THE HEALTH BENEFITS OF RETROFITTING PROPERTIES TO INCREASE THERMAL EFFICIENCY ACROSS THE EAST MIDLANDS COMBINED COUNTY AUTHORITY

Executive Summary

Background:

This report aims to provide a strengthened evidence base for investment in improving the thermal efficiency of housing across the East Midlands Combined County Authority (EMCCA) by identifying the health benefits and estimating the return on investment due to improved health and wellbeing.

The homes in which people live are central to an individual's life and are a key building block for good health and wellbeing. Poor housing conditions can lead to worse mental and physical health, reduced quality of life and premature death. Homes are also where many of the other building blocks for a good quality of life are created, including safety, warmth, connection, community, education, and work.

Effects of thermally inefficient housing:

Individuals of all ages living in thermally inefficient homes are more likely to have worse health and wellbeing due to cold, damp housing which is expensive to heat. Cold and damp housing has been found to cause and worsen respiratory and cardiovascular diseases across the life course, leading to, lower educational attainment, more time off due to sickness, increased hospital admissions and on occasions, premature death. Cold and damp homes are also associated with worse mental health and wellbeing, due to the stress and social isolation of living in a cold and damp home and the financial stress of expensive to heat homes leading to fuel poverty.

The negative effects of cold/damp housing on health are unfairly distributed across the population. Individuals living in deprivation, or from minority ethnic groups are more likely to live in cold and damp housing and be more vulnerable to the health and social effects of poor housing (Ranmal & Tinson, 2022; The Health Foundation, 2021).

Evidence for improving the thermal efficiency of housing:

Housing stock across the UK is most thermally inefficient in Europe leading to significant carbon emissions, expensive fuel bills and reduced health and wellbeing.

Retrofitting housing to improve thermal efficiency leads to improved mental and physical health, improved wellbeing, reduced school and work absence and lower levels of anxiety and stress from fuel poverty. Bringing housing up to minimum thermal efficiency standards is likely to have the greatest impact on the most vulnerable populations and poorest households. Adequate ventilation should be installed alongside insulation to maximise the health benefits of increased thermal efficiency and help homes remain cool during periods of excess heat.

Economic case:

The economic benefits of promoting the best possible health of the population through good homes are significant. A healthy population results in a thriving society and economy because:

- healthier children have better educational attainment,
- healthy working age populations have greater productivity,
- better health in older age results in later retirement,
- improved health at all ages results in lower health and social care costs.

It has been estimated that every £1 invested in housing brings £2 of benefit through costs avoided to public services including care, health, and crime costs (The Health Foundation, 2023).

Local evidence for improving health through retrofitting properties:
Across the EMCCA, it has been estimated that an average of 155 excess winter deaths each year could be caused by fuel poverty. Future deaths may be prevented by improving the thermal efficiency of housing.

It has been estimated that improving the thermal efficiency of homes across EMCCA with significant cold hazards could result in NHS savings of more than 32 million pounds per year. The total cost to mitigate these cold hazards is just under 350 million. In NHS savings alone, the payback for this investment would be 10.7 years, if wider societal savings are considered, the payback time would be much shorter.

Damp and mould are also likely to be impacting health and wellbeing across EMCCA. Currently data estimating the number of houses with damp and mould across EMCCA is not available. Derbyshire County Council have undertaken a Health Impact assessment and estimated that it would cost £17.7 million to repair all significant damp and mould hazards in Derbyshire. If all these damp and mould hazards were mitigated, then £1.4 million would be saved by the NHS annually resulting in a payback time on the investment of 13.1 years.

Local energy efficiency programmes:
There have been multiple funding streams to improve the energy efficiency of housing across the EMCCA area. However, there has been significant delivery gaps and there remains a substantial need for more work to improve the energy efficiency of housing stock across the area.

The impact of these energy efficiency schemes on the health of the EMCCA population is uncertain as there has been minimal evaluation of the health impacts of energy efficiency initiatives locally.

Recommendations

1. Investment in improving the thermal efficiency of housing across EMCCA should be a priority as this will lead to reduced carbon emissions, improved health and wellbeing and significant financial savings for health and social care services.

2. The EMCCA needs to work closely with Councils to develop a clear understanding of the housing stock conditions across EMCCA. This will enable identification of privately rented, owned and social housing that have significant cold and damp hazards that will be impacting the health and wellbeing of residents.

3. Local schemes for retrofitting properties should prioritise reducing health inequalities and tackling fuel poverty.

4. Adequate and appropriate ventilation should be installed when retrofitting properties to improve thermal efficiency.

5. Schemes to retrofit properties to increase thermal efficiency should also consider the how they can also ensure that homes remain cool during periods of excess heat.

6. Data collection on health and wellbeing improvements from current home improvement schemes should be collected and shared to increase the local evidence base on the impact of improving the thermal efficiency of homes on health and wellbeing.

1. Background

1.1 Purpose of report

The aim of this report is to provide evidence and narrative on the impact on health and wellbeing of improving the thermal efficiency of homes across the East Midlands Combined County Authority (EMCCA). It aims to strengthen the local evidence for investment in retrofitting homes across the triple bottom line (environment, economy and health). This will be done by estimating the health and social benefits and the return on investment to health and social care of retrofitting homes across EMCCA.

The objective of this report is to:

- Summarise the existing evidence on:
    - The impact on health and wellbeing of thermally inefficient housing.
    - The health and social benefits of retrofitting homes.
    - The economic benefit of retrofitting housing due to reduced health and social care utilisation and increased productivity.

- Describe the local evidence for retrofitting housing across EMCCA by:
    - Identifying available data on the number of houses across EMCCA that are potentially impacting health due to poor thermal efficiency.
    - Estimating the return on investment to health and social care from retrofitting this housing to improve thermal efficiency.

1.2 Housing as a wider determinant of health

The homes in which people live are central to an individual's life and are a key building block for good health and wellbeing. Poor quality housing has been linked to increased accidents, worsening of health conditions, reduced mental wellbeing, poor quality of life and premature death (Dahlgren G, 1991; Marmot, 2010; Finch, Farrington-Douglas, & Johnes, 2023). An individual's home is central to their life, and as well as directly influencing health, it is where many of the other building blocks of good life are created, including safety, warmth, connection, community, education and work (Finch, Farrington-Douglas, & Johnes, 2023).

The Decent Home Standard sets a minimum standard for 'decent' housing. Compliance with these standards means that a property (GOV.UK, 2023):

- meets the current statutory minimum standard for housing based on the Housing Health and Safety Rating System (HHSRS). Homes which contain a Category 1 hazard (a hazard that poses a serious and immediate risk to the health and safety of occupants) under the HHSRS are considered non-decent.
- is in a reasonable state of repair.
- has reasonably modern facilities and services.
- provides a reasonable degree of thermal comfort.

The English Housing Survey tracks compliance with this standard and this data can be seen in Figure 1. In 2022 14.6% of all homes in England did not comply with the Decent Homes Standard, with the greatest proportion being Private Rental homes (21% of Private Rental homes were classified as non-decent in 2022) (Finch, Farrington-Douglas, & Johnes, 2023).

