SUSTAINABLE ENERGY ASSOCIATION

Social Housing: Leading the Way to Net Zero

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Foreword by Lord Best

Lord Best, President of the Sustainable Energy Association

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As everyone knows, it is imperative that carbon emissions must be dramatically reduced. And it is clear that a big part in this must be played by those building and managing the nation’s homes.

But most new homes are built by the volume house-builders who have shown considerable reluctance to achieve the highest standards. And much of the rented sector is owned by private landlords for whom there has been little incentive to invest in energy efficiency.

This means that the nation must turn to the social housing sector to set high standards and to take positive action to cut carbon emissions. It is the housing associations who can and should take the lead in moving toward net zero carbon emissions from housing.

The UK is taking the issue of climate change seriously and has now legislated a net-zero emissions target by 2050. The energy we use in our buildings is key to the achievement of this target. Our homes contribute 22% of the UK's emissions, so more needs to be done to stop our buildings from contributing to global warming.

The social housing sector has a strong record of providing good quality, energy efficient homes for its tenants and is at the forefront of standards in the wider housing industry.

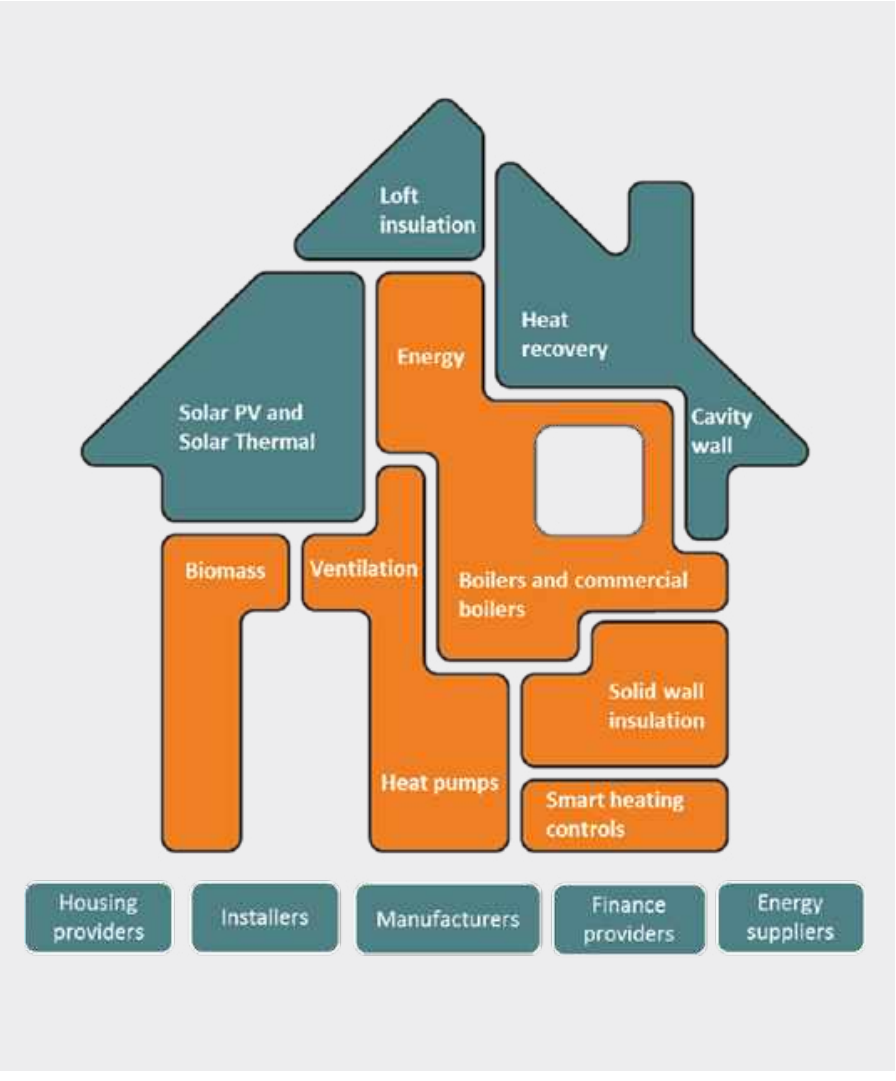
In developing this report, the Sustainable Energy Association brought together experts from social housing and the built environment in a round table discussion. The discussion, which focused on how the social housing sector can achieve the net-zero target, was both positive and encouraging, whilst acknowledging the challenges that need to be overcome and the change that is required.

This report includes detailed analysis of how net-zero could be achieved and industry insight into what actions will be needed to realise it. The analysis demonstrates that business as usual will not deliver the target and that significant change is required. The report builds on the round table discussion to make practical recommendations to government and industry on how social housing can stop its contribution to the UK's carbon emissions.

The important upcoming reviews of Building Regulations and standards in the social housing sector present an opportunity to ensure that homes achieve net-zero emissions whilst being affordable and comfortable to live in. If appropriate policy and frameworks are implemented, the UK's social housing can lead the way to net-zero.

With sincere thanks to all at the Sustainable Energy Association for their perceptive analysis and hard work, I commend this timely contribution to the wider debate.

About the Sustainable Energy Association



The Sustainable Energy Association (SEA) is a member-based industry body. We draw on our wide-ranging membership from manufacturers of energy saving technologies and heating systems to housing associations with an interest in sustainable energy. SEA member's manufacture, distribute, install, retail or regulate a range of technologies, they also own and manage homes and supply energy.

In a world of finite resources, the Sustainable Energy Association exists to help create living and working spaces fit for future generations. Our work seeks to align the interests of business, politicians and consumers to make this a reality. We are industry leaders in energy in buildings. We are technology agnostic and provide objective, evidence-based policy positions which help shape how we think about, generate and use energy. We are constructive, collaborative and committed to achieving our vision, by ensuring that buildings are energy efficient, low carbon and warm.

Acknowledgements

The Sustainable Energy Association would like to thank the following stakeholders for attending our social housing roundtable held on 2nd July 2019 in the House of Lords; Aster Group UK, Broadland Housing Group, Catalyst Housing Limited, Clarion Housing Group, Committee on Climate Change, Daikin UK, the Department for Business, Energy and Industrial Strategy, EDF Energy, Hastoe Housing Association, Incommunities, Irwell Valley Homes, Kingspan Insulation, Knauf Insulation, Mitsubishi Electric, Natural Building Technologies, Newlon Housing Trust, NIBE Energy Systems, Octavia Housing, Onward Housing, Optivo, Recticel Insulation, Showersave, South Yorkshire Housing Association, Sovereign Housing Association, The Guinness Partnership, The Riverside Group Ltd and Vaillant Group. Thanks also to other SEA members and stakeholders who have contributed to the development of this report.

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Executive Summary

The Climate Change Act of 2008 required the UK to reduce its emissions[1] by at least 80% of 1990 levels by 2050. With homes accounting for around 22% of UK emissions, the UK Government outlined its commitment to reducing emissions from buildings in the Clean Growth Strategy.

In May 2019, the Committee on Climate Change in its report Net-Zero: The UK's contribution to stopping global warming recommended that the UK should set and vigorously pursue an ambitious target to reduce greenhouse gas emissions (GHGs) to 'net-zero' by 2050, ending the UK's contribution to global warming within 30 years.[2] This target was subsequently adopted by the UK Government and came into force on 27th June 2019.

Social housing makes up just over 17% of homes across the UK and yet only contributes 10% of the residential sector's carbon emissions[3], showing the good foundations that have been laid in mitigating carbon emissions in this sector. However, to meet the net-zero carbon target, we must largely eliminate emissions from all homes which means that business as usual is not enough.

The aim of this report is to contribute to the discussion on how social housing can continue to lead the way in reducing emissions in the residential sector and help to meet the Government's 2050 target of net-zero.

The analysis carried out shows that given current trends, emissions from the social housing sector will continue to fall modestly up to 2050. However, this fall will not be anywhere near substantial enough to meet the original 80% reduction target, let alone the newly adopted target of net-zero. To even get close to reaching this target, policies to significantly improve energy efficiency and promote low carbon heating technology deployment need to be implemented urgently. Before the adoption of net-zero, some experts had already stated that the residential sector would need to reduce its emissions by over 80% to allow for a lack of emissions reduction potential in other sectors.[4] So even to achieve an 80% reduction, complete decarbonisation of heat was probably required. With the adoption of the net-zero target this is certainly now essential.[5]

This report evidences that only a combination of deep retrofit of existing social housing, raising the standards of all new builds and encouraging rapid market growth of low carbon heating systems such as heat pumps can be successful in achieving an 80% reduction in carbon emissions by 2050. To reach further emission reductions in line with the net-zero scenario, this combination of changes will need to be extended by implementing far higher standards for new builds and creating an even faster uptake of low carbon heating. The social housing sector is keen to take on the challenge of net-zero, recognising the benefits it can bring and the important role the sector can play. However, this will require significant changes from house builders and social housing providers alongside targeted support from government and propositions from industry to enable social landlords to carry out the combination of measures required.

SEA conclusions and recommendations:

KEY CONCLUSIONS

1. Conducting business as usual in social housing will not acheive net-zero carbon by 2050

2. Only a combination of deep retrofit of existing social housing, implementing far higher standards of all new builds and encouraging rapid market growth of low carbon heating systems can be successful in achieving the net-zero target.

3. Action is required now if we are to achieve net-zero. Recommended actions are summarised opposite

KEY RECOMMENDATIONS

1. REGULATION & STANDARDS

Legislate the EPC Band C target; raising all homes to EPC Band C wherever 'practical, cost-effective and affordable' by 2035 and starting with social housing by 2030. Energy efficiency is the first essential step in creating homes with a low energy demand.

Introduce a new improved 'Decent Homes Standard' for social housing. This is required to reflect the new net-zero target.

Set a clear deadline on the use fossil fuel heating systems in social housing. There needs to be a phase out of fossil fuel heating in existing social housing properties, starting from today. To help achieve this, a clear signal should be sent to industry by the introduction of a deadline.

Implement the 'Future Homes Standard' as soon as possible. This is essential to meet the carbon emissions target and will mandate the end of installation of fossil fuel heating in new build social housing.

2. FUNDING

Provide specific Central Government funding for upgrading energy efficiency in social housing. The Grenfell tragedy has resulted in increased spending on fire safety and budget cuts has meant that money allocated for home renovations including energy efficiency and heating system upgrades has been reduced. In line with the BEIS Select Committee recommendations, energy efficiency should have increased funding from Central Government to mitigate this.

Introduce a 'warm rent' option for social housing providers which addresses the issue of split incentives within the sector and recognises the long-term benefits of energy efficient housing whilst not compromising the affordability of the home for the occupants overall.

Ensure that environmental and social obligations placed on energy bills are not disproportionally placed on certain fuels, particularly where those fuels are lower carbon, as this conflicts with the achievement of net-zero.

3. QUALITY

Increase monitoring of new build homes and those procured through Section 106 to ensure the performance gap between the design and as-built performance of a home is closed. To achieve this, there should be improved access to redress for properties that do not meet the design standards when they are built.

Introduction

THE NEED TO DECARBONISE HOUSING

The growing importance of tackling global warming through reducing greenhouse gas emissions (GHG) is highlighted by the Intergovernmental Panel on Climate Change's (IPCC) report on the Impacts of Global Warming of 1.5°C.[6] The IPCC warn that "limiting global warming to 1.5°C would require rapid, far-reaching and unprecedented changes in all aspects of society", but this should be coupled with ensuring that society becomes more "sustainable and equitable". The Committee on Climate Change (CCC) is the independent body which under the Climate Change Act has specific statutory duties that include advising the Government on carbon targets and climate change risks. The Committee published a report, 'UK Homes: Fit for the Future?' which highlighted that "emissions reductions from the UK's 29 million homes have stalled, while energy use in homes – which accounts for 14% of total UK emissions – increased between 2016 and 2017". [7]

The UK Government had set targets to reduce emissions by at least 80% from 1990 levels by 2050. In May 2019, the Committee on Climate Change in its report, *Net-zero: 'The UK's contribution to stopping global warming'* recommended that the UK should set and vigorously pursue an ambitious target to reduce greenhouse gas emissions (GHGs) to 'net-zero' by 2050, ending the UK's contribution to global warming within 30 years.[8] On 12 June 2019 the Government laid the draft Climate Change Act 2008 (2050 Target Amendment) Order 2019[9] to amend the Climate Change Act 2008 by introducing a target for at least a 100% reduction of greenhouse gas emissions (compared to 1990 levels) in the UK by 2050 - known as the net-zero target. The draft instrument was debated and approved by the House of Commons and the House of Lords and the Order came into force on 27th June 2019.[10]

In the Clean Growth Strategy, the Government outlined its commitment to emissions reductions. This included raising all fuel poor homes and private rented sector homes to EPC Band C by 2030. For the social housing sector, the Government committed to consult on how these properties can meet similar levels over the same period.[11]

Improving the energy performance of the property can not only provide financial benefits to the occupant, but can also reduce the need for expensive retrofit later on and so create long-term savings for social housing providers. Additionally, there is evidence to suggest that higher EPC ratings lead to reduced void days, lower rent arrears and reduced spend on repairs. Rent arrears are on average half a month higher in Band F properties compared to other Bands. Additional benefits for the provider include reduced time spent seeking rent payments and lower legal costs.

Whilst this report focuses on social housing, it is also important to consider the wider housing stock in this context; the Government has set out an aspiration for all homes to reach EPC Band C by 2035. This aspiration has since been referred to as a target and this has been reiterated in subsequent publications including in the Transforming Heating: Overview of Current Evidence.[12] The SEA recommends that this target be enshrined in law to drive action across the whole housing stock and ensure that any future Government would retain this commitment and a legacy would be achieved. This is likely to also have positive consequences for the social housing stock. As installers are upskilled, costs fall through economies of scale and housing across the country becomes more affordable due to improved thermal performance.

With a programme of house building underway, new homes are also an important market. They can add to our current stock of poorly insulated homes heated with high carbon fossil fuels or they can provide an opportunity to deliver high quality, well insulated homes with low carbon heating systems. They can also support the development of the supply chain for the technologies and skills required to bring all homes to these standards. With many social housing providers currently undertaking building programmes, the sector has an important role to play in the new build market.[13]

There was recognition of the importance of ensuring that the emissions from new homes are minimised in March 2019 with the Government's announcement of the 'Future Homes Standard', which will future-proof homes with low carbon heating and deliver world leading energy efficiency standards from 2025.

This report sets out proposals for the energy performance trajectory for the social housing sector and analyses what is required to meet the net-zero target.

STARTING WITH SOCIAL HOUSING

The residential sector currently accounts for 22% of the UK's emissions, representing a large potential for emissions reduction, which mainly come from heating, lighting, cooking, and running appliances.[14] Social housing has been a forerunner in reducing emissions, and on average it is the most energy efficient part of the housing stock.[15] Currently, social housing constitutes 17% of the total housing stock, but only contributes 10% of the emissions from the sector.

The Energy Performance Certificate (EPC) rating of a home is dependent on a Standard Assessment Procedure (SAP) score, which is calculated by the energy consumption of a dwelling at a defined level of comfort and service provision (based on standardised assumptions for occupancy and behaviour). SAP is the Government's method for assessing and comparing the energy and environmental performance between buildings and is used to underpin many government initiatives.

In 2017, social housing stock had an average SAP rating of 68, which was higher than private rented and owner occupier sectors which had an average SAP rating of 61.[16] This is partly due to greater uptake of wall insulation and also the dwelling composition. There is a higher proportion of flats in the social rented sector in contrast to other tenures and flats also tend to have less exposed surface area through which heat can be lost compared to detached or semi-detached houses.

Over recent years, the average SAP ratings across all tenures have increased, however between 2016 and 2017, there was no change in average EPC ratings, inferring a hiatus in activity. In 2017, over half (52%) of dwellings in the social housing sector were in Bands A-C as shown opposite. Despite the average EPC rating of social housing properties being higher than private and owner occupier tenure properties, there is still a significant proportion in need of retrofitting.

