.1 million job posts affected by the shift to green jobs will need access to skills and training from government and industry.[76] This is a huge opportunity for the government to level up England's suburbs, where the vast majority of interwar homes can be found.

Social

Alongside the improved employment opportunities within communities, there are also wider benefits from retrofit investments, such as the improved health and well-being of occupants or fuel poverty reduction and local economic growth.

Increasing disposable income

Consumers spent £34 billion on domestic power and fuel in 2018.[77] Increasing the energy efficiency of homes to cut space and water heating requirements could save almost £15 billion annually in direct consumer costs. Heating water for use in the kitchen and bathroom accounts for 10% of energy bills. For individual households, additional disposable income from lower energy bills is an important factor. And so, retrofit measures will help the Government to meet their progress against statutory fuel poverty targets.

Saving lives and supporting the NHS

Poor quality housing has consequences on health. The direct cost to the NHS due to cold, damp, falls and other problems is £1.4 billion per year.[78] Vulnerable people have their lives cut short by cold, overheating and poor air quality. Cold homes cause 9,700 deaths each winter, overheating kills 2,000 people every year[79] and poor air quality causes about 30,000 early deaths each year.[80] These early deaths cost the UK around £3.5 billion per year.[81] The Building Research Establishment (BRE) has estimated that the total cost to society of poor housing in England alone, which includes the direct costs to the NHS, loss of earning potential and educational opportunities, is £18.6 billion annually.[82]

Environmental

Protecting the planet, starting at home

Reduced carbon emissions from our homes will help create a low carbon built environment and position England as a global leader in the low carbon economy. The UN Secretary General has proposed six climate positive actions for Governments to take to rebuild after the coronavirus pandemic. This includes investing in a green transition and creating green jobs. Implementing a National Retrofit Strategy will allow the Government to embed these positive actions into a roadmap for the future of England's built environment.

£15 billion
saved annually in direct consumer costs

9,700
deaths annually from cold homes

2,000
deaths annually from overheating

30,000
early deaths annually from poor air quality

Community regeneration

Retrofitting housing can create healthy and thriving communities

Communities can form groups and initiatives that make them a powerful changemaking force when it comes to climate change. They have knowledge of their local area and a sense of the specific challenges and opportunities that exist.[83] Retrofitting houses with energy efficiency measures can create warm and healthy homes for residents. But retrofitting entire interwar neighbourhoods, working with local people, ideas and skills, can create healthy sustainable communities. Since interwar suburbs tend to contain homes with very similar properties, retrofitting to support regeneration efforts is more straight-forward.

The delivery of high-quality whole-house retrofits can be used as the catalyst for wider improvements to local amenities and infrastructure, and for community engagement and employment programmes. Together these interventions can help to revitalise an area, enhance the standard of living and provide lasting benefits and opportunities for the community.

Interwar housing communities present an opportunity to implement a phased development programme with mass retrofit rollout. This will work alongside the Government's levelling up agenda and will both stabilise and decarbonise the communities in the short term whilst also creating inviting conditions for private sector led development, both within the community and using it as an example, in the long term.

Decarbonising homes can improve the economies of local areas

By looking at retrofit as a tool in wider improvements within an area, decarbonisation measures can help to instil pride, empower residents and create truly sustainable communities, turning the improvement of single homes into a strategy for the community. As with most regeneration projects, it is important that residents are at the heart of the process, to ensure maximum benefits for local people. Engaging effectively with residents about improvements is essential to understanding the needs of the residents.

Ongoing community engagement is essential to build trust, create demand and ensure lasting benefits from retrofitting housing clustered in a certain area

As well as increasing the energy efficiency of homes, retrofit should be used to improve the external appearance of properties, helping to instil a sense of pride among residents.[84] Many interwar houses will require external insulation installed, and this is covered with a render. This render can be used to revitalise the homes and cover imperfections, as well as create a sense of community pride. Simple measures such as refreshing façades and painting the outside of houses can significantly improve the overall appearance of an estate, with investment in the fabric of local homes creating a feeling that the community is valued.[85] Retrofit measures can also be complemented by revitalising dilapidated or vandalised buildings and underused public spaces. Doing so can improve a sense of ownership over the local living environment and reduce perceptions of dereliction.[86]

