GREENPEACE

The economic impact of decarbonising household heating in the UK in an era of high fossil fuel prices

cambridge econometrics
clarity from complexity

Final Report

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Introduction & the rationale for this report

Emissions from residential buildings, primarily from the use of fossil fuel for heating, are a major source of the UK's CO_2 emissions. As a result, and as part of its 10 Point Plan to build back better and support the UK's transition to Net Zero, the UK Government have set an ambition to deploy electric heating in residential buildings, by delivering 600,000 heat pumps installations per year by 2028. However, the Climate Change Committee's 2021 Progress Report to Parliament states that this target is insufficient and should be upscaled to 900,000 installations per year by 2028, if the CCC's Balanced Net Zero Pathway scenario, i.e. a scenario which successfully delivers the recommendations for the Sixth Carbon Budget, is to be achieved (Climate Change Committee, 2021). This is alongside £55bn of investment in energy efficiency measures to 2050, which is broadly in-line with the Government's ambition to spend £35-65bn upgrading as many homes as possible to EPC C standard by 2035. In the CCC's Balanced Net Zero Pathway, this £55bn equates to 15 million households receiving one of the main insulation measures (i.e. loft/wall/floor) and a further 8 million benefiting from draught-proofing. Combined, energy efficiency and behavioural measures within the Balanced Net Zero Pathway lead to a 12% reduction in heat demand by 2050.

An ambitious deployment of low-carbon heating technologies, together with the implementation of energy efficiency measures in residential buildings, has the potential to improve the efficiency, and reduce the environmental impact, of the UK's housing stock, while at the same time creating jobs and economic activity and addressing issues of inequality and social inclusion.

The energy price crisis and the case for decarbonising heating

In the latter part of 2021, gas prices began to rise steeply due to a perfect storm of events including ongoing supply issues following the global rebound in demand following Covid lockdowns, the UK's low levels of natural gas storage capacity and problems with interconnectors. Russia's invasion of Ukraine in early 2022 and subsequent sanctions and geopolitical tensions have led to reduced gas supply in Europe, compounding the existing issues the UK faced in 2021, and further increasing prices.

It is expected that energy bills will continue to climb throughout 2022 in line with increases to the UK's energy price cap, which was revised upwards in April 2022[1]. At the time of writing, the Government's latest response has been to announce the Energy Price Guarantee[2], which limits the price suppliers can charge customers for units of gas for two years. UK households will now pay up to an average of £2,500 a year, which is substantially less than the £3,549 energy price cap which was previously expected to come into force in October 2022 but is nonetheless about double the energy price cap in force over the 2021/22 winter.

Increases in household energy costs are a key driver to the rising cost of living in the UK, affecting all households, but particularly vulnerable households who are already experiencing, or are at risk of falling into, fuel poverty. The

[1] https://www.ofgem.gov.uk/publications/price-cap-increase-ps693-april

[2] Government announces Energy Price Guarantee for families and businesses while urgently taking action to reform broken energy market - GOV.UK (www.gov.uk)

evidence is clear that fuel poverty is becoming more widespread across the UK as energy bills become increasingly unaffordable for many; the national fuel poverty charity National Energy Action (NEA) estimates that the April 2022 increase in the energy price cap plunged a further 2 million households into fuel poverty, taking the total number in the UK to 6.5 million, representing a quarter of all UK households, and a 50% increase in just over six months (National Energy Action, 2022). With further rises in the price cap expected, the numbers facing fuel poverty are set to rise with research from the University of York suggesting that 50% of all UK households will be facing fuel poverty by January 2023[3] and over 80% of large families, lone parents and pensioner couples will be in fuel poverty at that time.

The cost-of-living crisis has brought about fresh questions about how best to support households with rising costs, while still achieving other Government priorities including decarbonisation and levelling up. The current energy price crisis the UK is facing is a stark reminder that we should be reducing our dependency on gas and exposure to volatile gas prices by upping the pace of electrification of heat and the decarbonisation of our energy system, while simultaneously reducing our demand for energy overall, through energy efficiency measures. Decarbonising heating provides dual benefits of both lowering energy bills for households, therefore helping to address the cost-of-living crisis, while also contributing to the achievement of net zero goals.