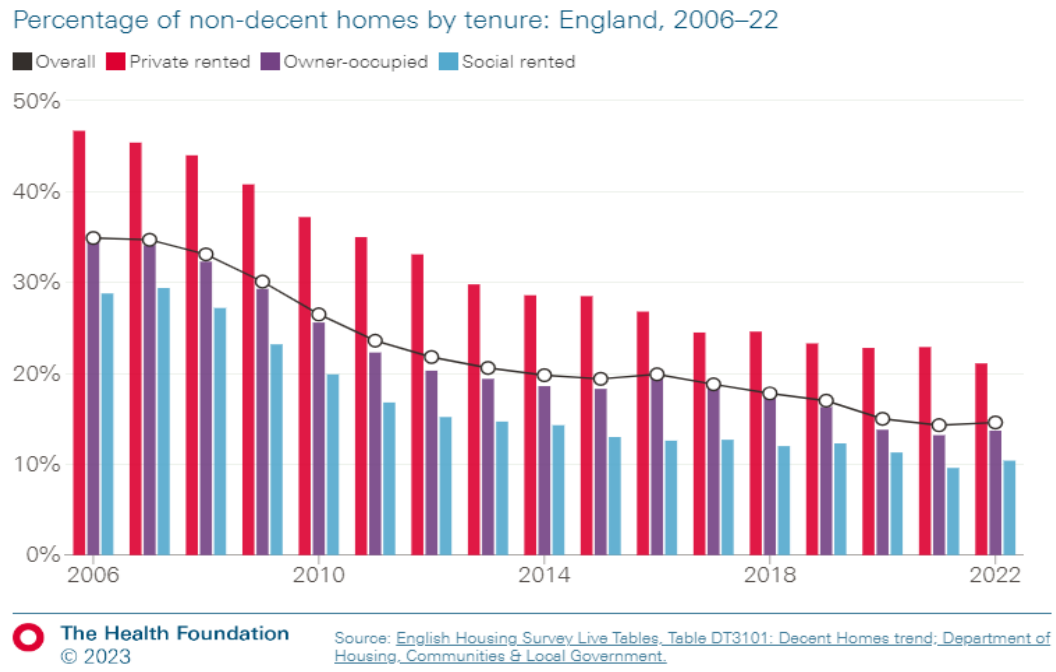


Figure 1: Percentage of non-decent homes by tenure 2006-2022 (The Health Foundation, 2023)

1.3 Health inequalities

Poor housing is known to drive health inequalities (unfair differences in health). Deprived populations, individuals with mental health illness and those from minority ethnic groups are more likely to live in poor quality, thermally inefficient housing and be more vulnerable to the effects of cold homes (The Health Foundation, 2021). This leads to these individuals experiencing worse mental and physical health, lowered social wellbeing, increased poverty and a shorter life than those in good quality, warm housing (Ranmal & Tinson, 2022).

2. Effects of thermally inefficient housing

2.1 Fuel poverty

Fuel poverty is defined as the situation in which a household is unable to afford to heat (or cool) their home to an adequate temperature. It is caused by low income, high fuel prices and thermally inefficient housing (End fuel poverty coalition, 2024; Sustainable Development Commission, 2010). Thermally inefficient homes are expensive to heat and for many vulnerable populations the cost of heating is too high, so they face the stark choice of 'eat or heat' (Sustainable Development Commission, 2010; End fuel poverty coalition, 2024). Deprived and vulnerable households are more likely to live in energy inefficient housing, be less likely to be able afford to heat their home or to cope with the impacts of cold homes and reduced income. This leads to a vicious cycle of worsening poverty and health perpetuating health inequalities which span generations (Geddes, 2011).

2.2 Impact of cold/damp homes on health

Cold homes have been identified to have a direct and indirect impact on health and social wellbeing in both children and adults (Donkin, 2024; Geddes, 2011). The most tragic consequence of cold homes is premature death. Excess winter deaths occur in both warm and cold housing, but it has been estimated that in the coldest quarter of housing, excess winter deaths are three times higher when compared with the

warmest housing, with 21.5% of excess winter deaths being attributed to the coldest quarter of housing (Geddes, 2011; PHE, 2019). Damp is associated with cold homes and often results in mould which also contributes to poor health and sometimes death (Geddes, 2011). The sad death of two-year-old Awaab Ishak due to black mould is stark reminder of the impact of damp and mould on health (Weaver, 2022). Due to the substantial health risks posed by cold and damp housing, significant cold and damp have been identified as Category 1 hazards in the HHSRS (Office of the Deptuy Prime Minister, 2004).

Cold and damp homes impact individuals across the life course as can be seen in figure 2 (more detailed information and evidence about the effects of cold homes on health across the life course can be seen in appendix 1).