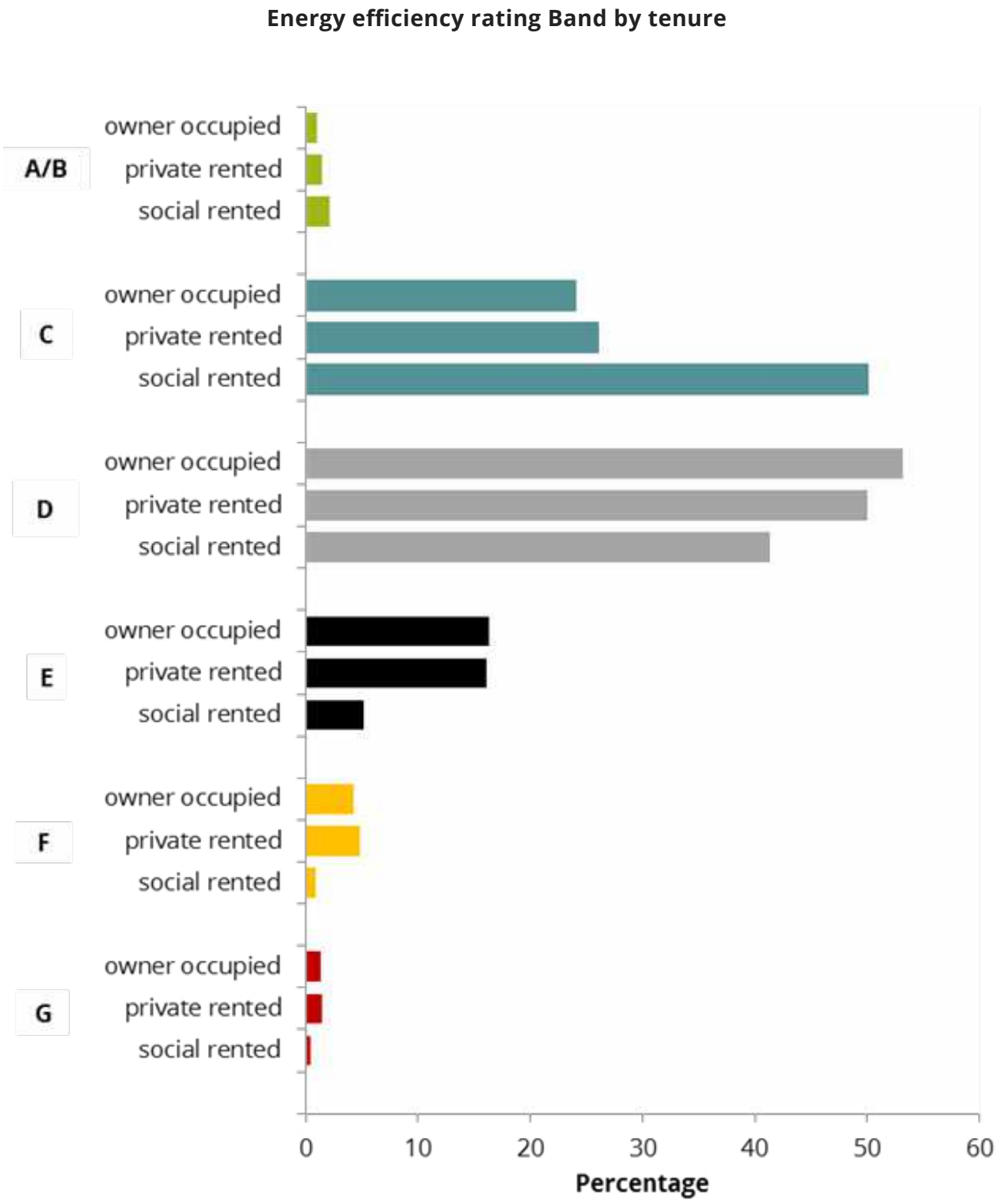


Figure 1 - Energy efficiency rating Bands, by tenure, 2017. Source: English Housing Survey [17]

For the Government's legally binding net-zero target to be met, significant reductions in carbon emissions are needed across all sectors. For the residential sector this will mainly require the heating demand of properties to be reduced through energy efficiency improvements as well as the shift to heating methods with lower carbon intensities and greater efficiencies. Despite leading the way so far, social housing will need to continue to reduce energy demand and lower emissions over the coming years. It is particularly poignant as reducing the energy bills of those living in social housing, through these improvements, will have the additional benefit of reducing their risk of living in fuel poverty.

The characteristics of the UK housing stock present a barrier to decarbonisation. The UK has a relatively slow turnover of houses compared to other European countries; it is estimated that at least 80% of the current housing stock will still be in place by 2050.[18] This means that a significant proportion of the old, energy inefficient homes that exist today are likely to remain in 2050 if nothing is done to improve them. Therefore, it is essential that emissions from these existing homes are reduced through retrofit measures. However, retrofitting of the existing stock has stalled.

It is significantly easier and cheaper to ensure that new buildings are built with high levels of energy efficiency and low carbon heating than it is to retrofit existing stock. We would expect standards to be higher from new builds but over a quarter of new builds are being built EPC Band C or below.[19] The SEA's report *'Halving Energy Use of New Homes'* [20] seeks to address the challenges faced in the new build sector and makes recommendations as to how we can ensure that the homes we build today are fit for future generations.

Number of New Dwelling Energy Performance Certificates lodged on the Register in England by Energy Efficiency Rating (all tenures)

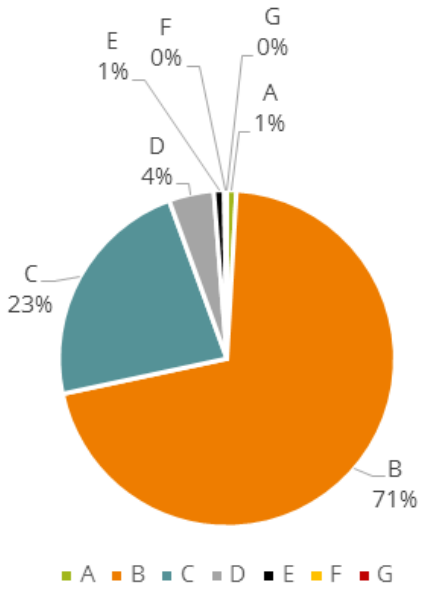


Figure 2 - Number of New Dwelling Energy Performance Certificates lodged on the Register in England by Energy Efficiency Rating. Source: MHCLG (2019) EPCs for all new domestic properties (including new build dwellings, conversions and change of use)[21]

ANALYSIS IN THIS REPORT

Energy Performance Certificates (EPCs) must be issued for all houses available to buy or rent in the UK. They provide information on the heating and lighting costs of a property and give a rating or 'Band' for energy efficiency from A (very efficient) to G (inefficient).[22] As the features of the UK housing stock adjust over time, this will be reflected by changes in the EPC Bands. Although the use of EPCs[i] is not an exact indicator of the energy consumption and emissions coming from the housing stock, they can be used to provide a strong indication of these values. The analysis in this report therefore models the movement in EPC Bands up to 2050 across the different scenarios.

The SEA recognises that the EPC Band might not accurately reflect the actual performance of every home as there can be a performance gap between the designed and built performance of homes, but for the purpose of this analysis EPC Bands are considered the most appropriate proxy for energy efficiency.

The report projects the emissions from the social housing sector up to 2050. The considered emissions are those from energy consumption in the house, such as heating and other electrical use. Other emissions, such as embodied carbon and those associated with manufacture of the products used, are beyond the scope of the analysis. The relative costs of technologies will be important in determining the uptake of low carbon technologies. However, this analysis focusses on the emissions of the social housing sector to illustrate the types of changes that will be necessary to achieve the net-zero target.

The total emissions are then compared to a 2050 target of 3.58 $MtCO_2e$, which would represent an illustrative 80% reduction in residential emissions from 1990 levels with social housing maintaining its current proportional contribution (10%) towards the total emissions. In addition, following the Government's adoption of the 'net-zero' target[23], a further target of 2.1 $MtCO_2e$ was developed for the social housing sector as another comparator for emission reductions achieved.[ii]

Several scenarios are then considered. The Business as Usual (BAU) scenario assumes a constant housing stock total and improvements to the energy efficiency and carbon emissions from social housing based on the extrapolation of existing trends. Additionally, scenarios for a widespread retrofit of the housing stock to EPC Band C, higher new build standards being introduced, and a mass market for low carbon heat (heat pumps have been used as an example of a low carbon heating system) are considered individually and in a combination scenario.

[i] Energy Performance Certificates contain information on potential energy costs and carbon dioxide emissions. For the purpose of this report the cost element has been used as this aligns with government analysis.

[ii] The target was calculated based on an 80% reduction in residential emissions by end users from the 1990 level (as set in the Climate Change Act of 2008) of 171.4 $MtCO_2e$ to 34.3 $MtCO_2e$ by 2050. Social housing accounted for 10.45% of residential emissions in 2016 (Energy Performance of Dwellings) and so maintaining this proportion in 2050 results in social housing emissions at the target level of 3.58 $MtCO_2e$. The same process has been followed for the net-zero target with a reduction on 1990 levels consistent with the CCC's 'Further Ambition' scenario for residential buildings used. This assumes that there will also be negative emissions elsewhere in the economy.

A Further Ambition scenario has also been considered going beyond the combination scenario to study how a net-zero target could be reached. The changes required for this Further Ambition scenario include the same retrofit programme and new build rate as the combination scenario, with even higher standards in terms of space heating requirements for new builds, in line with the 'world-leading' levels of energy efficiency set out in the Future Homes Standard, as well as a deeper transition to low carbon heating. Figure 3 illustrates (left to right) the current position, business as usual 2050 projection, the target average emissions required from a social rented property in 2050 to meet the 80% reduction target and the requirement to meet the net-zero target.

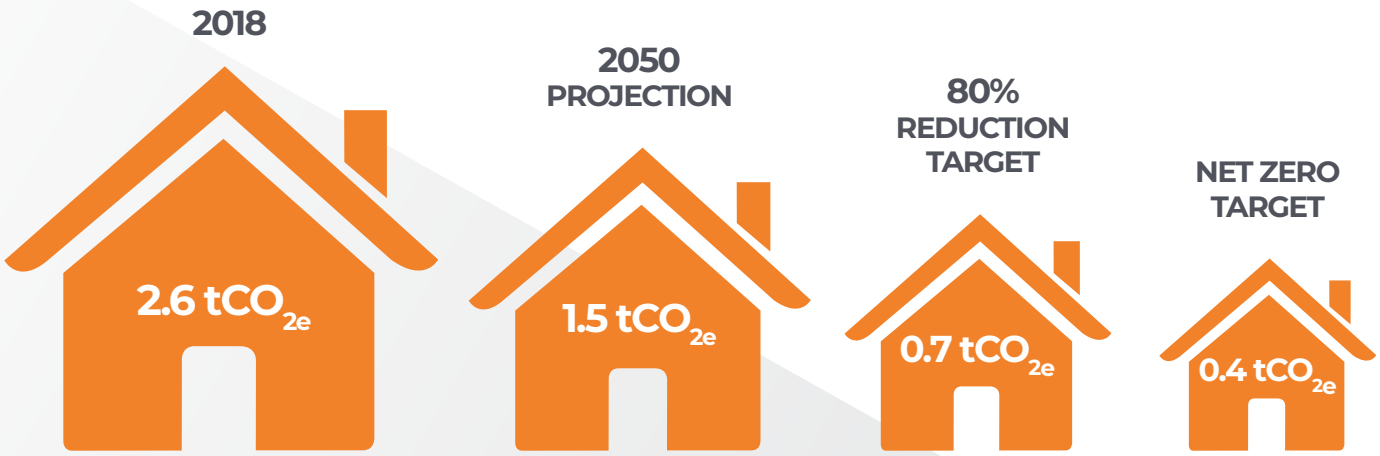


Figure 3 - Average emissions per household, 2018 level, 2050 projection under the business as usual scenario level, 80% reduction and the Net Zero target by 2050 level.

Table 1 provides a summary of the analysis conducted under the different scenarios considered: Business as Usual (BAU), EPC Band C retrofit, tightening of new build standards, a mass market for low carbon heat, a combination of these and the Future Ambition scenario which considers how the net-zero target can be achieved.

TABLE 1: SUMMARY OF PROJECTIONS BY SCENARIO

Scenario	Projected 2050 Consumption (TWh)	Projected 2050 Emissions ($MtCO_2e$)	Difference Compared to 80% Reduction Target	Difference Compared to Net Zero Target ($MtCO_2e$)	Percentage Decrease of Emissions from 2016 to 2050
Business as Usual	53.79	7.45	+3.87	+5.3	43%
EPC Band C 2030 Retrofit	47.07	6.24	+2.66	+4.09	52%
New Build	50.05	6.77	+3.19	+4.62	48%
Mass Low Carbon Heat Market	35.68	3.77	+0.19	+1.62	71%
Combination	31.54	3.19	-0.39	+1.04	75%
Further Ambition	24.45	1.72	-1.86	-0.43	87%
80% Reduction on 1990 Levels Target	N/A	3.58	N/A	N/A	72%

For an 80% reduction to be met, the average social housing property would need to achieve emissions of 0.716 tCO_2e per year from heating and other electrical consumption. Under the BAU scenario, households by 2050 would emit 1.49 tCO_2e and consume 10,758 kWh of energy on average per year, far above an 80% reduction.

The combination of the three scenarios, reaching a total of 3.19 $MtCO_2e$ across the whole stock, achieves the 80% reduction from 1990 emissions levels by 2050. This combination would see the average social housing property consuming 6,308 kWh and emitting 0.64 tCO_2e per year. However, reducing emissions to this level is unlikely to be enough to dampen the effects of climate change sufficiently and this has now been formally recognised with the adoption of a new legally binding target of net-zero by 2050. The combination scenario outcome is still above the net-zero target and only the Further Ambition scenario achieves the reduction necessary for net-zero. Under Further Ambition, emissions reach 1.78 $MtCO_2e$ by 2050, meaning the average social housing property would be consuming 4,891 kWh and emitting 0.36 tCO_2e per year.

The modelling suggests that a range of approaches will be needed, meaning that there is no silver bullet for large-scale carbon emission reductions in the residential sector. Without the widespread combination of increased energy efficiency, higher standards for new builds and the mass market deployment of low carbon heating, emissions are unlikely to fall sufficiently. Additionally, without the “unprecedented” interventions required as suggested by the IPCC and recommended by the CCC, the carbon emissions from heating our homes will continue to remain a barrier to achieving the net-zero target.

Analysis of Scenarios

BUSINESS AS USUAL SCENARIO

The BAU scenario is the baseline position for our analysis, which extrapolates previous trends up to 2050. We assume that the social housing stock will remain constant at 5 million homes and the proportion of property types (terraced, semi-detached, detached, bungalows and flats) contributing to this will also remain the same. The EPC ratings for these homes shifts over time, largely because of new builds, demolitions and retrofit measures taking place. For each property, the type of property, EPC Band, energy consumption by fuel, and underlying electricity demand were considered to calculate how heating and electricity consumption would change up to 2050 for the social housing sector. Other emissions that households may contribute, such as travel and waste, were not considered as part of the analysis.

Figure 4 shows the proportion of properties by EPC Band in the social housing sector by 2050 under BAU arrangements. The percentage of houses in Band A remains extremely low in 2050 at 0.22%. This can be explained by a very small number of highly rated new build properties being added to the stock combined with a minimal amount of homes being retrofitted to this standard. There are no houses at bands F and G by 2050. This is due to an assumption that on an annual basis, demolition of the most inefficient and likely older homes takes place. Our analysis assumes that, on average, just over 8,000 demolitions occur each year and these are targeted at the least efficient stock.[iii]

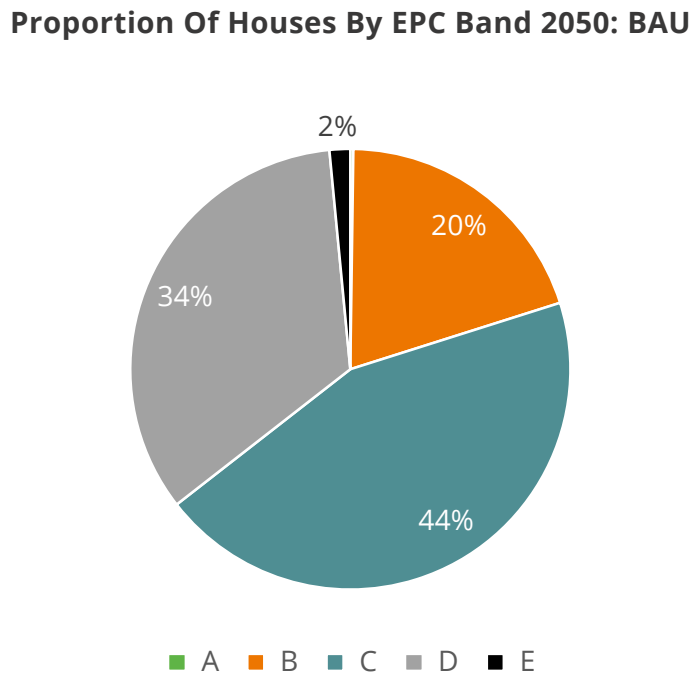


Figure 4 - 2050 proportions of social houses by EPC Band under the business as usual scenario

[iii] See assumptions tables

Over time, the EPCs of the social housing stock improve as the heating requirements for each property fall and there is a slight move to more efficient heating methods. The majority of homes continue to be heated using natural gas systems with a relatively low uptake of renewable heating solutions.