Retrofitting homes can increase the safety and security of the community

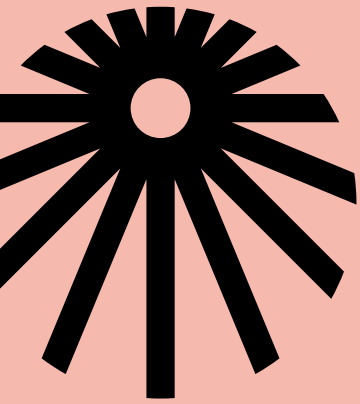
A wide-reaching whole-house retrofit programme can improve community cohesion, promote engagement and lead to reduced social problems in communities due to better quality housing and urban environment.[87]

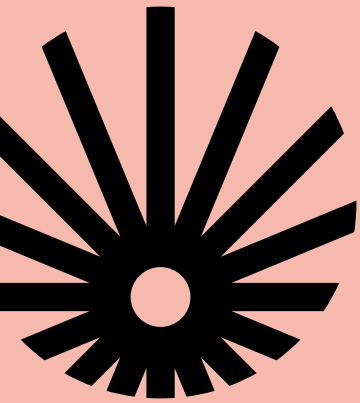
Close engagement with the existing community during the retrofit project could also lay the foundations to establish a local neighbourhood watch. Increased local pride and respect from the improvements to properties potentially encouraging a closer working relationship between the community and local police.[88]

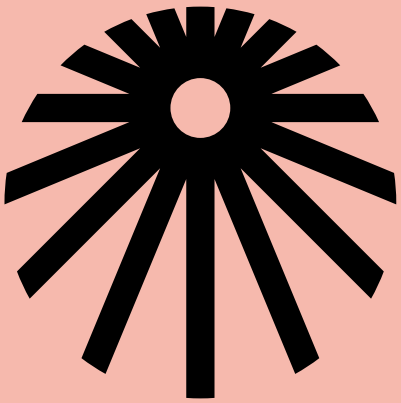
When adding external wall insulation to properties the outdoor lighting may need to be replaced. This can provide a good opportunity to enhance the external security features, such as lighting and fencing, to save time, money and hassle to residents down the line. Alongside home improvements, safety in public areas can be improved by adding or enhancing street lighting in an area.

10

SECTOR CHALLENGES







Sector challenges

Owner-occupiers

72.5% of interwar homes are currently owner-occupier. The retrofit the interwar housing stock is therefore heavily reliant on suitable policies promoting home retrofit to those who are able-to-pay. This must be coupled with educating home-owners on the benefits of retrofit, specific to their own homes. There must be support to residents through the retrofit process as well as appealing time restricted financial incentives. It is essential that owner-occupiers can see the value of the improvements to their homes.

This means educating owner-occupiers on the benefits and feasibility of deep retrofit, supporting through the project and (at least initially) providing financial incentives. Communication is critical, both before, during and after the retrofit. People need to feel and see the value of improvements.

Social landlords

In some ways, the social housing tenure is already leading the way when it comes to energy efficiency, with more than half of the social housing stock already reaching EPC band C.[89] However, in some cases energy efficiency is seen as a nice-to-have part of corporate social responsibility rather than a financial imperative, which means it is usually a very low priority. Over 11% of the interwar housing stock is either local authority or housing association owned. The sector is often talked about as having an important role in leading the effort to decarbonising the housing stock. The Government told the BEIS Select Committee in 2019 that the social-rented sector should be "a flag bearer" and an "exemplar" for energy efficiency standards.[90] The reason for this is severalfold: social housing is predominantly Government-funded stock, and social landlords have control over large estates; they have access to finance, and take decisions about planned stock upgrades that ought to account for longer time-horizons.

72.5%
of interwar homes are currently owner-occupier

Social landlords tend to take an element-based approach to carrying out investment works rather than a whole-house approach. The Government report Barriers to Retrofit quoted one housing association as saying that, 'retrofit is viewed as an added extra. We are mostly focused on fire-fighting and getting repairs right.' [91]

Most social housing providers categorise heating retrofit works as being separate from insulation retrofit works. Social landlords are legally obliged to provide a working heating system in their homes, therefore heating upgrade work is seen much more as routine planned investment and is included within standard contracts.