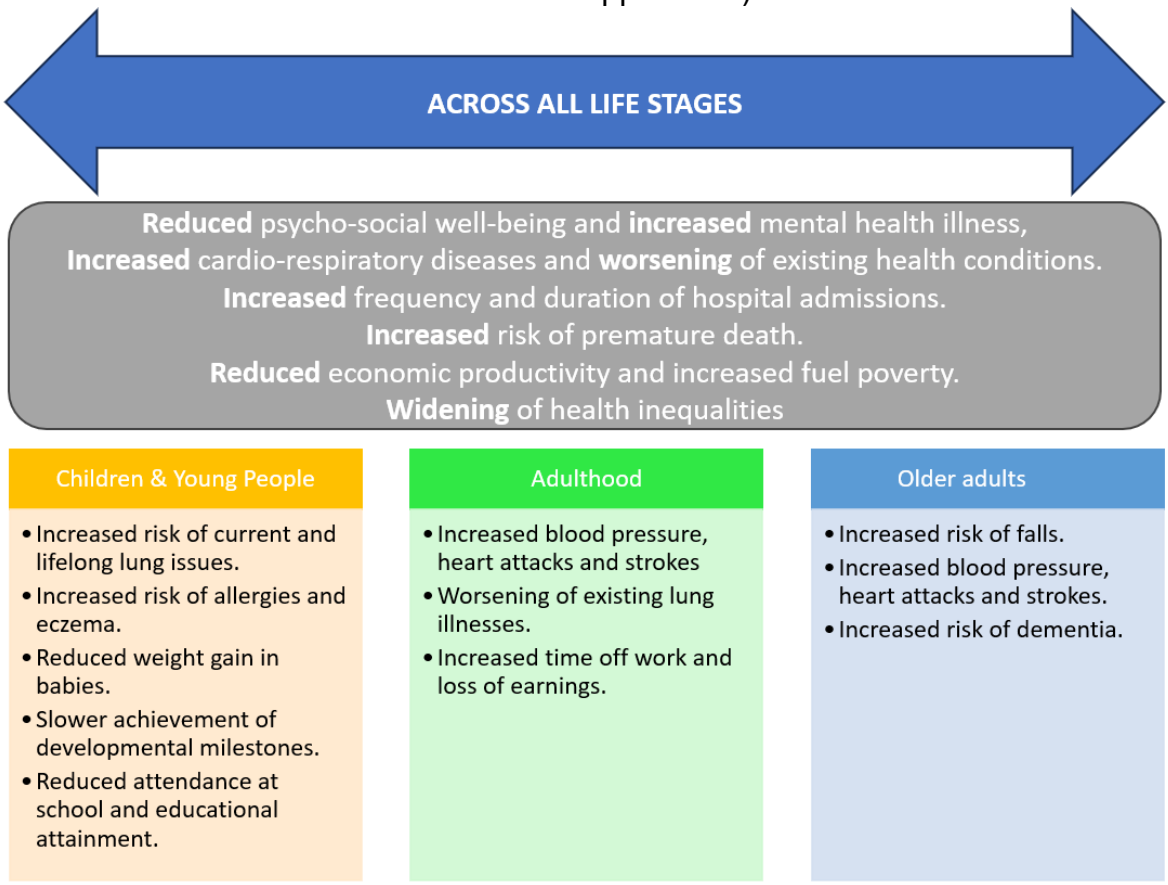


Figure 2: Impact of thermally inefficient homes across the life course

Cold and damp homes have been found to have a significant impact on the development, educational attainment, health and wellbeing of children. These negative impacts will persist into adulthood, leading to worse mental and physical health, reduced employment, poverty and widening of health inequalities (Donkin, 2024; Lee, 2022).

The main physical health conditions associated with cold homes in adults are circulatory and respiratory diseases, with cold homes increasing the risk of heart attacks, strokes, respiratory infections, and reduced lung function (Geddes, 2011; Donkin, 2024). Older adults living in cold homes have been found to have reduced muscle strength and are at increased risk of falls (García-Esquinas E, 2016; Donkin, 2024). Thermally inefficient housing can also lead to worse mental health. This is

due to the direct impact of the cold as well as the indirect impact of fuel poverty and the social isolation associated with cold homes (Cotter, 2012; Clair, 2022; Donkin, 2024). All the mental and physical health consequences of cold homes can lead to reduced productivity, increased time off work and increased healthcare utilisation (Donkin, 2024).

Older adults and individuals with chronic health conditions often spend longer in their homes and are more vulnerable to the effects of cold homes. Cold homes also have the potential to make existing health conditions worse (Donkin, 2024; Geddes, 2011). Consequently, the health effects of cold homes on these groups are more likely to be significant or life threatening (Geddes, 2011). Therefore, NICE have released guidance on 'Preventing excess winter deaths and illness associated with cold homes' (NICE, 2016). The guidance identifies the following groups as vulnerable to the effects of cold:

- people with cardiovascular conditions
- people with respiratory conditions (in particular, chronic obstructive pulmonary disease (COPD) and childhood asthma)
- people with mental health conditions
- people with disabilities
- older people (65 and older)
- young children (under 5)
- pregnant women
- people on a low income
- people who have attended hospital due to a fall.
- people who move in and out of homelessness
- people with addictions
- recent immigrants and asylum seeker

3. Evidence for improving the thermal efficiency of existing housing

The housing stock in the UK is the oldest and most thermally inefficient in Europe and around 80% of homes which will be occupied in 2050 are already in existence (Donkin, 2024; UKGBC, 2024). Improving the thermal efficiency of housing across the UK, will reduce the utilisation of fossil fuels, reduce the production of carbon emissions and improve the health and wellbeing of the population. Therefore, retrofitting existing housing stock to improve thermal efficiency is a national priority.

3.1 Health and wellbeing benefits of retrofitting properties to improve thermal efficiency:

The direct and indirect health benefits of increasing energy efficiency can be seen in the diagrammatic representation by Armstrong et. al (figure 3) (Armstrong B, 2018).

Retrofitting homes to be more energy efficient through additional insulation and improved heating systems to create warmer homes has been found to lead to improved health and social outcomes and reduced fuel poverty (Thomson H, 2013). For children, the available evidence demonstrates that improving heat in homes improves asthma symptoms and reduces days off school with asthma or recurrent respiratory illnesses (Somerville, 2000). For adults, retrofitting homes to improve thermal efficiency has been found to lead to an improvement in self-reported health,

a reduction in the incidence and severity of respiratory diseases, decreased blood pressure and improved circulatory health (Fyfe, 2022; Lloyd EL, 2008; Umishio, 2020). Thermal improvements have also been found to reduce hospital admissions, expedite hospital discharge, and reduce demand for health care (Kearns, 2023).

A reduction in fuel poverty due to increasing the thermal efficiency has been found to improve mental wellbeing, with individuals feeling happier, less anxious, and more relaxed (Sawyer, 2022; Grey CNB, 2017). In addition, the evidence suggests that warmth improvements in homes are associated with greater usable space, improved social relationships, and reduced absences from school and work (Thomson H, 2013).

Increasing the energy efficiency of housing often results in reduced ventilation due to the need to prevent heat loss. The impact on health is variable by setting, but reduced ventilation can have a positive and negative impact on the health of the inhabitants (Petrou G, 2022). It can prevent the ingress of pollutants from the external environment, but may increase damp and exposure to the pollutants generated inside the home, (e.g. Nitrogen dioxide from cooking, volatile organic compounds from cleaning products, radon, second hand smoke etc.) (Petrou G, 2022). Therefore, insulation must be installed with adequate ventilation to prevent damp and the build-up of harmful pollutants (Donkin, 2024). Research has also demonstrated that the health benefits and NHS savings of housing interventions are much greater if associated with adequate ventilation (Armstrong B, 2018).