Under the BAU scenario, total energy consumption falls slowly from 60.79 TWh in 2018 to 53.79 TWh in 2050, as shown in Figure 5. For the average household this represents 10,758 kWh of energy consumption by 2050. It is important to note that whilst this equates to a 12% reduction in energy demand, it is not sufficient to meet the carbon targets. Moreover, this limited demand reduction could risk achieving the UK's fuel poverty ambitions.

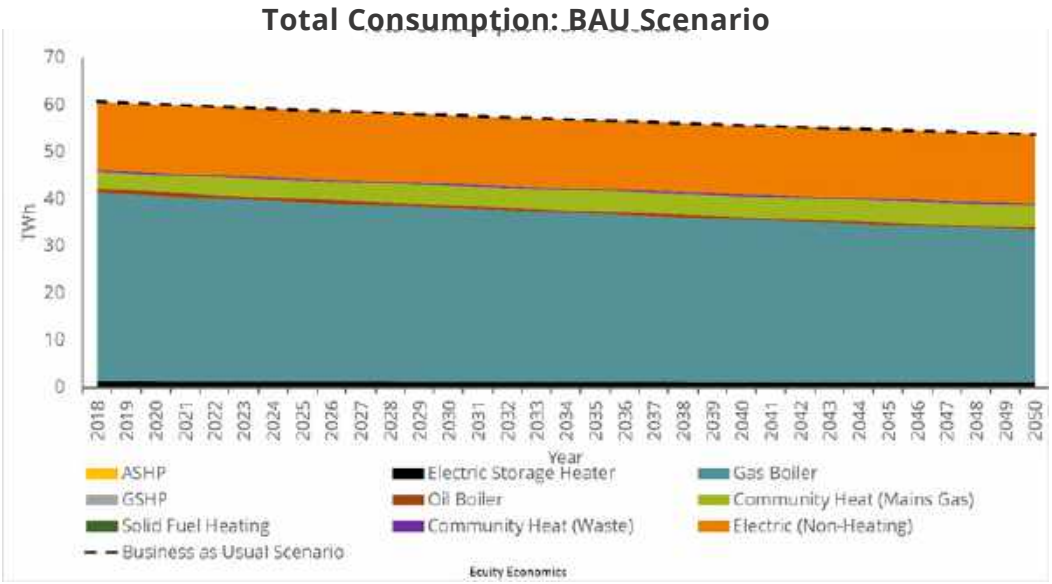


Figure 5 - Total consumption (TWh) projection based on the business as usual scenario

The second quarter of 2018 saw the total share of renewables within electricity generation reach 28.1%.[24] This was an increase of 22.2% points compared to the equivalent 2010 value. It is expected that the share of renewable generation will continue to increase up to 2050. This means that the carbon intensity of electricity is projected to continue to fall, as shown in Figure 6.

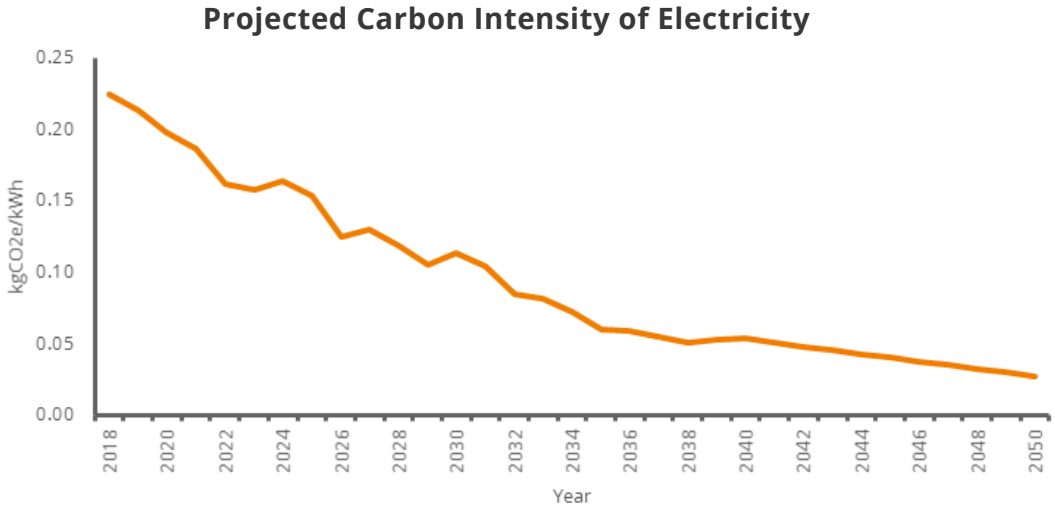


Figure 6 - Projected carbon intensity ($kgCO_2e/kWh$) of electricity. Source: BEIS, 2018[25]

This falling carbon intensity of electricity (shown above in Figure 6), the reduced consumption (shown in Figure 5) and a move away from high carbon fossil fuel heating systems results in a reduction in total emissions from 11.95 $MtCO_2e$ in 2018 to 7.45 $MtCO_2e$ in 2050 (black dashed line in Figure 7), which is the equivalent of 1.49 tCO_2e per household. This sits significantly above both the 80% emissions reduction of 3.58 $MtCO_2e$, and the net-zero target as shown below.

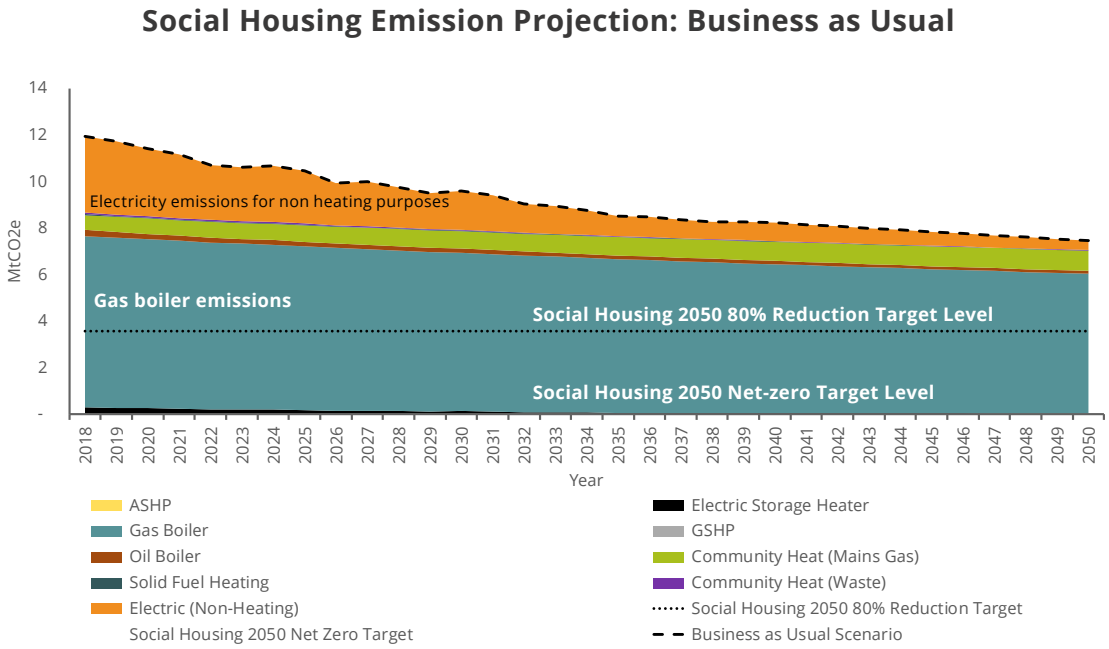


Figure 7 - Total emissions ($MtCO_2e$) from social housing projection based on the business as usual scenario.

Figure 7 shows that if the current trends continue to 2050, then emission reductions from the social housing sector are very unlikely to meet the 80% emission reduction threshold and indicates far-reaching changes are required. The progress made as part of this BAU scenario is hindered by limited volumes and poor quality of retrofitting, low new build standards and built-out rates, and minimal adoption of more efficient low carbon heating methods. The following scenarios will consider the effect on emissions from the social housing sector, if these adjustments were to happen in isolation and combination.

LOCATION: BOSTON, LINCOLNSHIRE

PROPERTY CHARACTERISTICS:

SEMI-DETACHED AND TERRACED HOUSING ASSOCIATION HOMES

(50 PROPERTIES)

TECHNOLOGIES USED:

PARTY WALL INSULATION ✓

THE PROJECT

Boston Mayflower, a housing association in Lincolnshire, wanted to improve the energy efficiency of around 50 of its semi-detached and terraced homes. As well as lowering energy bills, it was important that any works could be carried out with minimal disruption to residents.

Boston Mayflower decided to use Knauf Insulation's Supafil® Party Wall insulation, a Glass Mineral Blowing Wool insulation, designed specifically for use in separating party walls. Supafil® Party Wall is non-combustible, with a Euroclass A1 Reaction to Fire Classification. It offers excellent thermal and acoustic performance, and is manufactured with up to 80% recycled content.

SPECIFICATION

Field tests have proven that heat is lost when party cavity walls are uninsulated. This is due to a phenomenon known as party-wall thermal bypass, which occurs when cold air enters the uninsulated cavity at exposed edges. The cavity creates a chimney effect and the cold air rises as it is warmed by heat conducted through the eaves of the party wall from the adjoining homes. It then escapes from the cavity to the external environment.

Knauf Insulation's Supafil® Party Wall insulation has been independently proven to eliminate the air movement that causes party-wall bypass without compromising on acoustic performance. The insulation is manufactured with a blue colour, for easy on-site identification and to promote compliance with robust details - a means of satisfying the sound insulation requirements of the building regulations.

BENEFITS

The energy efficiency of 50 homes has been improved, reducing their carbon footprint.

Residents are benefitting from reduced energy bills and warmer, more comfortable environments. Boston Mayflower has therefore improved the quality of its housing stock.

"When we heard about the benefits of Supafil® Party Wall insulation and how it reduced heat loss between two properties, we knew that it would be a great fit for our homes and would allow our current and future tenants to live comfortably in a warm house with lower bills." ***Paul Benton, Property Investment Manager, Boston Mayflower.***

BAND C 2030 RETROFIT SCENARIO

Key Input:

All social homes are EPC Band C by 2030 following an extensive retrofit programme.

Key Output:

Emissions fall considerably, but not enough to reach the original 80% reduction target or the net-zero target.

This scenario considers an extensive retrofit of the existing housing stock. The modelling projected a rate of retrofitting across the stock to bring all social homes up to Band C by 2030. This is aligned with the Government's commitment to bring as many fuel poor households up to Band C by 2030.[26] The SEA is supportive of this objective and also of the target to extend this to ensure that all homes, wherever practical, cost-effective and affordable, are raised to EPC Band C by 2035.[27] The SEA recommends this target be adopted as a firm commitment and enshrined in law. This would help to tackle carbon emissions from the residential sector as well as raising the levels of energy efficiency in the housing stock making homes warmer and more affordable to live in. Whilst having obvious significant benefits for those in fuel poverty, making all social housing more efficient and affordable can increase resident's disposable income whilst making homes warmer and healthier. The social housing sector is likely to be able to implement a retrofit programme faster than the private rented and owner occupier sectors. Considering this, there is evidence to suggest that the social housing stock could be retrofitted within 10 -11 years and within the 2030 target if action is taken now.[28] There is also evidence that every £1 spent on improving energy efficiency provides £3.20 in returns via gross domestic product (GDP) increases across the country[29], making energy efficiency improvements a sensible and cost-effective approach to tackling carbon emissions from buildings.

The Fuel Poverty Strategy was first published in 2015 under the Coalition Government, recognising the importance of alleviating the health and wellbeing issues that arise from living in energy inefficient homes. The Strategy is being consulted on during 2019 and the adoption of a sustainability principle is proposed. This would ensure that policies contributing to the fuel poverty target are complementary to other Government priorities such as the Clean Growth Strategy and the Industrial Strategy. The SEA fully supports the inclusion of this principle in the Fuel Poverty Strategy. The net-zero target will not be achieved unless government strategies (and departments) are aligned and contribute to meeting our legally binding carbon targets.

Combined with clear policy and targets, financial support is likely to play a key role in improving the housing stock of the fuel poor. The new iteration of the Energy Company Obligation, which will run until 2022, targets fuel poor and vulnerable households. The scheme aims to improve the thermal efficiency and encourage the uptake of new heating systems to increase the overall performance of the housing stock.

There is a substantial evidence base suggesting a 'performance gap' between the measured energy requirements in the certification of the EPCs and the actual performance of a property. Here it is important that regulation works to close the gap and the social housing sector better understands the real performance of their stock.

Asset modelling may be needed to understand the specific issues that social housing providers face based on the characteristics of their stock. This could help to identify which homes can be improved to EPC Band C and what needs to be done to do so cost-effectively. There is a need to ensure that incremental improvements do not lead to higher costs. Taking a holistic and long-term approach to retrofit may help to ensure cost-effective improvements are made. This means providers may seek to achieve higher standards earlier to avoid the need to re-visit properties at a later date. However, this requires clear long-term targets and policy frameworks to be in place to allow the sector to plan improvements.

To help tackle some of the most poorly performing socially rented homes, there have been calls for additional targets to be set, reaching 2050 or beyond. The rationale behind this is social housing providers often have longer term asset management budgets to upgrade properties and own them for a long period of time. This means that it may be more beneficial to providers in the long term to aim for higher targets to ensure that their properties are future-proofed. This could reduce costs by mitigating any need for retrofit in the future and could lower maintenance costs ahead of standards being introduced.

As noted above, this scenario assumes that a strong commitment is made to improving all social housing stock to EPC Band C by 2030. In Scotland, there are proposals for all social housing properties to meet EPC Band B by 2032 with a minimum standard that no social housing should fall below EPC D from 2025. Whilst there is recognition that setting more ambitious targets might be challenging to achieve, there is support for a longer-term target given that 2030 is just over 10 years away which equates to a single boiler replacement cycle (average 12-year lifetime).

The inputs to the EPC Band C retrofit model are the same as the BAU scenario, including the number of homes, tenure type, energy consumption by fuel and underlying electricity demand but retrofitting to EPC Band C by 2030 is included. Figures 7 and 8 show the projected consumption and emissions respectively for the BAU scenario.