Previous policies and funding regimes have been successful in incentivising social landlords to complete the "low hanging fruit" of thermal retrofit. These comprise the lower cost measures – loft insulation, draught proofing, cavity wall insulation, central heating installations and improved heating controls. The remaining measures, such as insulation of solid walled homes, have the potential to deliver greater energy and carbon savings. However, they tend to be more complex, result in greater tenant disruption, and are more expensive to implement. These measures may require a different type of policy mechanism to deliver large scale retrofit than those that have gone before.

It will be essential for Government to provide incentives for social landlords to implement deeper retrofit strategies across

their interwar housing stock. Policies must support social landlords to fund retrofit works as social landlords do not have the mechanisms in place to make up-front long-term investments. Government must support landlords laying out a roadmap for packaging multiple projects to cover their housing stock, allowing it to reach a scale that will attract investment.

Construction industry

There is a skills gap in the construction sector. Too few people who can design and deliver successful retrofits. Within the construction sector, a lack of consistent Government policy is a barrier. There are also concerns about lack of demand, which impacts profitability.

There is hesitation within the construction industry in upskilling to match future retrofit demands due to inconsistent Government policy. Subsidy regimes have in the past distorted the market, and it is essential that we reach the point where deep retrofit is self-financing in order to instil confidence in the construction industry. This must be backed by consistent long-term Government policy and funding.

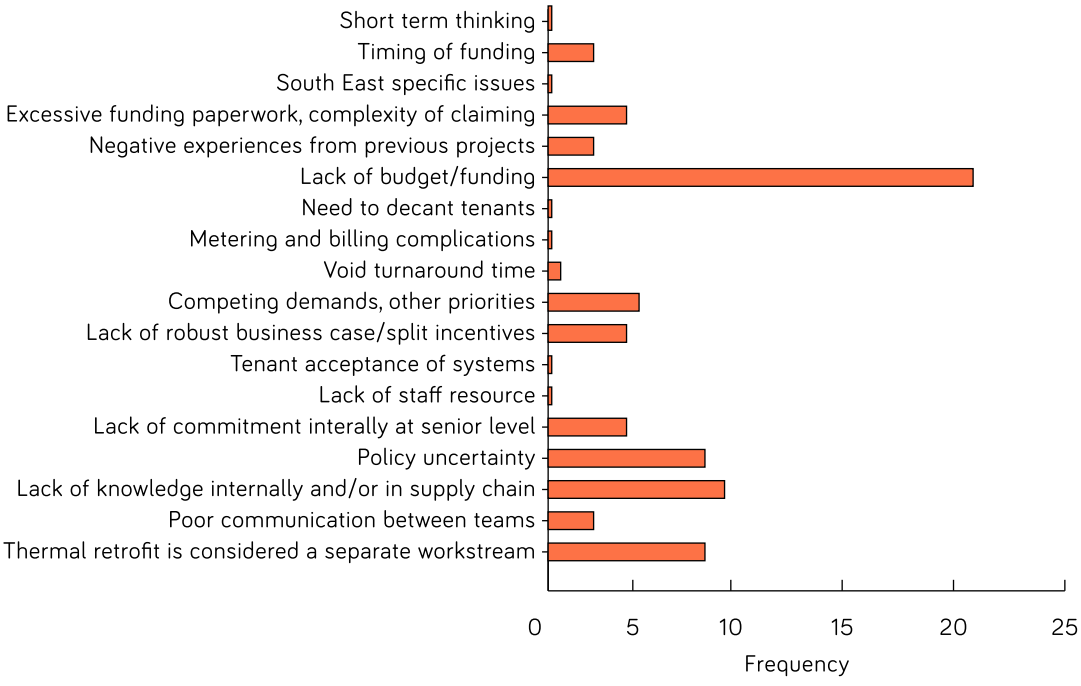
Demand needs to be increased and supported by the Government through targeted interventions on both demand and supply side.

Lenders

Financiers often view retrofit as a risky and fragmented market. Projects are too small, and the investments are illiquid due to the limited scale of retrofit rollout. Projects need to be much bigger to be attractive against other low-carbon infrastructure investments. This needs to come from the Government through the National Retrofit Strategy.

Financiers and real estate investors hold a massive influence in shaping and accelerating the market for retrofitting housing. There are clear market incentives to focus investors' attention on financing the retrofit of England's housing. Commercial banks are a key source of financing. Construction finance, mortgages, home improvement loans, and green financial products for home retrofit can build upon Government led retrofit, as can better financial terms such as lower interest rates and longer tenors.