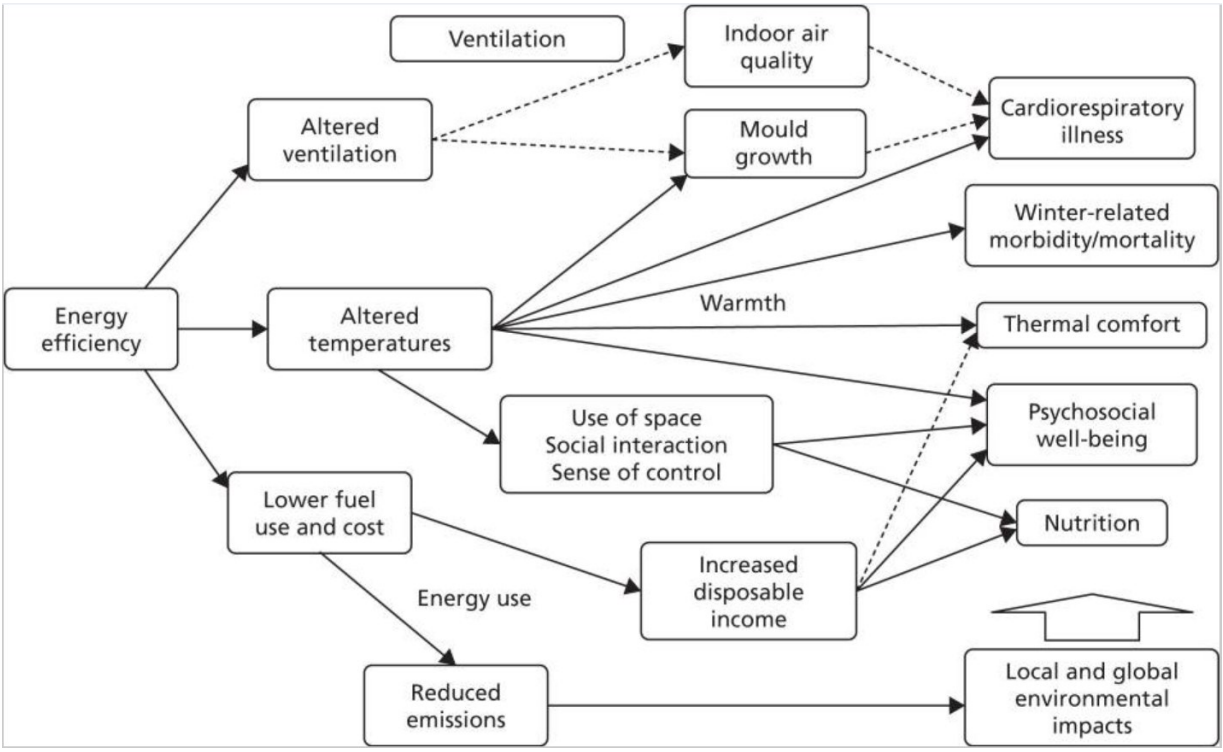


Figure 3: Diagrammatic representation of the main direct and indirect pathways by which energy efficiency measures affect health (Armstrong B, 2018)

Addressing the thermal inefficiency of housing and bringing housing up to a minimum standard is likely to have the greatest impact on vulnerable populations

and the poorest households, as these populations are likely to live in the worst housing and be most vulnerable to the impacts of cold and damp (Ranmal & Tinson, 2022). Increasing the warmth of the homes of the most deprived and vulnerable will consequently help improve the health of these households, reduce fuel poverty, tackle health inequalities, and prevent premature death in these populations (Geddes, 2011).

Excess heat can also impact health and during heatwaves within the UK there is an increase in demand for healthcare and deaths in vulnerable populations. This is because exposure to excess heat can result in an increase in both circulatory and respiratory diseases (Geddes, 2011; Armstrong B, 2018). Several studies have examined the impact of home insulation on the temperature of homes during heat waves. These studies have shown that dependent on the insulation measures installed, additional insulation of homes can either decrease or increase internal housing temperatures during heatwaves. Loft insulation, and external wall insulation have been found to decrease temperatures within the home whereas internal wall insulation and floor insulation in isolation have been found to lead to a slight temperature increase (Porritt, 2012; Mavrogianni, 2012). Climate change is resulting in an increase in the frequency and temperature of heatwaves within the UK and therefore, when retrofitting homes to reduce the impact of cold it is important to consider what effect these interventions will have on home temperatures during heatwaves and where possible utilise those interventions that protect against excess heat (Geddes, 2011). In addition, when undertaking retrofit of properties locally it is also worth considering installing measures that protect against excess heat in the home such as solar reflective paint on external walls and nocturnal ventilation measures (Mavrogianni, 2012; Solgi, 2018).

There has been attempts at quantifying the health benefits of retrofitting properties, and in 2013 the Department of Energy and Climate Change attempted to model the change in occupants' health from the installation of energy efficiency measures Table 1. The health benefits were measured in Quality Adjusted Life Years (QALYS) gained across the lifespan of the intervention, where a QALY of 1 means an additional year of life in full health was gained for the household that received the intervention. From the estimated QALYs gained the Net Present Value (NPV) of the intervention per household has been calculated to monetise the health impacts (Department of Energy & Climate Change, 2013). This data demonstrates significant health related gains from interventions to improve the thermal efficiency of housing. However, it is worth noting that the NPV modelling does not consider the savings to health and social care from the improved health and just places a value on the years of life gained, therefore the monetary gains are likely to be greater than demonstrated here. The return on investment to health and social care is further discussed in section 3.2.

Table 1: Estimated QALYs gained and NPV for households receiving thermal efficiency interventions (Department of Energy & Climate Change, 2013)

Intervention	QALYS gained per household with intervention installed	Value of health saving per measure installed (Net Present Value - £)
Cavity wall insulation	0.049	£969
Solid wall insulation	0.036	£742
Replacement boiler	0.009	£224
Central heating	0.012	£303

The energy efficiency of UK housing stock not only influences fuel poverty and cold homes, but it is a key contributor to the UKs CO_2 emissions. A third of domestic CO_2 emissions relate to domestic space heating and could be reduced through making housing stock more energy efficient (Geddes, 2011). In addition, the National Health Service (NHS) has a significant carbon footprint and reducing ill health and health care demands associated with cold homes will help contribute to a reduction in CO_2 admissions by the NHS (Sustainable Development Commission, 2010). Climate change is predicted to have a negative impact health and wellbeing, disproportionately affecting the most vulnerable, deprived and already disadvantaged by poor housing (Power, 2009). Therefore, protecting and improving health, reducing health inequalities, and mitigating climate change have a shared agenda in improving the energy efficiency of housing (Geddes, 2011).

3.2 Economic case:

Homes in the England and Wales have their energy efficiency rated using the A-G Energy Performance Certificate (EPC) rating scale. This rating will give an indication of the energy costs and carbon emissions of the building, with very efficient homes receive a rating of A and very inefficient homes receive a rating of G. The Climate Change Committee recommend insulating homes to a band C to reduce emissions, although less than half of homes in England currently have this energy efficiency rating (Donkin, 2024). The health benefits of insulating homes are found to plateau at an energy rating of D. However, increasing the energy efficiency of a home and achieving a rating of C may still positively impact health by reducing heating costs and consequently fuel poverty. Households living in EPC D rated homes are estimated to have energy bills that are £230 greater a year than those living in a home with an EPC C rating (Donkin, 2024; Smeeton, 2024). Households living in the most inefficient homes face significantly higher energy costs and from April 2024 electricity and gas bills for a home rated G were estimated to be £600 (40%) more than for a home with an EPC rating of C (Smeeton, 2024).

The economic benefits of promoting the best possible health of the population through improving the thermal efficiency of homes are significant A healthy population results in a thriving society and economy because:

- healthier children have better educational outcomes and greater productivity in adulthood,
- healthy working age populations have greater productivity and economic prosperity,
- better health in older age results in later retirement,
- improved health at all ages results in lower health and social care costs.

It has been estimated that every £1 invested in housing brings £2 of benefit through costs avoided to public services including care, health, and crime costs (The Health Foundation, 2018).

It is difficult to accurately quantify the cost of cold or damp housing to society as a whole, however, the largest cost burden to the NHS from owner occupied and privately rented homes is believed to be caused by cold homes due to people living in very energy inefficient homes (EPC rating F or G) (Garrett, Margoles, & Mackay, 2023). It has been estimated that across England, homes with a Category 1 cold or damp HHSRS hazard cost the NHS around 577 million annually (Garrett, Margoles, & Mackay, 2023). England data for 2019 on the average cost per property to remedy the cold and damp housing hazards and the estimated NHS savings from mitigating these hazards can be seen in table 2.