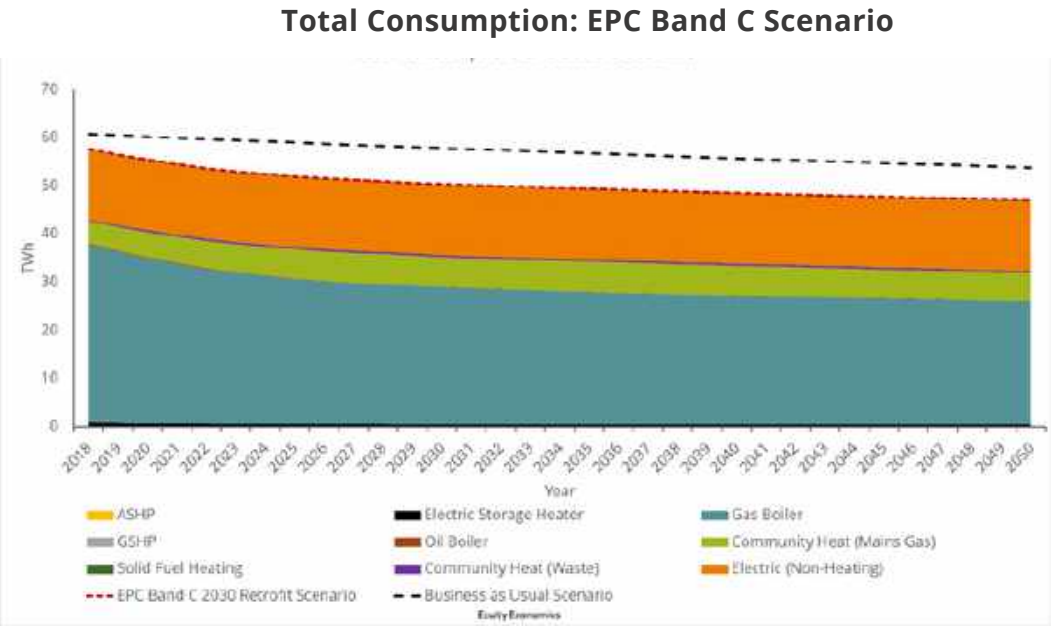


Figure 8 - Total consumption (TWh) projection based on the EPC Band C 2030 retrofit scenario

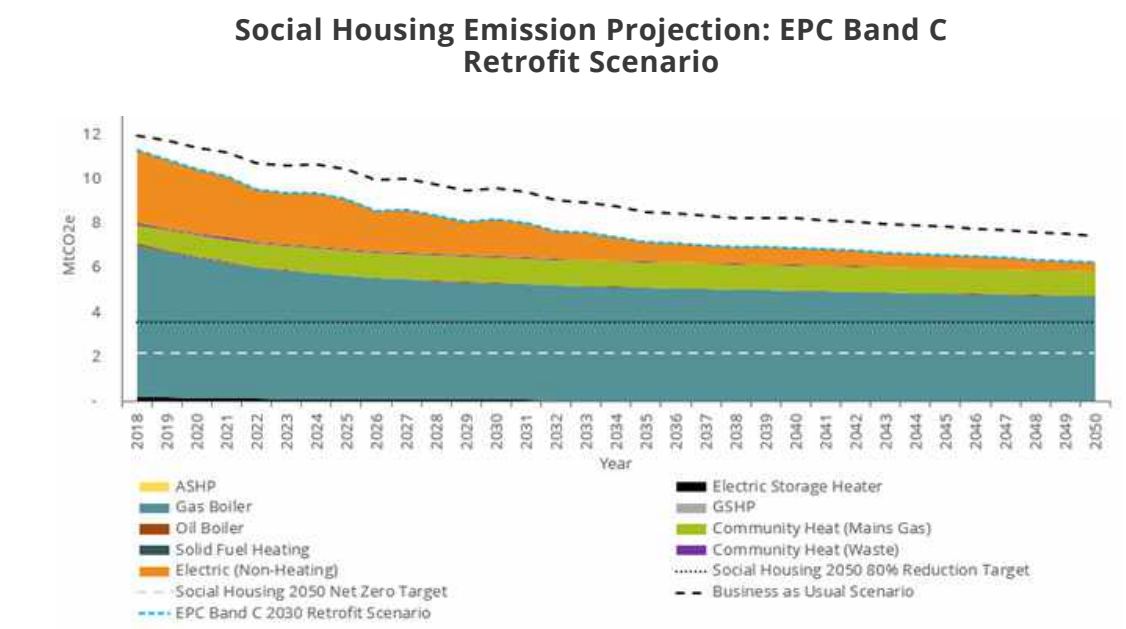


Figure 9 - Total emissions ($MtCO_2e$) from social housing projection based on the EPC Band C 2030 retrofit scenario

As can be seen in Figures 8 and 9, consumption under this scenario falls to 47.07 TWh and emissions to 6.24 $MtCO_2e$ respectively by 2050, a slight decrease on the BAU scenario. This represents an average annual consumption of 9,404 kWh and average emissions 1.25 tCO_2e per household.

Whilst there is a reduction in carbon emissions compared to the BAU scenario, this is not significant enough to meet either the 80% reduction threshold or the net-zero target. This is largely because the dominant heating method in Bands A, B and C properties is assumed to be a gas boiler, with a smaller proportion utilising community heating systems and electric heating. It is important to note that our analysis assumes there are no oil boilers in these Bands. This is because the Government has committed to phasing out 'high carbon fossil fuel heating' throughout the 2020s.[30] The analysis shows that even with these retrofit improvements and the subsequent elimination of more carbon intensive oil and solid fuels, the dominance of gas in heating up to 2050 could present a significant barrier to emission reduction within the EPC Band C Retrofit scenario. This is because this scenario assumes a relatively low uptake of low carbon heating system in line with current deployment rates.

Whilst it is currently unclear as to which decarbonisation pathway the UK will follow e.g. electrification, hydrogen, or a combination of the approaches, it is important that the housing stock is prepared for the transition to lower carbon heating solutions. From this analysis, it is obvious that further work is needed over and above achieving EPC Band C by 2030 if we are to meet our decarbonisation goals. In the subsequent section, we analyse the impact of widespread uptake of low carbon heat.

This analysis suggests that if a retrofit scenario was to be implemented then retrofit programmes will need to be more ambitious and aim for higher thermal efficiency ratings and/or low carbon heat deployment. Whilst we have not modelled the impact of retrofitting homes to Passivhaus standard, we have evidence to demonstrate that improving a property to this standard delivers significant carbon savings, improves thermal comfort and reduces energy bills for tenants.

TECHNOLOGIES USED:

HEAT RECOVERY	✓
AIR SOURCE HEAT PUMP	
SOLID WALL INSULATION	✓
MONITORING EQUIPMENT	✓

LOCATION: HOLBORN, LONDON.

OCTAVIA HOUSING

THE PROJECT

100 Princedale Road, London is a Victorian house in a Conservation Area. It was certified as Passivhaus standard in February 2011 and the tenant family moved into the house one month later.

The house was compared to one typical home on the same street and another which met the Decent Homes Plus standard for its final energy demand, emissions, energy bills and capital investment and payback, thermal comfort, indoor air quality and water usage.

SPECIFICATION

The house was retrofitted to have extremely high levels of energy efficiency at 63 kWh/m2a for final energy demand, a reduction of 83% compared to a typical home, and 46% less than a similar home retrofitted to Decent Homes Plus standard. This was achieved by upgrading the building's roof, walls and floors insulation and improving cold bridge resolution. New external windows and doors were also fitted to improve energy efficiency.

Solar thermal technology was installed to supply the majority of the hot water, combined with a Mechanical Ventilation with Heat Recovery system in combination with a small exhaust air heat pump system. This met all space heating requirements of the building.

BENEFITS

The house that was retrofitted to Passivhaus standard was kept at a steady temperature of between 19.3°C and 24.9°C for 95% of the year, yielding higher thermal comfort without overheating

A 70% reduction in carbon emissions for the Passivhaus home compared to the typical scheme, an annual saving of 5.5 tonnes of CO_2.

Energy bills for the year for the home improved to Passivhaus level were just £773, a saving of 62% compared to a typical home on the same street.

MASS MARKET FOR LOW CARBON HEAT SCENARIO

Key Input:

- Oil boilers and solid fuel heating to be phased out by 2026,
- Gas boiler usage to fall by 60% by 2050,
- No 'inefficient' electric heating by 2050.

Key Output:

Emissions fall considerably, but not enough to reach the original 80% reduction target or the net-zero target.

In this scenario, fossil fuel heating systems are replaced over time with low carbon solutions. For the social housing stock to get close to reaching the 80% emissions reduction by 2050, the analysis suggests that heating systems will need to become more efficient and there is a need to switch to a less carbon intensive fuel than natural gas. As recommended by the Committee on Climate Change, the Government recently agreed to mandate the end of fossil fuel heating in new builds by 2025 as part of the Future Homes Standard.[31] It is not yet clear if the Future Homes Standard will ban new gas connections. If new gas grid connections are allowed, then natural gas will need to be decarbonised over time at a significant cost. If there is widespread electrification of heat, this will require upgrades to the grid. It is important to note that this falls beyond the purpose of the analysis and outside the scope of the model. Off grid, where fossil fuels such as oil and LPG are currently used, these too will need to be decarbonised or replaced if the targets are to be met.

A conversion of the gas grid to hydrogen and a widespread use of biogas are options being suggested for the future of the gas grid, although currently both technologies require further research before it is known if they can become commercially viable, with questions over feedstocks and other potential uses of these fuels e.g. for transport, being raised. [32]

The analysis conducted in this scenario therefore focusses on the established technology of heat pumps (as an illustrative example of a low carbon heat source). Heat pumps are more efficient than the current mainstream heating methods, meaning that the consumption requirements will be lowered. Despite this, social housing providers are still installing gas boilers in the main, largely due to upfront cost considerations and are likely to do so until policy is introduced that provides a clear signal for the need to shift towards the installation of low carbon heat. For this we recommend the setting of a deadline for the end of fossil fuel heating systems in new and existing social housing properties. This would help provide stability and a clear trajectory for heat in social housing.

As a well-known mature technology with high uptake in many parts of Europe and with demand for low carbon solutions on the rise, installing heat pumps is an action which social landlords could take now. The SEA is technology agnostic, does not advocate the use of one technology over another and recognises that a range of solutions will be needed across the whole housing stock to meet carbon emission targets. For some properties, it may be more suitable to install bioenergy or other low carbon forms of heating, however for the purposes of this analysis we have not modelled this level of detail. Heat pumps have therefore been used as a proxy for low carbon heat for illustrative purposes in this report.

To ensure that low carbon technologies are deployed at scale, it will be necessary to grow the skills of the workforce over the next few years. The Government has committed to consulting on skills and training in a low carbon economy in 2019 and this is something that the SEA believes will be essential for meeting the needs of social housing providers and consumers more widely in the future. Clear direction is required from government to encourage installers to invest their time and money in training and certification for low carbon technologies. Installers will only be prepared to make the investment if there is clear policy to stimulate market growth. The lack of market growth has discouraged installers in the past and led to significant decreases in registrations with the Microgeneration Certification Scheme (MCS), which certifies microgeneration technologies used to produce electricity and heat from renewable sources. The cost and effort involved in renewable certification is significantly higher than for fossil fuels and given the difference in the market sizes, it is not surprising that many fossil fuel installers see little incentive to transition to renewables. The target of net-zero should be seen as an opportunity to set clear policy to encourage low carbon solutions and stimulate market growth.

For the reasons explained above, this scenario considers a mass market developing for heat pumps which can be used as a proxy for many low carbon technologies. For this to happen, we have projected a phasing out of inefficient electric heating, gas boiler usage to fall 60% by 2050, and oil boilers and solid fuel heating to be phased out by 2026. The gap left from the removal of these methods of heating is taken up by heat pumps, with an even split between air source heat pumps (ASHP) and ground source heat pumps (GSHP).[iv]

As can be seen in Figures 10 and 11 respectively, this scenario projects consumption to fall to 35.68 TWh and emissions to be 3.77 $MtCO_2e$ by 2050, the equivalent of 7136 kWh and 0.75 tCO_2e per household. Although this scenario sees significant emission reductions, the total emissions in 2050 are marginally above the 80% emission reduction threshold. This means that switching to low carbon heating in isolation, even at this aggressive rate, would not yield enough of a reduction by 2050.

Total Consumption: Low Carbon Heat Deployment Scenario

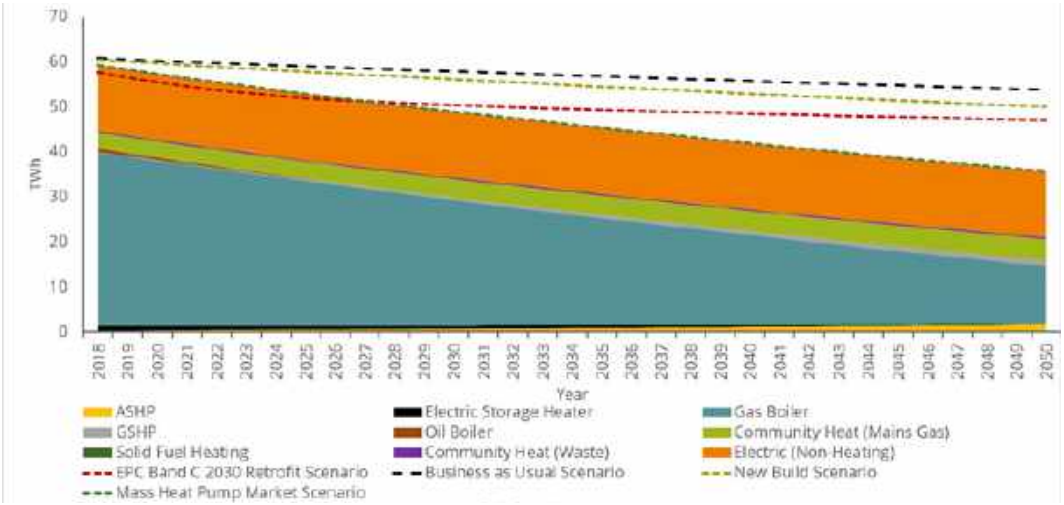


Figure 10 - Total consumption (TWh) projection based on the mass heat pump market scenario

[iv] This is an arbitrary split to highlight the emission reduction that low carbon heat can give.

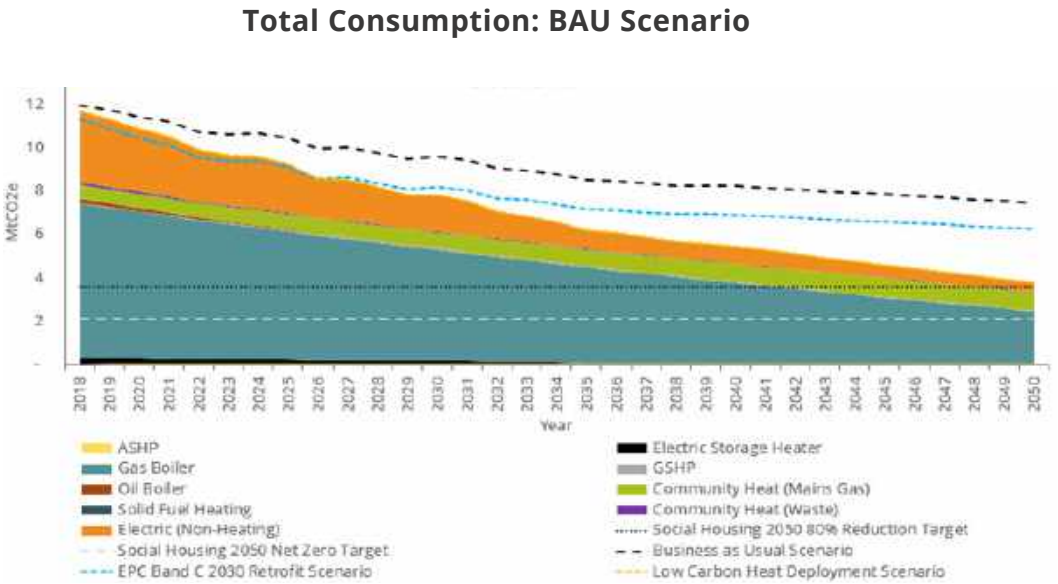


Figure 11 - Total emissions ($MtCO_2e$) from social housing projection based on the mass market for heat pumps scenario

it is unrealistic to expect uniform uptake of low carbon solutions (specifically heat pumps) across the entire housing stock given the varied property characteristics and the presence of hard to treat properties. It is important to recognise that a variety of low carbon heating solutions are available, including biomass, direct electric heating, fuel cells, hybrids and potentially hydrogen boilers, and the type of retrofitting that will take place will depend on the property itself.

TECHNOLOGIES USED:

AIR SOURCE HEAT PUMP ✓

LOCATION: SOUTH GLOUCESTERSHIRE

THE PROJECT

In 2016 Merlin Housing launched a programme to upgrade its housing stock, including 50 2 and 3-bed bungalows and semi-detached properties in South Gloucestershire. In this project, 50 off-gas grid properties were switched from electric storage heating or oil-fired systems to Daikin air source heat pumps to yield energy bill savings and improve the thermal comfort of the homes

SPECIFICATION

Depending on the size of the properties, 5kW or 7kW Daikin Altherma Monobloc systems (air source heat pumps) were installed as a new heating source along with 200-litre Daikin hot water cylinders. As the heat pumps are low temperature units, the systems have optional back-up heaters which raise domestic hot water to the required temperature, and can supplement heat pumps at times of extreme heating demand

BENEFITS

Heating bills for Merlin's tenants, who are often over the age of 55, were forecast to fall by three-quarters, from £80 per week to just £20.