Figure 22
Barriers to retrofit mentioned by social landlord interviewees



Source: Dr Jason Palmer, et al. *What are the Barriers to Retrofit in Social Housing?* Report for the Department for Business, Energy and Industrial Strategy [92]

Architects

Architects are one of the key professionals in the retrofit industry and play a pivotal role in construction projects. Their specialist skills and expertise include providing strategic advice and design solutions to assist clients with the process of commissioning projects and setting design predictions that are focused on energy performance as well as design quality. It is therefore important for any National Retrofit Strategy to highlight the role that architects will play on decarbonising the housing stock.

Many buildings are designed by architects and checked by building control, both of whom have an overview of the project. Both are then engaged in maintaining that overview during construction and have a role that is independent of the client and the builder. In many cases, a clerk of works is also employed to keep an eye on things on site on a day-to-day basis.

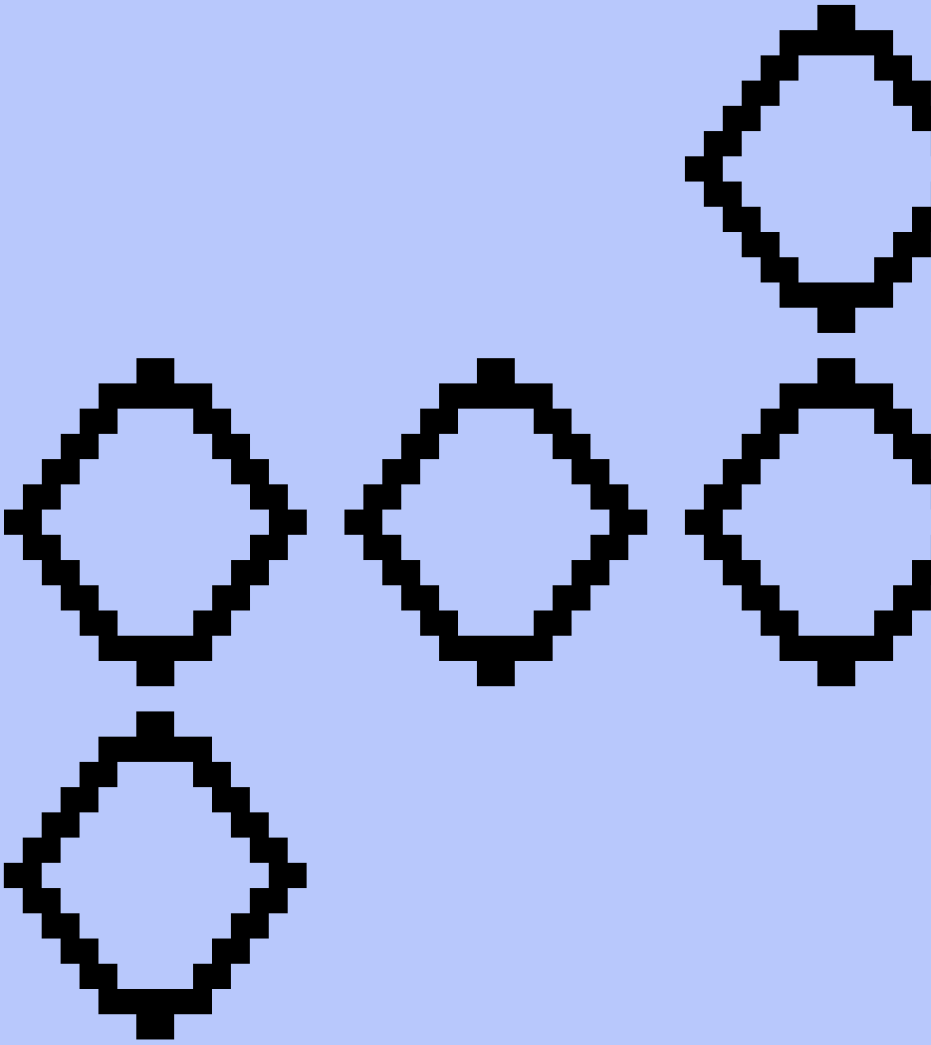
In many retrofit projects, none of those three roles are now involved. Architects tend not to be employed for the large-scale energy efficiency upgrades which affect the design quality of homes. Levels of regulatory involvement by building control vary, but on the larger scale energy efficiency upgrade projects, they tend to be restricted to a limited set of paperwork compliance issues to be provided in advance of the works. In many cases, housing associations and council housing departments do not employ a clerk of works who is independent of the builder. In this way, for many projects – and in particular projects expected to deliver carbon emissions and fuel poverty reductions – there is often no-one with an overview of the building in its entirety, nor someone with an independent role to inspect quality on site.