It is estimated to cost £6,835 to mitigate cold hazards and £6,209 to mitigate damp hazards per dwelling in private rental properties. Based on the estimated NHS savings alone, for private rental houses, there is a pay pack period of around 8 years for mitigating cold hazards and 12 years for mitigating damp hazards (Garrett, Margoles, & Mackay, 2023). These NHS estimates do not include the wider societal savings due to reduced use of social services, and economic gains from lower days of missed work and school. Building Research Establishment (BRE) estimate that the NHS costs only account for around 40% of the total costs to society of poor housing (BRE). Therefore, the overall societal savings of improving thermal efficiency and mitigating cold and damp hazards in England are likely to be much greater and the payback time for mitigating these hazards much shorter then estimated here. These calculations also only include homes with category 1 hazards and the health and social impacts of living in thermally inefficient homes with less severe cold and damp hazards are not included (Geddes, 2011; Donkin, 2024).

Table 2: Summary of costs and benefits in England, with Category 1 hazards ordered by NHS savings per annum if the hazard was mitigated, in homes, 2019 (Garrett, Margoles, & Mackay, 2023)

Housing type	Category 1 hazard	Number of Category 1 hazards	Average cost per dwelling to mitigate hazard (£)	Total cost to mitigate hazard (£)	Savings to the NHS per annum if hazard mitigated (£)	Payback (years)
Owner Occupied	Cold hazard	518, 168	6,690	3,466,741,060	382,936,715	9.05
	Damp and mould growth hazard	13, 243	2,365	31,323,796	6,899,558	4.54
Private Rental	Cold hazard	178, 541	6,835	1,220,371,478	148,952,992	8.19
	Damp and mould growth hazard	32, 701	6,209	203,035,223	17,037,110	11.92
Social housing	Cold hazard	22, 615	3,800	85,936 ,615	11,673,099	7.36
	Damp and mould growth hazard	18, 764	985	18,481,721	9,775,980	1.89

4. Local evidence for retrofitting properties

4.1 Excess winter deaths

Death is a tragic consequence of living in a cold home, and it has been estimated that some 10% of excess winter deaths are directly attributable to fuel poverty (Geddes, 2011). Table 3 demonstrates the excess winter deaths across EMCCA from 2015. This data shows that since 2015 (excluding 2019/2020 when COVID-19 was circulating) in winter each year, between 950 and 2,270 additional deaths occur. Therefore, across EMCCA, between 2015 and 2021(excluding 2019/2020) there has been an average of 1,552 excess winter deaths each year. If 10% of these are attributable to fuel poverty, then around 155 of these excess deaths each winter could have been caused by fuel poverty. Working to increase the thermal efficiency of housing could consequently help reduce fuel poverty and the excess mortality associated with this (UCL Insitute of Health Equity, 2014; Geddes, 2011).

Table 3: Additional deaths in winter compared to summer across EMCCA (ONS, 2024)

Winter deaths compared to non-winter deaths*						
	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021
Derby	80	130	210	130	20	290
Nottingham	150	140	220	130	30	270
Derbyshire	360	580	780	290	290	830
Nottinghamshire	450	610	830	400	90	880
EMCCA	**1,040**	**1,460**	**2,040**	**950**	**430**	**2,270**

*The ONS standard method defines the winter period as December to March and compares the number of deaths that occurred in this winter period with the average number of deaths occurring in the preceding August to November and the following April to July.

4.2 Excessive cold:

As discussed in section 3.1 there is evidence that households living in properties with an EPC rating of D and below may suffer worse health and social wellbeing due to the direct impact of cold and damp on health and wellbeing and the indirect impact of fuel poverty (Donkin, 2024). Data on EPC certificates issued between Jan 2008 and Dec 2024 can be seen in table 4. EPC certificates are only issued when properties are constructed, let, bought, or sold, therefore this data is not completely representative of all EMCCA housing stock (Department for Levelling Up, Housing & Communities, 2024). However, this data suggests that there are around 590,000 properties across EMCCA that are not sufficiently thermally efficient and are likely to be impacting the health and welling of the local population.

Table 4: EPC issued for properties across EMCCA between Jan 2008 and Dec 2024 (Department for Levelling Up, Housing & Communities, 2024)

EPC rating	Number of properties across EMCCA
A to C	386,575
D to G	592,087

EPC data shows that since January 2008 51,114 F or G certificates have been issued for homes across EMCCA, and therefore there are potentially around 51,000 homes with a category 1 cold hazard. An estimate of the number of houses within EMCCA with a category 1 cold hazard and the associated annual NHS costs can be seen in table 5. From this data, a calculation has been made of the costs of mitigation of cold hazards and the payback time to this investment. This data suggests:

- If category 1 cold hazards are mitigated across EMCCA then the savings to the NHS are excess of 32 million pounds per year (£32,712,960).
- BRE estimate that the average cost to mitigate a category 1 cold hazard in a private rental dwelling is £6,835, therefore, the total cost to mitigate category 1 cold hazards across EMCCA is just under 350million (£349,364,190).
- In NHS savings alone, the payback for this investment would be 10.7 years, if wider societal savings are considered, the payback time would be much shorter.

Table 5: EMCCA data on domestic properties with an EPC rating of F or G (and therefore a category 1 cold hazard) and the associated annual costs to the NHS (Department for Levelling Up, Housing & Communities, 2024; Greater Manchester Combine Authority , 2022)

	Number of properties with EPC rating F or G across EMCCA*	Annual fiscal benefit to NHS if category 1 hazards resolved
Derby City	5,461	£3,495,040
Amber Valley	3,270	£2,092,800
Erewash	2,884	£1,845,760
Bolsover	1,768	£1,131,520
Chesterfield	1,382	£884,480
Northeast Derbyshire	1,804	£1,154,560
High Peak	1,801	£1,152,640
Derbyshire Dales	3,469	£2,220,160
South Derbyshire	2,023	£1,294,720
Nottingham city	8,240	£5,273,600
Mansfield	1,898	£1,214,720
Bassetlaw	3,742	£2,394,880
Newark and Sherwood	2,942	£1,882,880
Ashfield	2,671	£1,709,440
Broxtowe	2,405	£1,539,200
Gedling	2,679	£1,714,560
Rushcliffe	2,675	£1,712,000
EMCCA	**51,114**	**£32,712,960**

***Roughly equivalent to a HHSRS category 1 cold hazard** (Garrett, Margoles, & Mackay, 2023)

There are significant limitations and assumptions associated with this calculation and therefore it needs to be interpreted with caution. However, it indicates that there are substantial savings to be made to the NHS locally if home improvements are undertaken to reduce excessively cold housing across EMCCA and if this investment is made, the payback time is short. The projected financial NHS benefits are likely an under-estimate of the impact of improving the thermal efficiency of housing across EMCCA because not all domestic properties have an EPC rating, and this data only considers cold housing and does not account for the impact of category 1 hazards of damp and mould on health and the subsequent costs to the NHS. It also does not account for the wider societal benefits which are likely to be great. The methodology for these calculations and the limitations can be seen in appendix 2.