At the time, the rates of the Renewable Heat Incentive policy meant that Merlin Housing could recuperate much of the costs of installation over 7 years subsequent to the retrofit.

"We're getting feedback on the tenants' costs and it's pointing to exceptional savings in some cases. The Daikin Altherma Monobloc will certainly help to alleviate the risk of fuel poverty for these people...the tenants seem very pleased with the new systems, which they are finding very simple to use" ***Tim Grimshaw, Special Projects Surveyor (Merlin Housing)***

NEW BUILD SCENARIO

Key Input:

- Increase in the number of social homes built each year to 50,000 from 34,500
- Build these homes to a space heating requirement of 40 kWh/m^2/year instead of the current 54 kWh/m^2/year.

Key Output:

Emissions fall, but not enough to reach the original 80% reduction target or the net-zero target.

The scenarios assessed in previous sections focus on the existing housing stock. Whilst these properties make up the greatest proportion of homes in the social housing sector, it is anticipated that the number of new social homes will increase over time. If we continue to build at current standards, these homes will cause emissions from buildings to rise, and homes will require retrofitting in the future to achieve the emissions reduction target. It is therefore vital that new builds strive to achieve the highest standards and do not increase emissions on top of the current housing stock.

This section considers the effect of increasing the rate at which homes are built, the heating systems installed and the thermal performance achieved. Here we assume the number of social sector new builds per year increases from 34,500 in the baseline to 50,000. This baseline reflects the average number of socially rented homes per year from 2012 – 2017 (34,500)[33] and increases to 50,000 in line with the Government's aim to tackle the housing shortage in England whilst providing more properties of every tenure type, including social housing, by 2030. The modelling assumes homes are built to at least EPC Band C, with proportions also being built to Bands A and B.

Social housing providers often procure homes through Section 106, which means they have limited control on the standard of the home which is built by a private developer. This means that most new property additions to the sector are built at current building regulations.

The current space heating regulations for new builds in the UK is 54.26 kWh/m^2/year.[34] The Government has committed to consulting on the standard of new build homes under the Building Regulations Part L review. Below we have modelled a slight reduction in space heating demand to 40 kWh/m2/year[35] but maintaining current heating solutions i.e. majority of homes heated with gas boilers.

Under this scenario energy consumption falls to 50.05 TWh and emissions fall to 6.77 $MtCO_2e$ by 2050 (as shown by Figures 12 and 13 respectively), which is significantly higher than both the 80% emissions reduction threshold and the net-zero target by 2050. This is linked to a large proportion of the emissions in 2050 coming from gas boilers under this new build scenario. This scenario is unambitious and contributes very little in terms of emissions reduction. There is therefore a need to further improve the thermal performance of new homes whilst reducing fossil fuel usage and/or combine carbon reduction scenarios to meet the target.

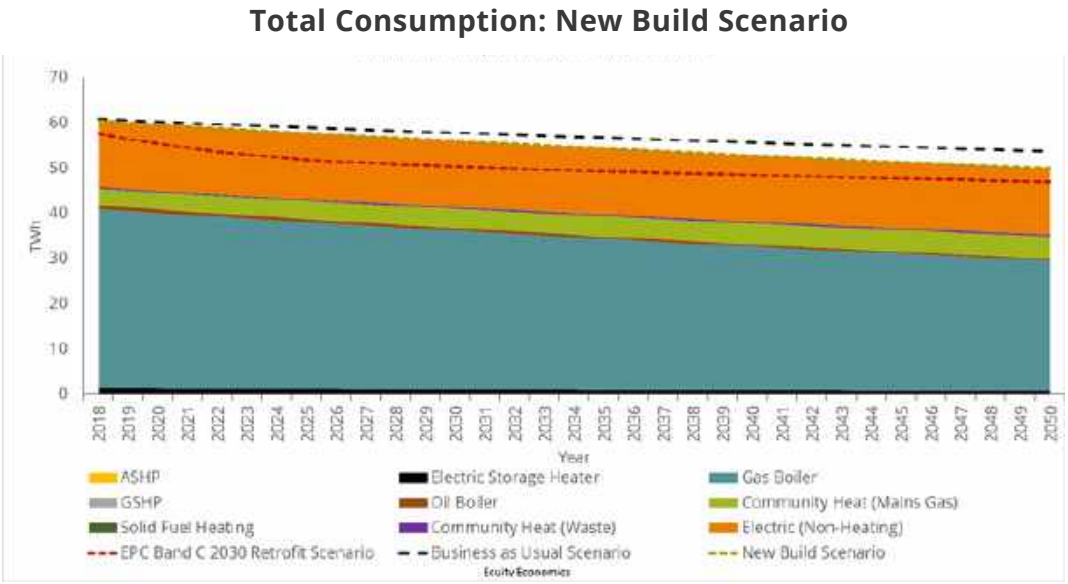


Figure 12 - Total consumption (TWh) projection based on the new build scenario

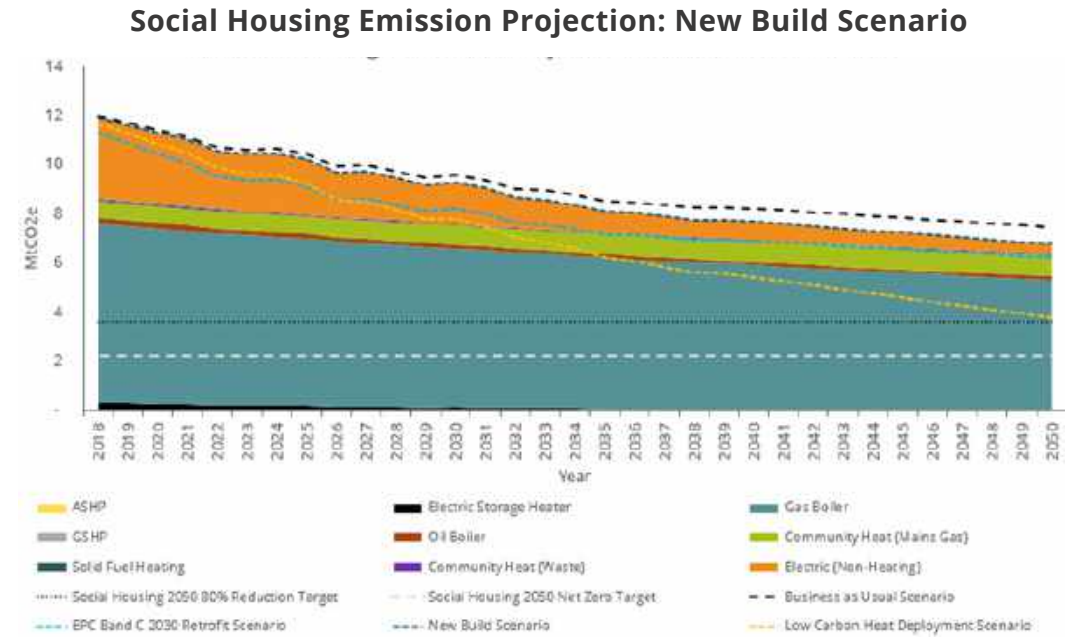


Figure 13 - Total emissions ($MtCO_2e$) from social housing projection based on the new build scenario

Whilst we see an urgent need for strong regulation to play a role in driving down emissions from new housing, there are numerous case studies of social housing providers choosing to build new homes to a standard which goes beyond the minimum building regulations without regulatory intervention. For example, there are multiple Passivhaus standard developments in the social housing sector. It is clear from the above scenario that small improvements in thermal performance in the new build sector will not be sufficient. As such, we have modelled a combination scenario which seeks to understand whether a mixture of the above scenarios will achieve the net-zero target.

PROPERTY CHARACTERISTICS:

WIMBISH PASSIVHAUS SCHEME. 14 HOMES FOR RENT - UK'S FIRST RURAL SOCIAL HOUSING PASSIVHAUS SCHEME

TECHNOLOGIES USED:

HEAT RECOVERY	✓
SOLID WALL INSULATION	✓
MONITORING EQUIPMENT	✓

LOCATION: BOSTON, LINCOLNSHIRE

Hastoe Group

THE PROJECT

Hastoe housing association's development at Wimbish, Essex, was the UK's first rural social housing Passivhaus scheme.

Since completion in 2011, Hastoe has worked with the University of East Anglia to monitor the performance of the homes and ensure they are still making the energy and fuel bills savings intended when they were completed.

SPECIFICATION

The construction of a Passivhaus requires incredibly low air tightness requirement of 0.6 air changes per hour (Building Regulations requires 5 air changes per hour). Mechanical ventilation and heat recovery (MVHR) is needed to change air in the property and keep heat within the homes.

The dwelling forms have been kept deliberately simple to avoid thermal bridging risks, and porches, meter boxes and brise soleil are all independently supported to avoid penetrating the insulation overcoat. East west orientation of the blocks facilitates passive solar gains, with careful attention to shading to avoid summer overheating.

Learnings from this first Wimbish scheme helped Hastoe to complete a second Passivhaus scheme in the village in 2016, as well as 100 more across Rural England. The knowledge from this evaluation - that Passivhaus really works over a sustained period - gives us confidence to build more in other villages across the country.

BENEFITS

At the latest assessment in 2018, the Wimbish Passivhaus homes were still recording exceptional performance of around £130 per year for houses and £62 per year for flats. That compares to an average annual UK gas bill of £676 per year. The exceptionally high energy efficiency standard cuts fuel poverty for social housing tenants, keeping more money in their pockets. It also substantially reduces overall carbon emissions.

One resident of Wimbish said: "We have been very comfortable and have enjoyed a constant pleasant temperature. The brise soleil has done its job beautifully, as have the exterior window blinds. It is a pleasure to have such large windows and triple glazing is most effective both in terms of temperature and noise levels." "Utility bills are much lower, even water bills have been reduced. Gas is very low"

COMBINATION SCENARIO

Key Input:

- EPC Band C by 2030 for all social homes from a retrofit programme
- Increase in new build numbers to 50,000 from 34,500
- Improvement in the space heating requirement in new builds at 40 kWh/m2/year instead of 54 kWh/m^2/year
- Oil boilers and solid fuel heating to be phased out by 2026
- Gas boiler usage to fall by 60% by 2050
- No 'inefficient' electric heating by 2050

Key Output:

Emissions fall enough to reach the original 80% reduction target, but not enough to reach the net-zero target level.

The Combination scenario represents a mixture of the scenarios modelled previously - it runs all the carbon reduction strategies for these scenarios simultaneously. As noted above, it is likely that a combination of energy efficiency and low carbon measures is needed for existing buildings given the diversity of the building stock. Moreover, none of the single scenarios detailed above are able to achieve the 80% reduction threshold in isolation, let alone the net-zero target.

The consumption and emissions levels for this scenario are illustrated in Figures 14 and 15 respectively. Consumption levels fall to 31.54 TWh and emissions are lowered to 3.19 $MtCO_2e$ by 2050, which falls below the 3.58 $MtCO_2e$ threshold which denotes an 80% emission reduction. Per property, consumption has reduced to 6,308 kWh and emissions to 0.64 tCO_2e each year.

This means that a combination of scenarios; retrofitting, moderately raising the standard of new builds and mass deployment of low carbon heating options can successfully reduce carbon emissions from the social housing sector significantly. However, emissions under this scenario still do not fall sufficiently to reach the net-zero target level, meaning that further measures will need to be introduced in social housing if the legally binding target is to be achieved.

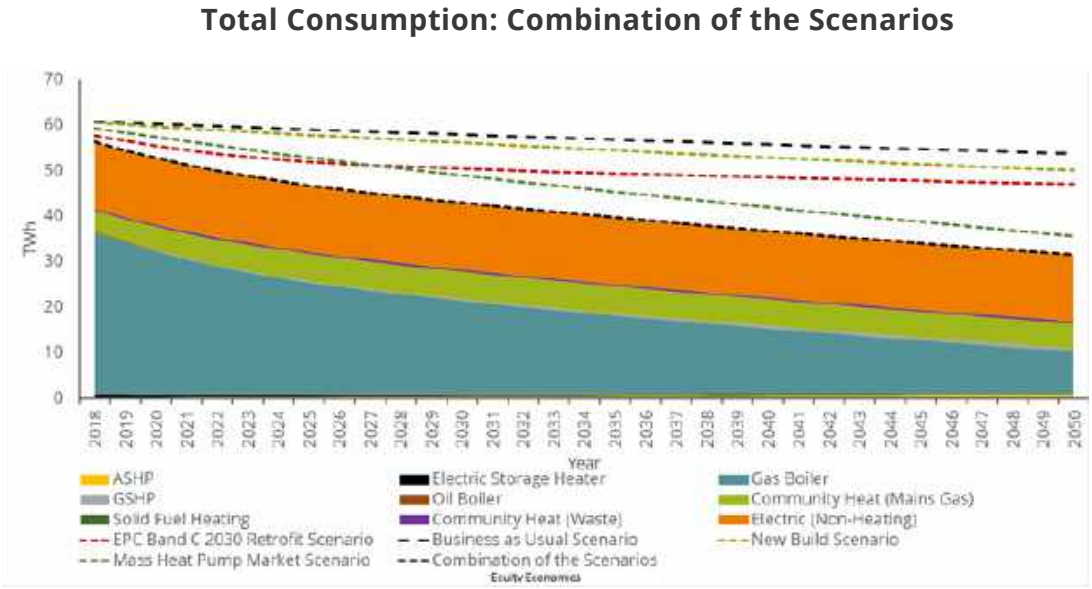


Figure 14 - Total consumption (TWh) projection based on the combination of scenarios

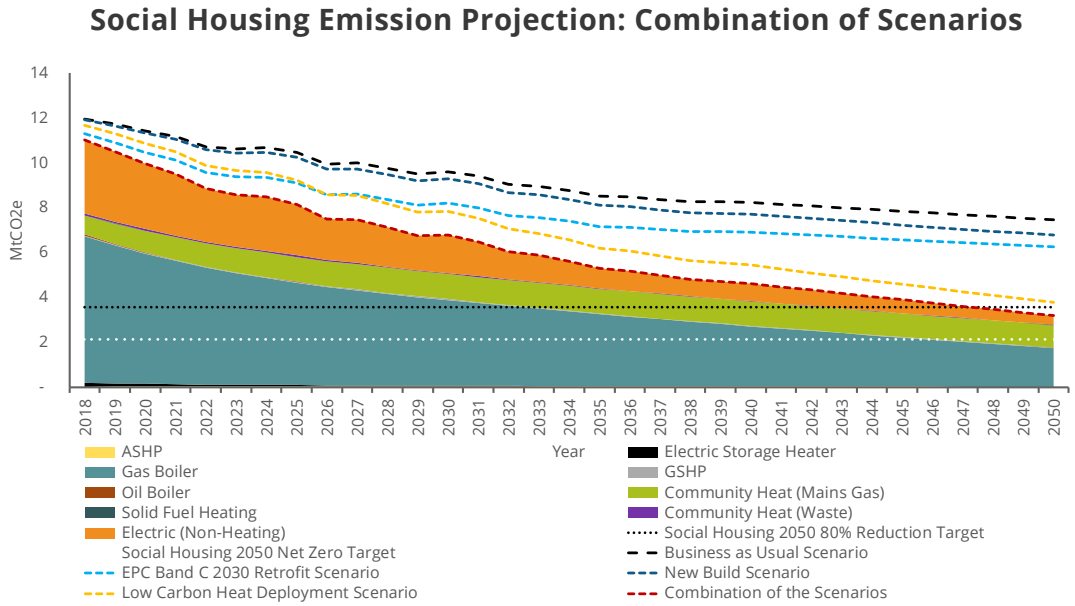


Figure 15 - Total emissions ($MtCO_2e$) from social housing projection based on the combination of scenarios

Figures 16 and 17 show the proportions of houses by EPC Band and heating method in 2050 under this combination scenario. Under this scenario, it is assumed that just over 1 in every 2 homes would have a low carbon heat source (for illustrative purposes a heat pump has been used) and nearly a quarter would be EPC Band A. As the proportion of houses in Bands A, B and C increases, the proportion of homes with communal heating also increases, reaching just under 16% by 2050. The Clean Growth Strategy highlighted that heat networks are likely to play an increasingly important role in heating buildings, and in each pathway modelled within the Strategy there was an assumed 17% proportion of heating in buildings assigned to heat networks by 2050.[36] Therefore, the modelling in this report reflects a similar projection.