Deeper retrofit demands, in line with England's net zero commitments, also demand a higher standard of workmanship than previously required, such as the additional demands of airtightness and renewable energy systems.

Complexity is increasing, design and specification information is not always up to scratch and being generic is rarely applicable when looking at housing retrofit. All of this is also set against an economic context in which clients are under pressure to reduce costs, so profit margins and tolerances in the system are being worn down.

11

RECOMMENDED WAY FORWARD



The impact improving to EPC band C will have

Recent analysis published by E3G has found that improving the energy efficiency of homes currently rated EPC band D or worse for energy performance to EPC band C would save households £511 per year should gas prices increase in April 2022 as has been predicted. This saving would help lift a large number of residents out of fuel poverty.

Building on the Clean Growth Strategy is essential to empower local areas to retrofit homes

After a period of declining support for energy efficiency policy, with decisions to withdraw funding for the Green Deal, discontinued Warm Front and reduce funding for the ECO, the Government published its Clean Growth Strategy in October 2017.

In its 2019 manifesto, the Conservative Party pledged to spend £9.2 billion on upgrading the energy efficiency of homes, schools and hospitals. This included a Social Housing Decarbonisation Fund Homes of £3.8 billion over a ten-year period; Home Upgrade Grants worth £2.5 billion over a five-year period and a Public Sector Decarbonisation Scheme of £2.9 billion over a five-year period.[93]

For a National Retrofit Strategy to be successful, it needs to avoid the pitfalls of previous efforts

On the 8 July 2020, Chancellor Rishi Sunak also announced a £2 billion Green Homes Grant, with vouchers of up to £5,000 to help homeowners upgrade their homes, and up to £10,000 available to some of the UK's poorest families. This also included a £1 billion programme to make public buildings, including schools and hospitals, across the UK greener and £50 million to pilot innovative approaches to retrofitting social housing at scale.[94]

£511
saving per year by improving the energy efficiency of homes currently rated EPC band D or worse for energy performance to EPC band C

£9.2 billion
Conservative Party pledge for upgrading homes, schools and hospitals.

£3.8 billion
Social Housing Decarbonisation Fund

£2.5 billion
Home Upgrade Grants

£2.9 billion
Public Sector Decarbonisation Scheme

These efforts were characterised by stop-start funding that led to boom and-bust cycles, ultimately leaving the largely SME suppliers of construction for retrofit with unsustainable business models. If these poor outcomes are to be avoided moving forward, the Government will need to bring forward a plan to ensure that consumer demand is built up and is sustainable.

The Green Homes Grant was a welcome measure to help boost to demand, however, the axing of the scheme may have resulted in industry losing further confidence in investing in the skills and supply chain needed to retrofit the UK's housing stock.

Funding must be backed with a strategy to ensure to homes are not forgotten

An estimated investment of £65 billion is required to achieve the UK Government's stated ambition to improve as many homes as possible to an EPC rating of C by 2035.[95]

For homeowners in the 'able-to-pay' category, private capital will deliver the largest proportion of investment in energy efficiency improvements. Ready availability of private finance is critically important, but – as the Green Finance Taskforce and Green Finance Strategy have acknowledged and experience in other countries shows – will not on its own drive sufficient demand for insulation and other efficiency measures. For low-income and fuel-poor households, public capital has a much larger role to play.

Across all housing tenures, additional activities are needed to generate consumer demand and unlock the provision of finance for decarbonising and improving the resilience of our homes. These include activities such as the providing better information and access to capital, to ensure that projects deliver the predicted energy savings, as well as incentives and regulation for both borrowers and lenders to act. As highlighted in the Government's Call for Evidence on Building a Market for Energy Efficiency,

> **"...there is no single 'silver bullet' policy for improving energy efficiency."** [96]

Strategising for decarbonisation of homes must be holistic

The overall Government ambition for, and pace of change in, the decarbonisation of homes currently falls short of addressing the net-zero challenge. For the challenge to be met, the Government needs to provide a roadmap for individuals to overcome regulatory barriers faced to drive the investment needed to retrofit homes at the speed required. The first step is to establish a common goal for all homes to achieve EPC band C by 2030, in line with England's fuel poverty targets, from which the finance industry, supply chain, homeowners and tenants can have a secure foundation in order to incentivise these changes.