4.3 Damp and Mould

Damp and mould are likely to be also having significant impacts on health and wellbeing across EMCCA, and in 2023 a coroner reported that mould in a property in Mansfield could have contributed to the death of 52-year-old Jane Bennett (Sharma, 2023). Currently, data estimating the number of houses with damp and mould across EMCCA is not available and so the potential mitigation costs and NHS savings cannot be calculated.

Derbyshire County Council are the first local authority across EMCCA to have modelled a housing stock database which estimates the number of properties within the area with various HHSRS category 1 hazards (Derbyshire County Council & Derby City Council, 2023). This data has been used in the Housing and Health impact assessment where they have estimated that:

- 2,402 private homes in Derbyshire have a category 1 hazard of damp and mould,
- It would cost £17,728,139 to repair all damp and mould category 1 hazards in Derbyshire,
- £1,353,828 would be saved by the NHS annually if all the damp and mould hazards were mitigated resulting in a payback time on the investment of 13.1 years.

5. Local energy efficiency programmes:

Over recent years there have been multiple grants and funding schemes administered locally for energy efficiency home improvements, including the 3 phases of the Local Authority Delivery scheme (LAD) funding, the Home Upgrade Grant (HUG), the Energy Company Obligation (ECO) schemes, The Sustainable Warmth Fund (SWF) and Social Housing Decarbonisation Fund (SHDF). Other sources of funding that local authorities utilise for energy efficiency home improvements include the Disabilities Funding Grant and Warm Homes on Prescription. These funds have been, and some continue to be, utilised to improve the warmth and energy efficiency for households across EMCCA. However, due to the limited level of funding and the inclusion criteria there are significant delivery gaps and there remains a substantial need for more work to improve the energy efficiency of housing stock across the area.

The impact of these energy efficiency schemes on the health of the EMCCA population is uncertain as there has been minimal quantitative or qualitative data collection to evaluate the health impacts of energy efficiency initiatives locally. In section 5.1 and 5.2 the case studies and EPC data provide some insight into the health and wellbeing impacts that increasing the warmth of homes locally has had.

5.1 Local case studies:
Two case studies are included below which demonstrate the positive impact that retrofitting homes to improve warmth has had on the health and wellbeing of residents locally. A short description of two case studies can be seen below, and the full case studies can be seen in appendix 3.

Case study 1: Mrs P
Improvements installed:

- Air source heat pump,
- Plate in chimney (reduce heat loss up chimney).
- Mrs P had previously installed loft and cavity wall insulation.

Reported benefits:
'*Mrs P said she feels the installation will make a massive difference to her lifestyle and independence. Previously, she would go to bed early in the wintertime because the house was so cold. Now she will be able to enjoy her home to the full – in comfort. Mrs P says she feels more secure and better equipped to cope alone in the future. She can now heat her home without physically struggling with the coal system or, alternatively, worrying about the high running costs of the oil-filled radiators and immersion heater.'*

Case study 2: Mrs G
Improvements installed:

- New Warmflow Kabinpak Combi 120 ECO boiler installed to replace old boiler that was less than 70% efficient and needed to be turned on for several hours at a time for Mrs G to get hot water.

Reported benefits:
'Mrs G said she is overwhelmed by the help she has received and the positive impact it has had on both her mental and physical wellbeing. She openly states that she would never have been able to afford a new boiler; her only option would have been either getting into debt with a loan or living in a cold house. Mrs G says she is already sleeping better now this worry is off her shoulders.
Mrs G has been advised that the new boiler should significantly reduce her heating costs (to almost half, based on her current heating regime) easing the financial burden on her limited income.
Living in a warm environment is vital to Mrs G's wellbeing as her mobility is so limited, getting cold easily has been a real issue for her. She also has hot water on tap now which is fantastic for her.
In a nutshell, this work has provided Mrs G with the platform to stay in her own home for the foreseeable future, a big comfort for her.'

5.2 EPC improvements from insulation and heating measures

Table 6 displays EPC data (provided by Yes Energy Solutions), demonstrating the EPC rating of 138 properties across EMCCA before and after installation of heating and insulation improvements. Prior to the installation of energy efficiency measures all 138 properties had an EPC rating of D or below and therefore this housing is likely to be having an impact on the health and wellbeing of the residents and may be contributing to fuel poverty. This data demonstrates that following the installation of the energy efficiency measures 129 (93.5%) of the properties had an improved EPC rating and 105 (76%) of the properties achieved an EPC rating of C or greater. This suggests that these interventions are likely to have had a positive impact on the health and the wellbeing of the local population through creating warmer homes and reducing fuel poverty.

Table 6: EPC improvements following installation of insulation and heating measures under the LAD3 and HUG schemes in Derby City and Nottingham City (2022-2023) (Yes Energy Solutions)

EPC rating	Number (%) of properties with each EPC rating prior to retrofit n=138	Number (%) of properties with each EPC rating following retrofit n=138
A	0 (0%)	0 (0%)
B	0 (0%)	1 (1%)
C	0 (0%)	104 (75%)
D	82 (59%)	26 (19%)
E	44 (32%)	6 (4%)
F	11 (8%)	0 (0%)
G	1 (1%)	1 (1%)

6. Conclusions:

- Cold and damp homes have significant impact on mental and physical health across the life course resulting in premature death, reduced quality of life, reduced educational attainment and school attendance and increased poverty. These all result in significant NHS and societal costs.

- Deprived and vulnerable populations are more likely to live in cold and damp homes and be more susceptible to the effects of cold and damp. This leads to a widening of health inequalities and a vicious cycle of poverty and poor health.

- Retrofitting homes to improve thermal efficiency while ensuring adequate ventilation has benefits to all aspects of the triple bottom line (societal, economic, and environmental).
    - Societal benefits: increased thermal efficiency been shown to improve health, social wellbeing, reduce school and work absences and reduce health inequalities.
    - Economic benefits: improvements in health and wellbeing result in increased productivity of the population and significant financial savings due to and reduced health and social care utilisation.

- Environmental benefits: increasing thermal efficiency of homes reduces energy wastage and use of fossil fuels resulting in a reduction in carbon emissions. Investment in retrofitting housing would bring EMCCA closer to its Net Zero targets.

- Across the EMCCA it is estimated that on average 155 excess winter deaths a year are attributable to cold homes. Some of these deaths may be prevented by increasing the thermal efficiency of homes.

- The exact number of thermally inefficient homes leading to cold and damp hazards across EMCCA is currently unknown.

    - It is estimated that there are around 5114 homes across the EMCCA with a category 1 cold hazard.

        - If these category 1 cold hazards are mitigated across the EMCCA then the savings to the NHS are excess of 32 million pounds per year.
        - The total cost to mitigate these category 1 cold hazards across EMCA is estimated to be just under 350million.
        - In NHS savings alone, the payback for this investment would be 10.7 years, if wider societal savings are considered, the payback time would be much shorter.