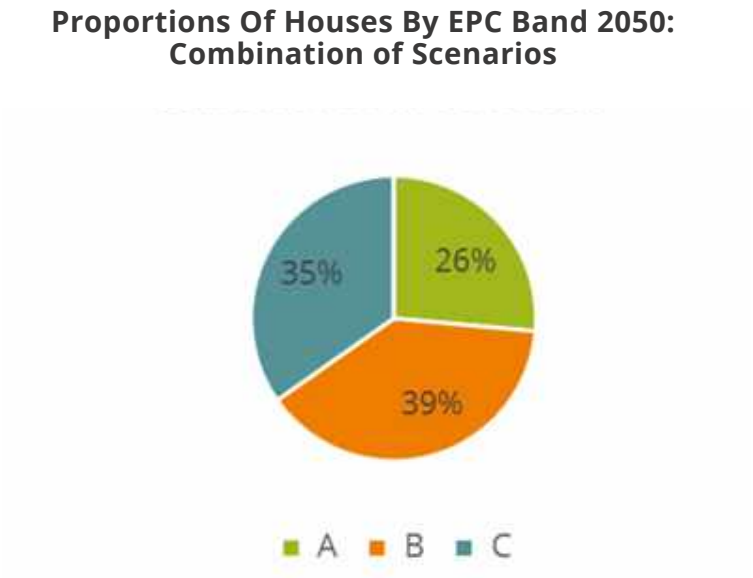


Figure 16 - 2050 proportions of houses in each EPC Band for the combination of scenarios

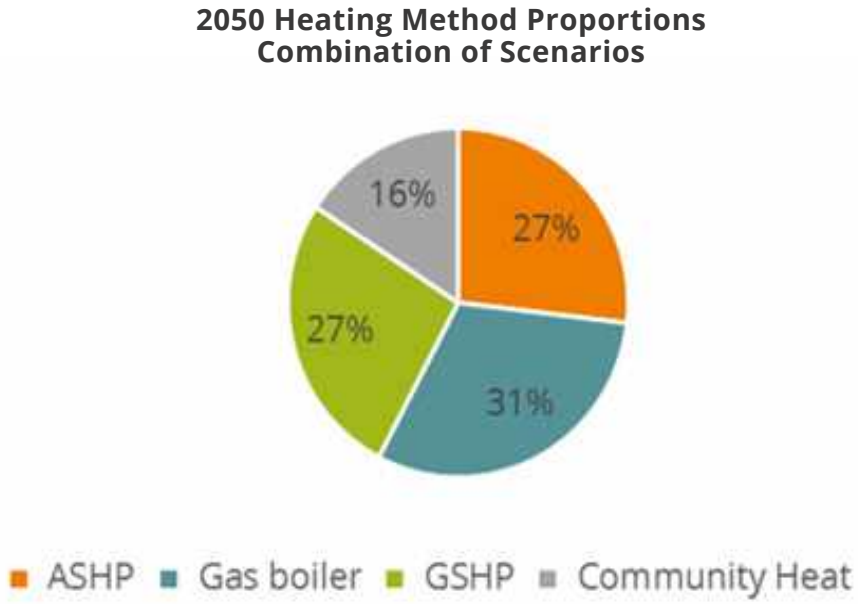


Figure 17 - 2050 heating method proportions under the combination of scenarios

As noted above, this combination scenario will not achieve the net-zero target. Our modelling suggests that net-zero is unlikely to be achieved without unprecedented changes over and above the scenarios we have projected. In addition to the changes to fuel mixes, there is also a need to consider storage and smart technologies to reduce demand at peak times. Whilst our modelling has not attempted to forecast the uptake of smart solutions, demand response and storage, these are likely to play an increasingly important role as we see increased deployment of electric heating.

FURTHER AMBITION SCENARIO

Key Input:

- EPC Band C by 2030 for all social homes from a retrofit programme,
- Increase in new build numbers to 50,000 from 34,500,
- Improvement in the space heating requirement in new builds in line with the Future Homes Standard at 15 kWh/m2/year instead of 54 kWh/m2/year
- Oil boilers and solid fuel heating to be phased out by 2026,
- Gas boiler usage to fall by 92.5% by 2050,
- No 'inefficient' electric heating by 2050.

Key Output:

Emissions fall Net-zero sufficiently in thjs sector to allow net-zero by 2050 overall

The Further Ambition scenario reflects a pathway where emissions reach a level in line with the illustrative net-zero target. As previously proposed, a multifaceted approach will be needed targeting existing and new homes from both a thermal performance and heat perspective.

The CCC have recommended that a space heating demand of 15 – 20 kWh/m2/year should be considered for new homes[37] which would put the UK at the forefront of international building standards in line with the Future Homes Standard. Our new build standard above demonstrates that a moderate improvement in energy efficiency will not be sufficient and that we must go further in terms of demand reduction. The building regulations review in 2019 offers a unique opportunity to drive up performance and mitigate the need to retrofit homes at a significant cost in the 2020s and 2030s.

For this to happen, new builds must be built to the Future Homes Standard, providing "world-leading" levels of energy efficiency as soon as possible. To reflect this, the analysis uses an annual space heating demand of 15 kWh/m2/year (the lower end of the range recommended by the CCC). Building new homes to this tighter space heating requirement, whilst ambitious, is achievable with many projects across the country achieving and exceeding this level of air tightness.

In addition, the Future Homes Standard will ensure that no fossil fuel heating systems are installed in new builds. The accelerated transition to low carbon heating is reflected in the Further Ambition scenario through a quicker move to low carbon heating methods such that, in addition to the combination of scenarios, gas boilers reduce by a further 32.5% points, with these houses switching to air source heat pumps.

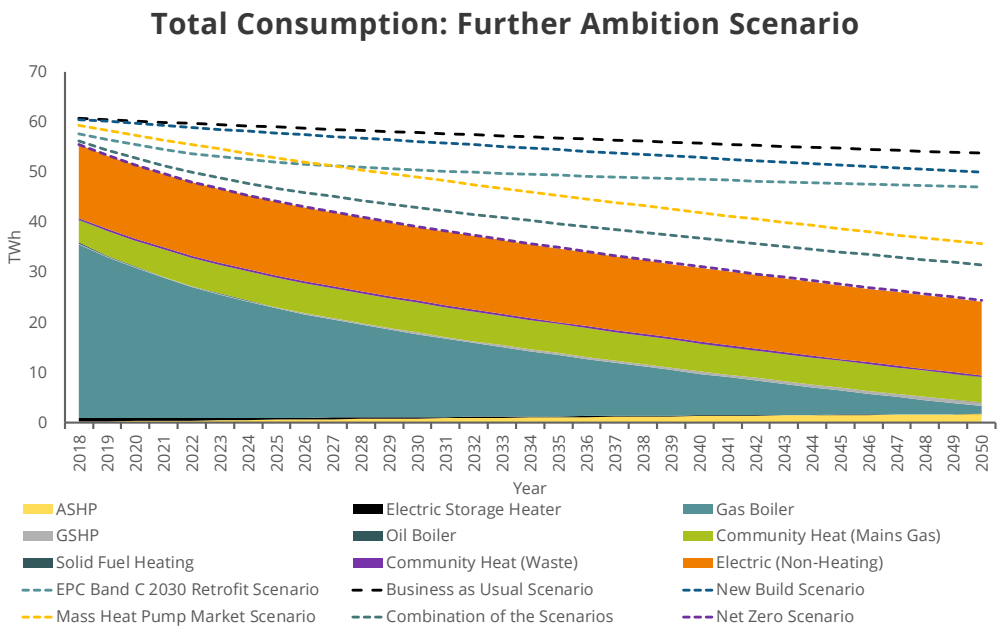


Figure 18: Total consumption (TWh) projection based on the net-zero scenario

Figure 18 shows the sharp reduction in consumption under this Further Ambition scenario. Here total consumption is 24.45 TWh in 2050. This translates to a fall in emissions to just below the net-zero target for the social housing sector (see Figure 19).

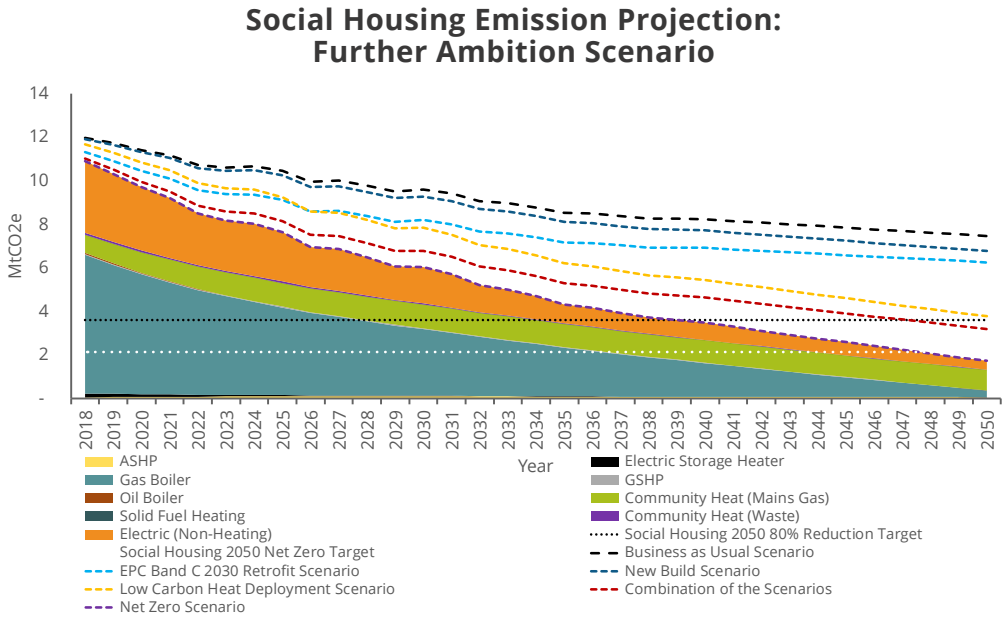


Figure 19: Total emissions ($MtCO_2e$) from social housing projection based on the net-zero scenario

The emissions in this scenario fall to 1.72 $MtCO_2e$, which is below the net-zero target of 1.79 $MtCO_2e$. The modelling carried out for this report emphasises the scale of the change which is needed to achieve emission reduction in the social housing sector. This includes the predominant heating fuel needing to shift away from natural gas to low carbon alternatives, as shown in Figure 20. Note that ASHP, GSHP are proxies for low carbon heating solutions and community heating is technology agnostic so can incorporate a multitude of low carbon technologies.

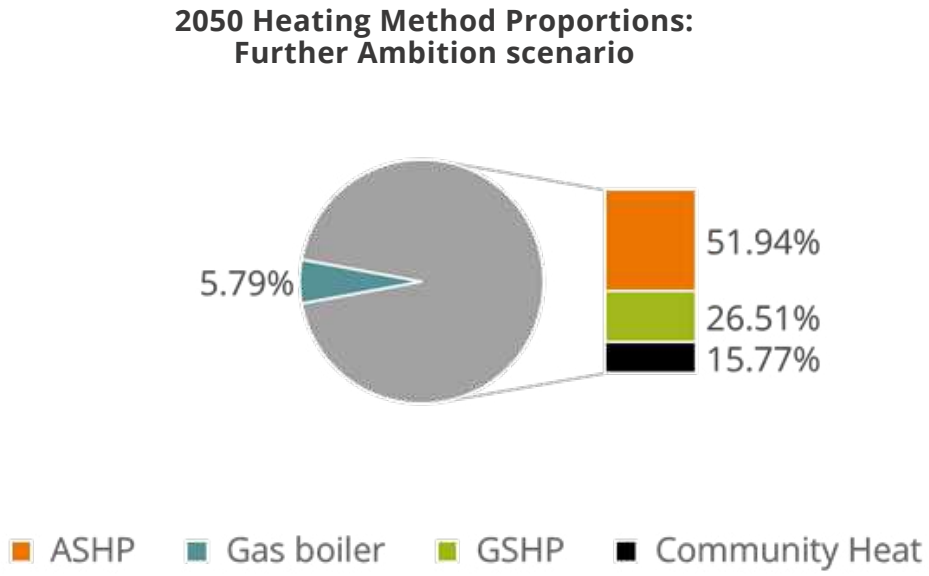


Figure 20: 2050 heating method proportions under the Further Ambition scenario

Widespread adjustments are needed, with tight standards for energy requirements in new builds (to a space heating of 15 kWh/m2/year), a programme of retrofit across the current stock, an almost complete shift to low carbon heating methods, as well as an increase in the development of new build homes. This array of changes needs to happen in combination and the time to implement these is now. Any further delays will only add to the already very difficult challenge of decarbonising the social housing sector.

TECHNOLOGIES USED:

SMART CONTROLS	✓
AIR SOURCE HEAT PUMP	✓
HEAT EMITTERS	✓

LOCATION: WEST BERKSHIRE

THE PROJECT

Sovereign is one of the largest housing associations in the country, providing quality, affordable homes, within strong and sustainable communities, for people priced out of the housing market. Modernising its homes and making best use of technology to help residents heat their homes for less is one way Sovereign is meeting its commitment to long-term investment and creating great places for residents to live.

As a result, the association recently carried out an Air Source Heat Pump trial that is producing some impressive early results to build on in the future.

21,000 of Sovereign's 58,000 homes are off gas, so it's a strong supporter of the affordable warmth that heat pump systems can provide for these homes.

It has already installed over 800 such systems but wanted to further develop this innovative approach. So, it decided to carry out a detailed trial using Mitsubishi Electric Ecodan Air Source Heat Pumps, combined with smart control and remote access so that performance could be measured and monitored more effectively.

SPECIFICATION

The trial involved replacing old storage heater systems in six 1970s one-bed and two-bed bungalows for older people in a small village in West Berkshire.

Supported with funding from the domestic Renewable Heat Incentive, the study focused on carbon reduction, energy efficiency and looking at real world performance and operation of the systems. The aim was to provide insight to inform the association's financial modelling requirements for future off gas project planning.

The association's long-term vision is to use a balanced technology approach, which focuses on gas and electric heating rather than solid fuel or oil. For off gas grid houses, bungalows and maisonettes, the preference is to fit ASHP systems.

The aim is to provide residents with energy-efficient homes that are more affordable to run, warmer and have less impact on the environment by reducing carbon emissions. This project's results so far suggest this is one way to achieve that.

BENEFITS

Early results have been impressive with the following headline figures after the first eight months:

- better energy performance – the RdSAP and EPC figures have gone from 52 (Band E) to 71 (Band C)
- lower fuel bills – bills are now around 57% lower than previous levels, making the homes far more affordable for residents
- warmer homes – residents' own warmth ratings have significantly increased: from 1/5 to 5 out of 5

Micky Cummins, Sovereign's Commercial Director said, one of the residents told us, "It's absolutely amazing, 10 out of 10".

Achieving Net-Zero

THE ANALYSIS CARRIED OUT SHOWS THE SCALE OF THE CHALLENGE IN MEETING NET-ZERO.

The social housing sector exists to provide housing to people of low incomes or those with particular needs. As such, they have a long-term interest in the affordability and sustainability of their stock and the well-being of their tenants. They regularly invest in the maintenance of their existing properties and the acquisition of new homes to meet demand. Despite this commitment and many in the sector initiating innovative projects to drive up the performance of their stock, there is unlikely to be a universal shift without the right market signals in place. Thus far we have discussed the technology mix and performance requirements which could help the sector meet the net-zero target. In this section, we outline the policies which will enable this transition. Without sufficient long-term and ambitious sector specific targets alongside stable policy and financial support mechanisms, we do not foresee the sector delivering the required emissions reduction by 2050. This section considers how prepared the sector is, and what changes are required from both the Government and providers to achieve net-zero.

A HOLISTIC APPROACH

If the UK is to achieve net-zero by 2050, widespread deployment of energy efficiency measures and low carbon heating in the UK's buildings is essential and the social housing sector will be key to the success of any strategy.

The BEIS Select Committee's Energy Efficiency: Building towards net zero report, published in summer 2019, commented that although 'the Government wants the social housing sector to be a "flag bearer" for energy efficiency standards', it has so far 'failed to set out a delivery mechanism for the sector'.[38] There is growing consensus among stakeholders that more needs to be done by government more quickly, and there is an appetite for a market framework that delivers energy efficiency and low carbon heating across all sectors. The availability of funding alone will not be sufficient to drive largescale change but similarly regulations without financial support will risk quality. The Government must consider how the whole suite of support mechanisms, nudges and regulation work together to drive improved thermal performance and the uptake of low carbon heat.