Accelerating retrofit rollout should happen in unison with recovery from the coronavirus pandemic

Embedding energy efficiency and resilience investment into the wider fiscal stimulus and economic recovery plan should be a top priority for the Government. The Conservative Party's manifesto commitments on home energy efficiency can be implemented via the forthcoming Infrastructure Strategy and subsequent Spending Review, such as the a £3.8 billion Social Housing Decarbonisation Fund and £2.5 billion Home Upgrades Grant.

Clarity on the long-term MEES requirements for the rented sectors is urgently needed to motivate landlords and the supply chain to plan and invest. New MEES for owner-occupied homes that mitigate the risk of a two-tier market would provide the clearest signal to homeowners of the need to upgrade their homes. Complementing this, fiscal incentives for private homes are needed, for example a Landlords Energy Saving Allowance and Stamp Duty or Council Tax-linked rebates that reward owners of efficient and resilient homes.

Existing policy, existing commitments, new incentives and information frameworks must form an integral part of the developing response and recovery from the coronavirus pandemic, 'levelling up' infrastructure and opportunity across the UK, rapidly stimulating investment and local consumer spending, while contributing towards net zero, fuel poverty targets and healthier, more resilient places to live.

Incentivising owner-occupiers to retrofit can be achieved through linking Stamp Duty Land Tax to EPCs

We propose linking the Stamp Duty Land Tax system to the energy performance of homes, thereby creating a financial incentive for home-buyers to purchase a more efficient home, and for homeowners to improve the energy efficiency of their home.

A further twist on this policy could be introduced such that the purchaser of a home with low SAP score, and so an increased Stamp Duty Land Tax charge, could receive a rebate if they can increase the SAP rating of the property through energy efficiency measures within a set period of time.

Moving house is a key trigger point at which people consider making energy efficiency improvements.

Therefore, a time-limited rebate period would add a further incentive for those who have recently bought a home and are considering carrying out renovations. Including a rebate period as part of the policy would result in less revenue for HM Treasury but could make it considerably more attractive and therefore effective at stimulating demand for energy efficiency improvements. In 2017-18, the last year for which broken down Stamp Duty Land Tax data is available, there were 1.1 million residential transactions, the majority of which were above £125,000 and so incurred Stamp Duty Land Tax.[97] A change to Stamp Duty Land Tax that affects almost the entire housing market is therefore likely to have a considerable impact and is not comparable to the Stamp Duty Land Tax zero-carbon homes relief.

Linking stamp duty to energy efficiency would create a much clearer financial incentive for energy efficiency than which exists as a result of market forces.

It would reinforce the premium attached to more efficient homes and give homeowners an incentive to invest in the efficiency of their home prior to sale (when they are likely to receive little in the way of energy cost reductions). As was discussed in the previous section, homeowners rarely view energy efficiency separately from other questions such as warmth and comfort. Linking property values and transaction costs more explicitly to energy performance would

The least energy efficient dwellings emit much more carbon
Average carbon emissions for each EPC grade

EPC Grade	Average CO_2 emission per sqm (t)	Average cost per year (£)
A	0.3	396
B	1.7	396
C	3.2	643
D	4.7	921
E	6.5	1,392
F	8.7	2,008
G	12	2,998

Source: Department for Levelling Up, Housing and Communities, EPCs for all domestic properties (existing and new dwellings), 2020

Figure 23
Average carbon emissions for each EPC grade

increase the likelihood of homeowners pursuing energy efficiency alongside other upgrades during their occupancy. The hope is that, over time, this would lead to greater engagement by the likes of estate agents and builders, who would encourage householders to invest in energy efficiency and increase the value of their home.

Financing the retrofit of interwar housing can be reduced by considering mass customisation policies

Too often residential retrofit is characterised by partial measures undertaken unsystematically. This leads to inefficiency, waste, re-working, disruption and unnecessary expense.

Factors in the failures of adequate retrofit rollout are lack of expertise in the domestic construction labour workforce, lack of knowledge and skills, as well as lack of efficiency, productivity, local supply chains, creation of a skills base and reduced cost per unit.