    - The number of homes with a category 1 damp hazard across EMCCA is unknown. Derbyshire County Council have undertaken a piece of work creating a housing stock database and a Housing and Health Impact Assessment. It is estimated there are around 2,402 homes in Derbyshire with a category 1 mould and damp hazard and it would cost around £17.7 million to repair all damp and mould category 1 hazards in Derbyshire. If all the damp and mould category 1 hazards were mitigated, then £1.4 million would be saved by the NHS annually resulting in a payback time on the investment of 13.1 years.

- There is limited data available on the impact of local home improvement initiatives on the health and wellbeing of the EMCCA populations.

7. <u>Recommendations</u>

1. Investment in improving the thermal efficiency of housing across EMCCA should be a priority as this will lead to reduced carbon emissions, improved health and wellbeing and significant financial savings for health and social care services.

2. Develop a clear understanding of the housing stock conditions across EMCCA, to enable identification of privately rented, owned and social housing that have significant cold and damp hazards that will be impacting the health and wellbeing of residents. Derbyshire County and Derby City already have developed a housing stock database and work is being undertaken to develop

one for Nottinghamshire. It is important that these valuable information sources are renewed and kept up to date to help guide future investment in housing.

3. Local schemes for retrofitting properties should take account of and work towards reducing health inequalities. This means when considering how to target thermal efficiency interventions it is important to consider and prioritise deprived and vulnerable populations in addition to selecting the most thermally inefficient buildings.

4. Installation of ventilation increases the health benefits of greater thermal efficiency and therefore adequate and appropriate ventilation should be installed when insulating properties to improve thermal efficiency.

5. Schemes to retrofit properties to increase thermal efficiency should also consider the how they can also ensure that homes remain cool during periods of excess heat. This will involve reviewing the available evidence on insulation types that help keep homes cool in hot weather, as well as specific interventions for heat e.g., overnight ventilation and solar reflective services on external building surfaces.

6. Data collection on health and wellbeing improvements from current home improvement schemes should be collected and shared to increase the local evidence base on the impact of improving the thermal efficiency of homes on health and wellbeing.

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Appendix 1

Cold and damp homes impact health across the life course

Age group	Respiratory	Cardiovascular	Mental health	Other
Early years	Increased lower respiratory tract infections and bronchiolitis (Ingham, 2019)			Babies and young children living in cold homes require more calories for growth and development. However, families living in fuel poverty may not be able to meet these needs which will result in reduced weight gain and impact child development (NICE, 2016; Lee, 2022). Children in cold homes are known to have increased hospital admissions (Ingham, 2019).
Children and adolescents	Increased prevalence of asthma and acute asthma attacks, with 10-15% of asthma cases across Europe believed to be due to cold and damp housing (Gehrt D, 2021). Rates of respiratory illness are twice as high in children who have lived in cold, damp homes in the last three years (Liddell, 2010).		Parental depression is a recognised Adverse Childhood Experience, and it has been identified that there is an increased prevalence of depression in parents living in energy poor households (Mohan, 2022). Worse mental health and wellbeing, with over a quarter of young people living in cold homes having four or more negative mental health symptoms (compared to 4% of those living in warm homes) (Barne, 2008)	Children living in cold damp homes are known to have an increased time off school, causing around 1.7 million school days to be missed a year across Europe (Gehrt D, 2021). It is harder for children to undertake and complete their homework in cold homes, where households crowd into one or two warm rooms (Gehrt D, 2021).

Adults	Cold and damp housing reduces resistance to respiratory infections (Geddes, 2011). Cold temperatures increase broncho-constriction and mucus production, triggering exacerbation of existing lung disease (COPD and asthma) (Lee, 2022).	Colder temperatures have been found to be associated with increased blood pressure, more viscous blood, and higher cholesterol. All of which increase the incidence of heart attacks and strokes (Geddes, 2011; Lee, 2022).	Living in cold homes has been found to double the odds of experiencing mental distress in adults with no pre-existing mental disorder and triple the odds of mental distress in those with previous mental distress (Clair, 2022). This is believed to be due to the direct impact of the cold in combination with the financial stress of fuel poverty (Donkin, 2024).	High fuel costs and energy inefficient homes contribute to increased poverty, this results in food insecurity, malnutrition and obesity, stress and poor sleep (Donkin, 2024). Cold homes are associated with ill health and can make existing health conditions worse. This means that cold homes are likely to lead to individuals having time off work or being unable to work (Donkin, 2024). Cold homes have been identified as being associated with social isolation and loneliness. This is because those unable to heat their homes will avoid inviting friends over and going to bed to keep warm (Cotter, 2012).
Elderly	The cardiovascular and respiratory effects described above have a greater impact on older adults because they are more likely to have pre-existing health conditions, spend longer in their homes and their temperature control is weaker. This means that older adults are at higher risk of mortality or developing life threatening conditions (Geddes, 2011).			Cold homes have been identified to reduce grip and muscle strength. Studies have identified reduced lower extremity performance in cold homes which can lead to balance problems and increased falls (García-Esquinas E, 2016; Donkin, 2024).

Appendix 2:

Methodology of calculation:

1. Number of domestic properties with an EPC rating issued between Jan 2008 and Dec 2024 of F or G for each local authority obtained from here: Energy Performance of Buildings Search Results (opendatacommunities.org)
2. ASSUMPTION: all properties with an EPC rating of F or G have a category 1 cold hazard. Properties with an EPC rating E or greater, do not have a category 1 cold hazard.
3. Calculated the fiscal benefits to the NHS of the properties with a category 1 cold hazard using the GMCA low carbon and energy projects roadmap health and wellbeing interactive tool: low-carbon-and-energy-projects-benefits-roadmap-v14-final.xlsx (live.com). This tool estimates the fiscal benefit to the NHS of changes in housing hazards. The unit costs have been derived by Ministry of Housing Communities & Local Government base on research conducted by BRE into the health burden of housing hazards. They reflect the annual saving to the NHS of moving from recognised category 1 HHSRS hazards to an acceptable level and can be used where residential energy projects - such as domestic retrofit - are deemed to have impacts on the level of safety in homes.

Limitations and assumptions:

- EPC rating data is not truly representative of building stock because EPC certificates only required when properties are bought, sold, let, or constructed and therefore not all domestic properties have an EPC rating, and some will have multiple certificates.
- It has been assumed that all properties with an EPC rating of F or G have a category 1 excess cold hazard, and properties with an EPC rating of E or above do not, which may not be the case.
- Cold housing that does not meet the definition of a category 1 cold hazard is likely to also impact on health and wellbeing, however, such housing is not included in this calculation.
- This calculation provides insight into the annual NHS savings if the cold hazards were resolved, it does not account for the wider societal benefits due to increased productivity and reduced demands on social care.
- The cost to retrofit and mitigate the cold hazards is based upon BRE 2019 estimates calculated from modelled English Housing Survey data. There may therefore be some inaccuracy in these estimates and due to inflation these costs may now be higher.