Ensuring that there are robust and ambitious frameworks in place across the whole housing market as well as clear targets for the social housing sector will encourage economies of scale and allow providers to plan renovations and investments over the long-term. The chopping and changing of policy such as the Zero Carbon Homes policy has not been helpful for this industry and it is important that this is avoided in future. Stability is key for investment in the housing industry if it is to contribute to meeting the net-zero target.

Existing market frameworks encourage social housing to be affordable, a crucial aspect of this sector which is essential to uphold. However, more importance should be placed on the quality of the asset itself, particularly its energy performance, and the value of this should be better reflected in the property's price.

The analysis conducted in this report has shown that if the current trend of gradually reducing emissions from the social housing stock continues, (Business as Usual Scenario) then by 2050 emissions will not even reach an 80% reduction compared to 1990 levels let alone the net-zero target legislated in 2019. **The Further Ambition scenario reflects a pathway where emissions reach a level in line with the net-zero target**. This requires a holistic approach which means;

- retrofitting existing homes to EPC Band C by 2030,
- raising standards of new builds to the Future Homes Standard providing "world leading" levels of energy efficiency at space heating demand of 15 kWh/m2/year and without fossil fuel heating systems, and
- accelerating the development of the low carbon heat market for existing homes with gas boilers market share reducing further.

For the average household to meet the requirements in energy consumption and emissions for the target level, it would mean consumption per household of 4,833 kWh and emissions of 0.344 tCO_2e. For the illustrative net-zero target to be met, our analysis suggests that around 75% of social housing will have a low carbon heating system, such as a heat pump, with the rest mainly served through heat networks and a minor share of gas boilers (6%) still being used. In addition, just over a quarter of homes would need to be EPC Band A and none should be below Band C. [v]

A key challenge as we transition to low carbon heating is how to ensure that installers are equipped to support the transition. The transition is likely to involve (re)training and may also require important changes to standards, assessment and enforcement to ensure all installations are carried out in alignment with a clear framework. Training our heating installers will provide them with the skills and knowledge to install and service a mix of heating systems, thereby positioning them within a much larger market. The Government has committed to a consultation on skills and training in 2019.

REGULATION AND STANDARDS

SETTING CLEAR LONG-TERM TARGETS

The Government has expressed its desire for the social housing sector to be a "flag bearer" for energy efficiency standards and our research confirms that the sector is willing to act as such however, a clear trajectory and policy framework for the sector is required if net-zero is to be achieved.

Our analysis shows that retrofitting existing homes to at least EPC Band C is essential if net-zero is to be achieved. The existing EPC Band C target should therefore be legislated to ensure it is delivered and not disregarded by any subequent governments.

The Further Ambition scenario models an accelerated transition to low carbon heating methods, such that, in addition to the higher new build standards and increased retrofit rates to EPC Band C, gas boilers reduce by a further 32.5% as homes switch to heat pumps.

The mass market growth of low carbon solutions and recognising their importance in decarbonisation is key. A range of low carbon solutions must be available as the most suitable solution will be dependent on the characteristics of the home, occupant and location. However, setting clear longer-term targets beyond 2030 should be considered to drive greater uptake of low carbon heat. There needs to be a phase out of fossil fuel heating in existing social housing properties, starting from today. To help achieve this, a clear signal should be sent to industry by the introduction of a deadline. This will allow housing providers to better plan works and reduce the risk of unintended consequences which could be associated with taking a shorter-term approach. Setting a deadline and outlining a roadmap for the decarbonisation of heat in social housing, including an end date for the use of fossil fuel heating in existing homes and implementing the Future Homes Standard to ensure no new builds are installed with fossil fuel heating would be helpful.

GOING BEYOND THE DECENT HOMES STANDARD

The Decent Homes Standard of 2006[39] set a new standard for social housing including requiring effective insulation and efficient heating. It also required key building components to be in a suitable state (do not need replacing or a major repair) including external walls, central heating boilers and storage heaters. Homes with a Standard Assessment Procedure (SAP) (using the 2005 framework) of less than 35 were deemed unsuitable for human habitation. The introduction of this standard did lead to improvements in social housing stock performance. However, many social housing providers feel that a new standard, which sets higher ambition than the Decent Homes Standard and is more representative of modern climate change targets would be helpful for the sector and its tenants.

In March 2019, the Homes Fit for Human Habitation Act[40] came into force having been successfully taken through the Commons by Karen Buck, MP and through the Lords by SEA President Lord Best. The Act aims to ensure that rented houses and flats are 'fit for human habitation', which means that they are safe, healthy and free from things that could cause serious harm. If they are not, then tenants can take their landlords to court to get them to carry out repairs or pay compensation. New tenancies must comply with the requirements of the Act now and those in existence must comply by March 2020.

The Act adds to the requirements of the risk-based housing health and safety rating system (HHSRS), which was implemented as part of the Housing Act 2004. Under the HHSRS, a decent home is free of category 1 hazards, and the existence of such hazards should be a trigger for remedial action. However, it is important to note that HHSRS is a risk assessment procedure and does not set a standard.

An adapted and updated Decent Homes Standard should be introduced, which more accurately reflects the challenges in the industry today and the net-zero target. This would help to ensure that homes are highly energy efficient and have low carbon heating systems, provided sufficient funding is also in place. This standard should be aligned with the Future Homes Standard to ensure that homes are future-proofed.

BUILDING REGULATIONS

The 2019 Building Regulations review presents a substantial opportunity to drive a step change in the performance of our building stock. As highlighted by the analysis, moderate improvements in thermal efficiency will not be sufficient to meet the net-zero target. The Further ambition scenario requires new builds be built to the Future Homes Standard, providing "world leading" levels of energy efficiency at space heating demand of 15 kWh/m2/year and without fossil fuel heating systems. The SEA believes that the social housing sector can and should lead the way by ensuring that any new builds are highly energy efficient and have low carbon heating systems installed as standard. **This is in line with the Committee on Climate Change's recommendations[41] and the 'Future Homes Standard,' which will mandate the end of fossil fuel heating in all new build properties. The SEA believes this should be implemented in the upcoming iteration of Building Regulations.**

In order to meet the net-zero target by 2050, and the Government's Grand Challenge Mission to halve the energy use of new builds by 2030, there needs to be deep increases in energy efficiency in new build social housing properties.

Without the regulations to mandate that these minimum standards are met, we will continue to see a piecemeal approach to higher standard developments which will inevitably mean that the net-zero target is not achieved. Regulation is a key step to reach net-zero in social housing, and it is important that social homes built by social housing developers as well as those bought from other sectors in Section 106 are monitored. New build homes need to be specified to higher standards and also built to those standards. **Closing the performance gap should be considered a priority to ensure that homes actually perform to their specified standard** if net-zero is to be achieved in practice as well as in theory.

FINANCIAL MECHANISMS

ACCESS TO FINANCE

Social landlords have control over whole estates, access to capital and approach investment in terms of coordinated stock upgrades. Social housing providers recognise and understand the need to improve the energy performance standard of their stock, however there is often limited resource to do so. The social housing sector is under pressure to build new homes, and to upgrade their existing homes but they operate within a rent-setting regime and have limited financial resources. There are currently limited public funding options for improving the energy performance of social housing and providers are often faced with competing priorities for budget allocation. This includes building maintenance issues and fire safety particularly following the Grenfell tragedy. There is therefore concern that the investment required to upgrade stock could leave some social housing providers in breach of their financial regulations.

For this reason, it is important that the Government provides specific funding for energy efficiency upgrades to address funding issues in the sector. There must be sufficient resource for social housing providers to improve the quality of their homes without compromising their affordability or safety. A dedicated fund for improving the energy efficiency of social housing, in line with all properties in this sector reaching EPC Band C by 2030, would support achievement of net-zero in the sector.

There are restrictions in place on how much social housing providers can increase their rents meaning that budgets are currently constrained. However, they have long term asset management budgets to upgrade properties.[42] Social housing providers have highlighted that changes to funding in the past have led to a reduction in investment in retrofit of existing properties. This can also impact resources with fewer members of staff able to focus entirely on retrofit work.[43] If a motivated sustainability or energy manager is lost, this can often hamper projects and slow progress.

There is evidence that every £1 spent on keeping homes warm can save the NHS 42p in health costs[44] therefore social housing providers would be contributing to societal benefits by undertaking this work and this should be acknowledged. This is something government should recognise in its policy making.

Widespread schemes to improve the energy efficiency and heating systems in social housing properties need support and long term commitment from government to raising standards. There have been several trials of Passivhaus (see case studies throughout this report) in the social housing sector which demonstrate the sector's willingness and ability to carry out largescale improvements. However, in most cases previous trials have not been deemed cost-effective and therefore the Passivhaus standard was not rolled out more widely. To overcome this barrier, funding from central government for low carbon solutions and measures that improve a property's energy performance, would be helpful.

It has been highlighted in recent government research[45] that some larger social housing providers have dedicated energy efficiency budgets, resulting in these improvements falling into a different category to routine maintenance operations (which are more focussed on aspects such as new kitchens and bathrooms). Having different budgets can be beneficial as energy efficiency upgrades, including installation of a new heating system, can be carried out more quickly and systematically by targeting the worst performing (lower EPC) buildings first. However, there can sometimes be challenges with gaining access to the property when there are multiple upgrades happening at different times, for example energy efficiency upgrades being carried out separately to bathroom and kitchen upgrades. There is a need to ensure a joined-up approach between these different departments to improve efficiencies.

For some smaller housing associations, smaller budgets mean that the focus is on emergency repairs and short-term essential maintenance. It is important to also ensure that funding aligns with retrofit cycles and the practicalities of carrying out the work such as weather conditions. Only around half of social landlords have internal budgets available to carry out insulation retrofit works and those without internal funding streams tend to carry out works based on the availability of funding rather than in a structured way to meet a target EPC rating.[46] It would be useful to provide a framework, as well as dedicated funding, that allows associations to plan and budget for a longer-term approach to improving the energy performance of their properties.

The proposals on energy efficiency within the recent Green Finance Strategy[47] were welcomed by the social housing sector, particularly the funding for innovation and whole house retrofit. However, there is scope to take the Strategy much further and introduce a range of packages that are attractive to landlords and tenants in the social housing sector. This includes considering the introduction of 'warm rent' where slightly more rent is charged for more efficient properties.

RENT CALCULATIONS AND ENERGY COSTS

Market barriers, specifically split incentives, impede energy efficiency renovations across the building stock. This is particularly apparent in the social rented sector because those who benefit from improvements (the tenants) do not pay for the renovation. **We recommend that an assessment of the range of solutions to address split incentives** is undertaken to recognise the long-term benefits of energy efficient housing whilst not compromising the affordability of the home for the occupants overall. Below we outline some of the options available.

Some housing associations already **take into account energy efficiency when setting rent structures for new acquisitions and new build properties.** For example, a point system has been used by Almond Housing Association to calculate the rental value which takes into consideration the benefits associated with new developments or major refurbishment where the average energy efficiency rating over all properties is 80 or above.[48] However, the impact of energy efficiency in this overarching rental calculation is likely to be minimum and is not applicable to existing homes and cannot be increased as a result of renovation works. However, in the Netherlands, through a bill approved in March 2011, the rental price evaluation system incorporates energy performance. This is used to determine the rental price for houses and apartments in the social housing sector and offers landlords the opportunity to increase the rent if the score on the EPC improves (ensuring that the benefit outweighs the rental price increase), thus incorporating energy efficiency in the evaluation criteria.

It is important to note that under the current social housing regulation an increase in rents or a separate energy efficiency related charge is not permissible. To overcome this, Energiesprong has introduced energy performance guarantees with tenants paying a fixed monthly/annual energy service plan charge which entitles them to a defined annual energy allowance. This results in an additional yet secured cash flow for the housing provider.[49] The approach means that industry takes the responsibility for the long term performance of the refurbishment which allows the provider to **offer tenants an energy service plan, giving them an energy allowance for a fixed monthly fee.**

Government should however consider introducing the ability for landlords to provide a 'warm rent' tenancy, where slightly more rent is charged for more efficient properties thus reflecting the value, driving demand and raising awareness of improved performance. The extra cost associated with a 'warm rent' service charge is remediated by the tenant through lower energy bills as a result of increased property efficiency. This is similar to the above Energiesprong model, however the energy performance impacts the rental value and can be applied to any home. This addresses the issue of split incentives within the sector and recognises the long-term benefits of energy efficient housing whilst not compromising the affordability of the home for the occupants overall.

Rents can also be used to drive energy efficient behaviour. Holistic rent arrangements which include heating costs could be adopted. These are typically used in Western or Northern countries (e.g. Germany and Sweden) but can be found in student or professional lettings in the UK. A consequence of this approach is that the consumer has little incentive to conserve energy as they are not responsible for paying the bills.[50] Monitoring energy use in these circumstances can help to overcome user-related split incentives. A gross warm rent model with direct feedback can allow landlords and tenants to agree on a set of comfort conditions (e.g. indoor temperatures). If the tenant consumes less than the agreed energy usage, they receive compensation but if they exceed the threshold, they pay the additional energy costs. This could encourage energy efficient behaviour.

Important to consider in the transition to low carbon heating is the relative levies and charges placed on electricity bills compared to gas. By 2050, gas is considered to be a more carbon-rich source of energy than electricity if the decarbonisation trends in electricity continue. The charges placed on electricity include environmental and social obligations and this results in electricity bills being more expensive than their gas counterparts. Therefore, low carbon heat sources, such as electric heat pumps, may be more expensive than gas which could act to disincentivise low carbon heating and risks the achievement of net-zero. As recommended by the CCC, **a review of electricity and fossil fuel bills should be carried out to mitigate this risk.**

PROCUREMENT AND DISPOSAL

Current procurement frameworks for social housing include Section 106 of the land use planning system, where private sector housebuilders are required to assign a certain proportion of their new builds for affordable and social housing. Section 106 homes can fall into 3 sections;

1. Social Rent – usually based on 25% of average earnings,
2. Intermediate Housing – which often takes the form of shared ownership lease,
3. Affordable Rent – which is a rent equal to 80% of open market rent.

A high proportion of new social housing is gained through Section 106, with our research indicating that this can be as high as 50%[vi] of a social housing provider's new homes annually. Section 106 provides a good opportunity to procure homes for the social housing market, and these are often mixed with privately rented and owner-occupied homes which creates a diverse community to live in, as recommended by the Decent Homes Standard.

However, there are some concerns about this procurement framework. Firstly, as land is reaching its limits, more and more associations are competing in a very competitive private market for land. This means that social housing providers are regularly outbid by private developers. This then increases the price of the property when built and/or reduces the quality of the home to try to limit costs.

Secondly, there are some concerns about the quality of the homes procured through Section 106 as social housing providers themselves are not responsible for their design or build and have little control on the final as-built quality of the property. Sometimes the concerns over the quality of properties procured through section 106 are so great that social housing providers feel they are unable to use this route to market. To overcome this, **there needs to be higher standards and regulation placed upon private sector housebuilders to ensure they deliver higher quality homes**. The SEA's report, Halving Energy Use of New Homes[51] includes recommendation for raising standards.

In addition, there are concerns surrounding the performance gap of buildings in the UK more generally. The difference between estimated and actual energy usage needs to be closed by focusing on the outcome when new homes are built, not on their initial specification. We recommend that the Energy Performance Certificate (EPC) should reflect the buildings actual performance, to ensure that what is specified is actually installed and any cost-saving changes to building design are reflected in the EPC. Furthermore**, there is a need to ensure better inspection of works to ensure performance post build.**

To assist in closing the performance gap, all new properties should come with detailed information about the products installed, guarantees and maintenance information. The rollout of smart meters which will record the energy use of homes is likely to be helpful in reducing the performance gap, and the Government's smart meter programme should be encouraged in the social housing sector. A property inspection should be carried out after completion to ensure compliance with the energy performance promised at the outset, and monitoring homes procured through Section 106 will help to raise the standard of new builds across the UK. The testing of homes procured by social housing in this way would not only ensure that homes purpose built for social housing are of a high quality but also help to ensure that the performance gap is closed across private sector homes through knowledge spill over.

[vi] This statistic was provided by social housing providers at the SEA hosted roundtable on 2 July 2019.