Mass customisation also allows retrofitted homes to blend in with their surroundings, meaning that within communities of interwar housing, the aesthetic appearance of the area is maintained and enhanced in a uniform way. Modern methods of construction should enable cost per unit to decrease over time, subject to 'learning curves' as seen in the solar panel and fuel cell industries. The learning curve theory assumes that with every doubling of production, the unit price falls at a consistent rate (dependent on a number of factors). If cost per unit reaches the break-even point for social landlords (£35,000 in some discussions), then roll-outs of 5,000 homes per local area could generate £175 million in revenues, with a proportion going to the local supply chain. Mass customisation then, combined with modern manufacturing methods, would allow for the retrofit of these homes to be rapidly and cost-effectively adapted to a much wider range of properties. This will help drive costs down to the point where they are commercially viable for larger landlords.

Mass customisation would be easiest to develop and have the greatest impact if targeted at relatively large numbers of similar properties in an area. Therefore, the uniformity of interwar estates, as well as the urgent necessity for these homes to be decarbonised, makes them a perfect place to start.

Funding for the able-to-pay market

The Energy Efficiency Infrastructure Group has calculated that to protect consumers as we move off gas and to meet the UK's climate targets, an energy efficiency investment package worth an additional £7 billion for the remainder of this Parliament is needed, backed up with a future investment plan to 2030 and beyond. As follows:

— Full support for low-income households by fulfilling outstanding Conservative Manifesto commitments to the Homes Upgrade Grant (£2.35bn this Parliament) and Social Housing Decarbonisation Fund (£3.6 billion to 2030, of which £1 billion by 2025).

— Make energy efficiency upgrades affordable for all by establishing a new, streamlined grant scheme available for all households – with £3.6 billion provided in a 3-year Spending Review, tapering support from 2025.

Without closing the current funding and policy gap for the able to pay market, through a new grant scheme and supportive policy measures, such as supply chain support and protection, it is unlikely the Government will be able to meet climate targets and levelling up ambitions. The Spending Review must therefore be backed up by a comprehensive set of measures.

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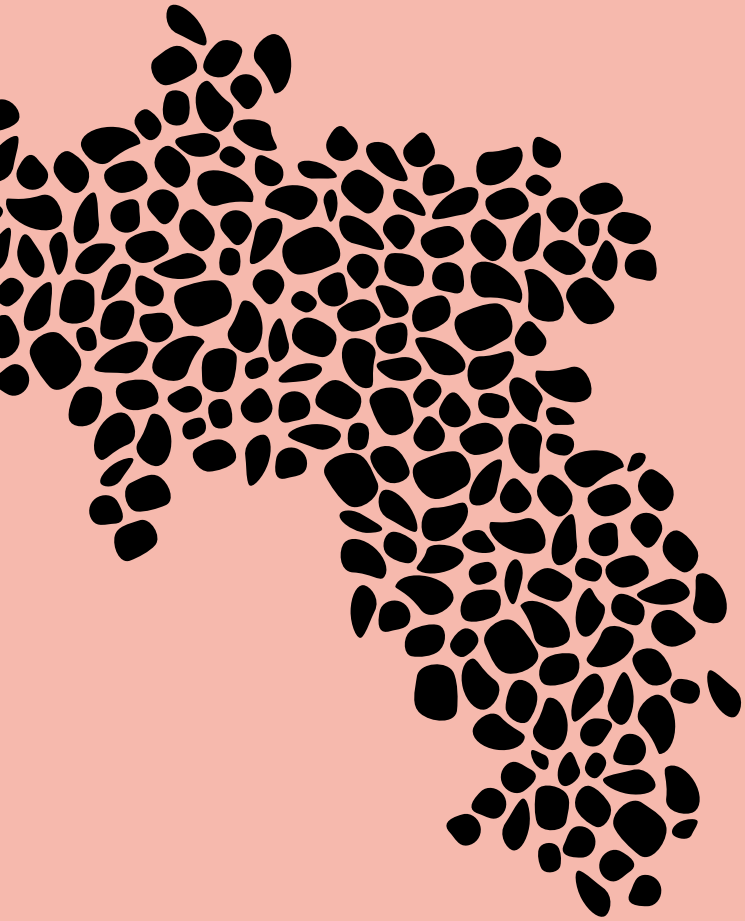

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