Appendix 3

Case Study 1:

Mrs P is 56 years old and lives alone in her own 3 bed semi-detached ex council house (her childhood home that she previously shared with her mother) in a non-gas village near Southwell.	
How was the client referred for assistance?	Newark & Sherwood District Council's Environmental Health Officer referred this resident to the project following the installation of a wet room via a Disabled Facilities Grant.
Detail of assistance given	

Due to Mrs P's Osteo/inflammatory arthritis and ME she feels the cold but could no longer physically get down to light the open fire which fed the 50-year-old back boiler supplying just 4 radiators downstairs and the domestic hot water.

As a result, her only form of heating at the time of the home assessment visit was an electric oil filled radiator in the dining room. Mrs P was using an immersion heater on normal day rate electricity for hot water. These arrangements were proving expensive and inadequate.

Mrs P is on Employment & Support Allowance, Personal Independence Allowance (mobility criteria) and has a gross monthly household income (after mortgage payment) of just £386.88. She has £5K personal savings.

There is no mains gas supply to the village so installing gas central heating was not an option.

We considered:

- Electric storage heaters and existing emersion for hot water - expensive to install and run.
- Oil central heating and hot water - expensive installation because there is currently no oil storage tank and space in the garden is very limited. Although oil prices are reasonable now, they fluctuate widely and are expected to rise again to previously high price levels. This resident would also struggle to pay up-front to fill the oil tank.
- LPG central heating and hot water- too expensive in terms of running costs and the siting of a large, pressurised gas tank would be difficult.
- Air source heat pump for central heating and hot water- much lower running costs than coal, electric, LPG; easy to use and a lower carbon option.

Equipment installed: A Mitsubishi 8.5KW air source heat pump (externally wall mounted), unvented pressurised hot water cylinder, radiators, TRVs and associated controls plus first year annual service at a total cost of
£8,514.20 (£4K from NEA's Warm & Healthy Homes Fund and £4,514.20 from Newark & Sherwood District Council's Keeping Well and Warm Fund).

We also referred Mrs P Severn Trent for a water meter.

What has been the impact of this assistance on the householder(s)? (e.g., improved health, reduced bills, wider improvements to their lives, movement in SAP etc.)

Mrs P said she feels the installation will make a massive difference to her lifestyle and independence. Previously, she would go to bed early in the wintertime because the house was so cold. Now she will be able to enjoy her home to the full – in comfort. Mrs P says she feels more secure and better equipped to cope alone in the future. She can now heat her home without physically struggling with the coal system or, alternatively, worrying about the high running costs of the oil-filled radiators and immersion heater.

Lessons:
Apart from the higher installation costs associated with an air source heat pump, they require a well-insulated home (Mrs P's loft and cavity walls had previously been insulated and the property is fully double glazed and draught-proofed).

To reduce the heat lost up the chimney, the contractor (T&S Heating Ltd) fitted a plate in the throat of the chimney and installed breathable cowls on the chimney pot to prevent condensation build-up in the chimney. The open fire grate and fire surround were retained for decorative purposes only, as requested by the resident.

Mrs P was an ideal candidate for this type of technology as she was open and receptive to change and understood the need to basically 'set and forget' the system rather than switching it on/off. She also appreciates the vital importance of annual servicing – especially of the unvented cylinder. Annual servicing costs of £250 are considerably more than a gas boiler but are more than compensated for by low running costs. (Regrettably, it is currently not possible to claim the Renewable Heat Incentive due to the public funding that has gone into this project, however, this may change in the future.)

Case study 2:

Mrs G, a 69-year-old widow, lives alone in the 3-bedroom, 18th Century detached cottage that has been her home since she married 38 years ago. The rural setting means there is no access to mains gas, and Mrs G's old, inefficient oil-fired boiler no longer heated the water effectively – the heating had to be on for hours to get any hot water which was both uncomfortable and expensive in the summer months.	
How was the resident referred for assistance?	Newark & Sherwood District Council's Environmental Health Officer referred Mrs G to the Warm Homes on Prescription project following a Disabled Facilities Grant application for a walk-in shower.
Background and assistance given	

Mrs G is disabled (she has a crippled knee on which she has had 10 operations) and now walks with the aid of crutches. She also suffers with Rheumatoid Arthritis and Osteoporosis. Her limited mobility contributes to her feeling cold, particularly in the winter months.

The existing oil-fired boiler (circa 28 years old) no longer heated the water effectively. The back-up electric immersion heater (installed many years ago) no longer worked so Mrs G found it necessary to switch the boiler on for several hours to generate any hot water and then the radiators would get hot too, wasting fuel/money and proving unaffordable for this fuel poor pensioner. The boiler was uneconomic to repair as it was an old, obsolete model and identified as less than 70% energy efficient.

Mrs G lives on a low income (less than £900 per month) and is in receipt of various means-tested state benefits.
She had no savings or investments to call upon to replace the old boiler. Her home heating costs were averaging £92 per month over the year; bills that could be significantly reduce through the installation of a modern, efficient oil-fired boiler. (Gas central heating was not an option as there is no gas supply to the village.)

Quotations were sourced to replace the heating system but all three proved too expensive (they all exceeded the maximum grant available under the Warm Homes On Prescription scheme due to the size and complexity of the installation). It was therefore necessary for Newark & Sherwood District Council to seek Energy Company Obligation (ECO) funding for the work to proceed.

Newark & Sherwood District Council partnered with Effective Energy Solutions Limited, a local business established in 2008 and one of the UK's leading energy consultancies with full access to ECO funding.

Effective Heating, Effective Energy's own heating company, surveyed Mrs G's home and installed a Warmflow Kabinpak Combi 120 ECO boiler outside. (The old boiler was located inside the property and re-siting the new boiler externally solved the problems Mrs G was experiencing with the oil storage tank, tidied the pipework up significantly and made more usable space inside the property.) The installation took just over two days to complete, and Mrs G is delighted with the results, commenting: "The new boiler supplies hot water on demand which is just what I need".

As Mrs G qualified for ECO funding this meant all works were free of charge for Mrs G and the Council.

Mrs G was also referred to Nottinghamshire Fire & Rescue Service for a Home Safety Check as she had no smoke alarms in the property, and to Citizens Advice who will help her compare energy deals and ensure she is maximising her income by claiming the benefits she is entitled to receive.

What has been the impact of this assistance on the householder?

Mrs G said she is overwhelmed by the help she has received and the positive impact it has had on both her mental and physical wellbeing. She openly states that she would never have been able to afford a new boiler; her only option would have been either getting into debt with a loan or living in a cold house. Mrs G says already she is sleeping better now this worry is off her shoulders.

Mrs G has been advised that the new boiler should significantly reduce her heating costs (to almost half, based on her current heating regime) easing the financial burden on her limited income.

Living in a warm environment is vital to Mrs G's wellbeing as her mobility is so limited, getting cold easily has been a real issue for her. She also has hot water on tap now which is fantastic for her.
In a nutshell, this work has provided Mrs G with the platform to stay in her own home for the foreseeable future, a big comfort for her.