Social housing providers have indicated that disposal of their stock that is not able to reach EPC Band C cost-effectively, affordably or technically is important to relieve funds for other works and to ensure that tenants are not exposed to unnecessarily high energy costs. However, it is crucial that social housing properties unable to reach EPC Band C are not simply passed onto the private sector with no incentive for the property to be improved. A holistic energy efficiency policy framework is needed to ensure that properties do not fall through the gaps. This type of disposal is undesirable because it allows poorly performing homes to continue to be inhabited, having consequences for occupant's health and finances. It is acknowledged that some exemptions may be needed if it is not possible to improve a property, however there should be a requirement to demonstrate that all practical and cost-effective measures have been completed. In our modelling, we have assumed that demolitions occur for the worst performing properties, but sales are proportional across the social housing stock.

Conclusions and recommendations:

KEY CONCLUSIONS

Conducting business as usual in social housing will not acheive net-zero carbon by 2050

Only a combination of deep retrofit of existing social housing, implementing far higher standards of all new builds and encouraging rapid market growth of low carbon heating systems can be successful in achieving the net-zero target.

Action is required now if we are to achieve net-zero. Recommended actions are sumarised below:

KEY RECOMMENDATIONS

1. REGULATION & STANDARDS

Legislate the EPC Band C target; raising all homes to EPC Band C wherever 'practical, cost-effective and affordable' by 2035 and starting with social housing by 2030. Energy efficiency is the first essential step in creating homes with a low energy demand.

Introduce a new improved 'Decent Homes Standard' for social housing. This is required to reflect the new net-zero target.

Set a clear deadline on the use fossil fuel heating systems in social housing. There needs to be a phase out of fossil fuel heating in existing social housing properties, starting from today. To help achieve this, a clear signal should be sent to industry by the introduction of a deadline.

Implement the 'Future Homes Standard' as soon as possible. This is essential to meet the carbon emissions target and will mandate the end of installation of fossil fuel heating in new build social housing.

2. FUNDING

Provide specific Central Government funding for upgrading energy efficiency in social housing. The Grenfell tradegy and budget cuts have resulted in increased spending on fire safety, and money allcoated for home renovations including energy efficiency and heating system upgrades has been reduced. In line with the BEIS Select Committee recommendations, energy efficiency should have increased funding from Central Government to mitigate this.

Introduce a 'warm rent' option for social housing providers which addresses the issue of split incentives within the sector and recognises the long-term benefits of energy efficient housing whilst not compromising the affordability of the home for the occupants overall.

Ensure that environmental and social obligations placed on energy bills are not disproportionaly placed on certain fuels, particularly where those fuels are lower carbon, as this conflicts with the achievement of net-zero

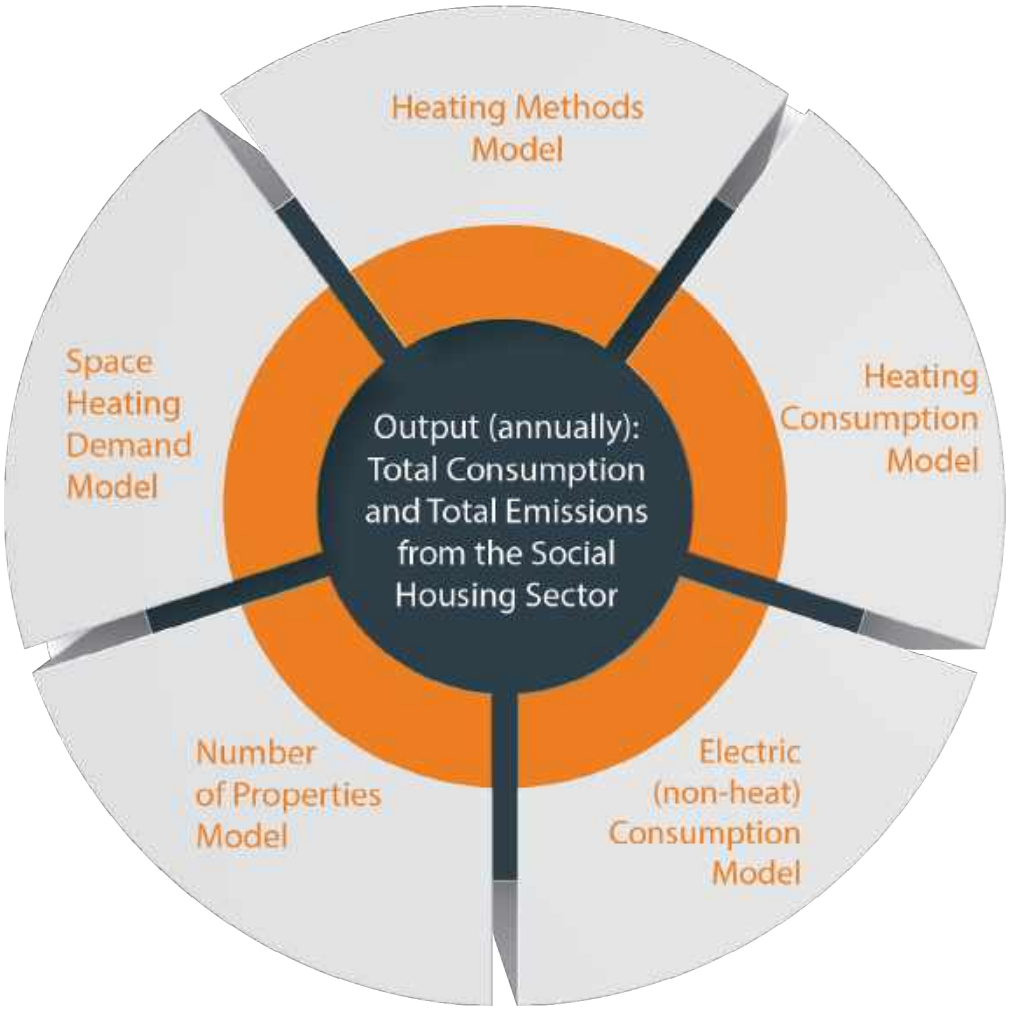
3. QUALITY

Increase monitoring of new build homes and those procured through Section 106 to ensure the performance gap between the design and as-built performance of a home is closed. To achieve this, there should be improved access to redress for properties that do not meet the design standards when they are built.

ANNEX

METHODOLOGY AND DATA ASSUMPTIONS

The graphic below provides an overview of the structure for the modelling used in this report.



EXPLANATION OF EACH MODEL

NUMBER OF PROPERTIES MODEL

Number of Properties Model: this model assumes a stationary total social housing stock of 5 million homes up to 2050. Within these homes there is an ongoing improvement in the EPC Bands of the properties, which is a result of standards of new builds, demolitions and improvements from retrofit.

SPACE HEATING DEMAND MODEL

Space Heating Demand Model: this model is used to adjust the heating requirements for properties which are affected by new build regulations. It represents the fact that over time, as more new build properties are built, the average space heating demand of the housing stock will fall. This is then fed into the Heating Consumption Model as a multiplier for each property type at the applicable Bands.

HEATING METHODS MODEL

Heating Methods Model: this model uses the output from the Number of Properties Model for each year in combination with the proportion of heating methods for each EPC Band to calculate the number of different heating methods by property type and EPC Band yearly. This therefore reflects the shift in heating methods which is likely to occur from the improvement of the housing stock across the time-frame.

HEATING CONSUMPTION MODEL

Heating Consumption Model: this model uses a baseline heating demand across the various fuel and property types. This is then adjusted for the efficiency of the different heating methods that proportionally make up each fuel type and multiplied to calculate the consumption of energy through each of the different heating methods and number of properties in each year.

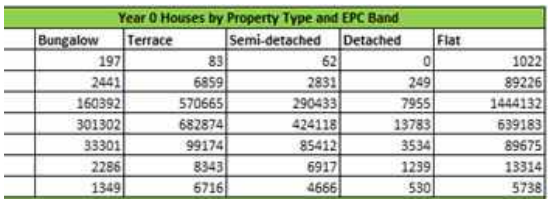
ELECTRIC (NON-HEAT) CONSUMPTION MODEL

Electric (non-heat) Consumption Model: this model considers the extra electrical consumption that occurs for uses such as lighting, cooking and other appliances across homes. It is simply multiplied by the number of houses to work out the total consumption, which remains constant each year.

OUTPUT

Output: this is where the consumption values from the various models are aggregated and multiplied by the suitable carbon intensities to work out the overall emissions for each year.

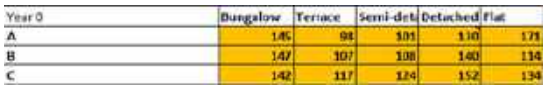
MODEL PARAMETERS	VALUE	COMMENT	SOURCE
NUMBER OF PROPERTIES MODEL			
Number of properties	5,000,000	Stays constant across all years.	Live tables on Dwelling Stock, Northern Ireland Housing Market
New Builds	34,500 (per year)	Stays constant across all years. Increases to 50,000 under new build scenario. Average value between 2012-2017 based on data across the countries of the UK and scaled proportionally for any missing points.	NI, SCO, WAL, ENG
Demolitions	8,179 (per year)	Demolitions assumed to take place on lowest EPC Bands each year. Average value between 2012-2017 based on data across the countries of the UK and scaled proportionally for any missing points.	SCO, Social Housing Sales: Demolitions of Social Housing Stock for England
Retrofit	A +1.25, B -26.75, C 280.125, D -91.75, E -116, F -34.5, G -12.375 (number of homes per year)		EPC Open Data

New Build EPC Band Proportions	A 1.1%, B 86%, C 12.9%	Calculations based on data and then assumption no social housing new builds below Band C	Live tables on energy performance of buildings
Number of houses per property type	Terrace 1,374,714, Semi-detached 814,438, Detached 27,291, Bungalow 501,268, Flat 2,282,288	Proportion of property types in England social housing stock scaled up to a UK level (5 million)	Stock profile
Starting housing profile		Based on data from EPC certificate database and adjusted for social dwellings EPC Bands % from	EPC Open Data, Energy Performance - Dwellings

Year 0 Houses by Property Type and EPC Band

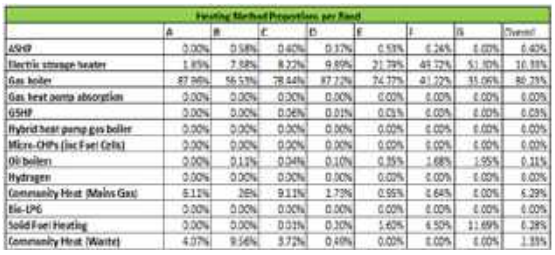
	Bungalow	Terrace	Semi-detached	Detached	Flat
	197	83	62	0	1022
	2441	6859	2831	249	89226
	160392	570665	290433	7955	1444132
	301302	682874	424118	13783	639183
	33301	99174	85412	3534	89675
	2286	8343	6917	1239	13314
	1349	6716	4666	530	5738

SPACE HEATING DEMAND MODEL

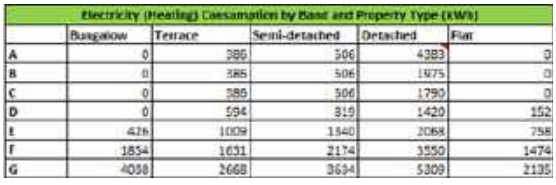
Starting space heating demand	 (kWh/m$^{2)}$	Ecuity calculations	Ecuity calculations
New build space heating demand	54.26 (kWh/m^2)	Value taken from NHBC building regulations	NHBC

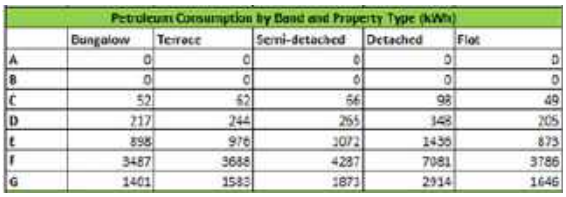
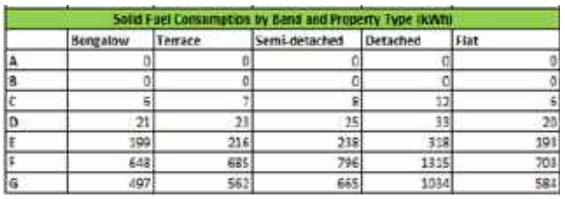
Year 0	Bungalow	Terrace	Semi-det	Detached	Flat
A	145	98	101	130	171
B	147	107	108	140	134
C	142	117	124	152	134

HEATING METHODS MODEL

Heating Method Proportions per EPC Band		Ecuity calculations.	EPC Open Data

HEATING CONSUMPTION MODEL

Efficiency of Heating Methods		Values taken from various sources	SAP, Rehva, Cibse, Pure Energy Centre, Senedd
Gas consumption by Band and Property Type		Values taken from NEED EPC analysis, weighted for social housing	NEED
Electricity (heating) Consumption by Band and Property Type		Assumed to come from oil boilers. These values are calculated using a combination of proportions from Need, EPC Band heating fuel types and ECUK data for the domestic sector by fuel type	NEED, EPC Open Data, UK Energy Consumption

Petroleum Consumption by Band and Property Type	 Petroleum Consumption by Band and Property Type (kWh) Bungalow / Terrace / Semi-detached / Detached / Flat A 0 0 0 0 0 B 0 0 0 0 0 C 52 62 66 98 49 D 217 244 265 348 205 E 898 976 1072 1436 873 F 3487 3688 4287 7081 3786 G 1401 1583 1873 2914 1646	Assumed to come from oil boilers. These values are calculated using a combination of proportions from Need, EPC Band heating fuel types and ECUK data for the domestic sector by fuel type	NEED, EPC Open Data, UK Energy Consumption
Solid Fuel Consumption by Band and Property Type	 Solid Fuel Consumption by Band and Property Type (kWh) Bungalow / Terrace / Semi-detached / Detached / Flat A 0 0 0 0 0 B 0 0 0 0 0 C 6 7 8 12 6 D 21 23 25 33 20 E 199 216 238 318 191 F 648 685 796 1315 708 G 497 562 665 1034 584	Assumed to come from oil boilers. These values are calculated using a combination of proportions from Need, EPC Band heating fuel types and ECUK data for the domestic sector by fuel type	NEED, EPC Open Data, ECUK
ELECTRIC (NON-HEAT) CONSUMPTION MODEL			
Underlying Household Electricity Consumption	2933.4 (kWh)	Value calculated from ECUK data using the sum of electric consumption for cooking, lighting and appliances (3.02) divided by the number of households (3.03)	ECUK
OUTPUT			
Projected Emission Intensity	Gas 0.184, Electric (varies), Fuel oil 0.268, Bio-LPG 0.37, Solid Fuels 0.362 ($KgCO_2e/kWh$)	Emission intensities calculated for values of grid average for the domestic sector.	Data tables 1-19
2050 Target 80% Reduction in Social Housing Emissions from 1990 levels	3.6 ($MtCO_2e$)	Residential emissions by end user were extracted. Adjusted for the proportion of emissions from social housing.	UK GHG by end user, Energy Performance - Dwellings

ASSUMPTION	RATIONALE
No new builds coming in below Band C	Although new builds in 2018 have had some below Band C, it is assumed that social housing has a higher standard to allow for calculation simplification
Proportion of new builds going into the different Bands remaining constant across time	Future trends in this are extremely hard to predict
Future trends in this are extremely hard to predict	This is based on historic data and although this may change, it could be an increase or decrease. An increase is probably more likely, but to allow simpler calculations the model assumes a constant value
Stock of acquisitions and sales similar in terms of characteristics (no effect on the Bands or across property types) compared to the previous year	This allows the total stock to remain constant without adjustments to the proportions of property types
Demolitions to reduce the stock of the lowest Bands	Some higher Bands are likely demolished, but this is a minority and allows far easier calculations
Constant movement between Bands from retrofit	Constant movement between Bands from retrofit
EPC proportions per property type have been calculated from data for England and Wales, it is assumed this proportion is constant across the whole of the UK	Allows scaling up to UK level, a safe assumption as Scottish and Northern Irish housing will not differ hugely
All social housing retrofits were included on the EPC register between 2008-2016	This allows a number to be placed on the number of retrofits per year
Retrofit has the same proportional effect across all property types	Breaking down the data into smaller samples would have made the findings less reliable to calculate at this level
No petroleum and solid fuel consumption for Bands A and B in social housing	This allows for the phasing out of these fuels across the time-frame
Constant underlying electricity use is the same for all households and matches the national average	This allows for a quick calculation to be made on electric consumption across properties for purposes other than heating

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