Rationale for this report

This report provides a robust analysis of the potential macroeconomic impacts of deploying energy efficiency measures and low-carbon heating technologies in the UK's residential buildings. The report builds on work previously carried out by Cambridge Econometrics in 2021, before gas prices began to climb upwards. In this new piece of analysis, updated gas, electricity and heating oil prices have been incorporated into the economic modelling, along with new future trajectories to 2030, to reflect an updated outlook on prices. Incorporating these adjusted energy prices in the analysis allows us to provide a more accurate picture of the potential macroeconomic benefits of decarbonising heating.

What scenarios were modelled?

In this analysis a scenario reflecting the CCC's Balanced Net Zero Pathway ambition for heating technologies and energy efficiency was modelled. In this scenario average heat pump installation costs are assumed to start at £9,490 in 2022 and decrease over time in line with the CCC's assumptions. The same scenario was modelled in Cambridge Econometrics' 2021 analysis. For the current analysis, the scenario has been updated to include up-to-date assumptions reflecting measures announced by the Government in 2022 to help with the rising cost of energy, namely an increased Government grant for heat pump installations and a cut in VAT for energy efficiency materials.

Impacts of the scenario are compared to a 'no action' counterfactual, drawn from the CCC's Sixth Carbon Budget baseline.

Key macroeconomic impacts

The table below shows the economic impacts of shifting to low-carbon heating and implementing energy efficiency measures. The economic impacts shown in the following table include direct, indirect, and induced employment effects.

[3] Fuel poverty: updated estimates for the UK | CPAG

Table 1.1 Headline macroeconomic impacts

	2025	2030
GDP (£bn)	3.6	6.8
GDP (% change)	0.16	0.30
Employment (number of FTEs)	58,765	138,375

The headline messages from these results are:

- The adoption of low-carbon heating technologies, energy efficiency measures and the shift towards low-carbon fuels can lead to positive impacts on the economy.
- The estimated impacts are greater when assuming higher energy prices persist into the future; shifting to low-carbon fuels and low-carbon heating technologies reduces the adverse effect of soaring fossil fuel prices through reducing demand.
- Shifting away from high-carbon heating and fossil fuels has a positive impact on economy-wide employment.
- Furthermore, the impact on total employment is greater when modelling high energy prices and greater Government support for energy efficiency measures and low-carbon heating technologies.

There are further socioeconomic benefits too…

The benefits of decarbonising heating in, and improving the energy efficiency of, residential buildings are not just limited to environmental and economic effects. Decarbonised heating can also cultivate positive social effects, alongside reductions in emissions, gains in employment and the creation of economic output. Further benefits identified in this report include:

- Reduced vulnerability to fuel poverty
- Improved health and wellbeing
- Greater educational attainment and employment opportunities
- Financial benefits of occupiers and property-owners
- Improved local air quality

Key takeaways for policymakers

The findings of this analysis demonstrate:

- The shift away from high-carbon heating technologies can have a positive impact on the UK economy, in terms of GDP and employment.
- The economic impacts of shifting towards low-carbon heating and energy efficiency measures are even higher when accounting for the current high (and increasing) energy prices and greater government support for energy saving measures…
- …this means that by 2030 the costs of installing and running low-carbon heating technologies and energy efficiency measures is more than

compensated by large savings made from switching away from gas for heating.

1 Introduction

1.1 Policy context and rationale for this report

Introduction & the rationale for this report

Emissions from residential buildings, primarily from the use of fossil fuel for heating, are a major source of the UK's CO_2 emissions. As a result, and as part of its 10 Point Plan to build back better and support the UK's transition to Net Zero, the UK Government have set an ambition to deploy electric heating in residential buildings, by delivering 600,000 heat pumps installations per year by 2028. However, the Climate Change Committee's 2021 Progress Report to Parliament states that this target is insufficient and should be upscaled to 900,000 installations per year by 2028, if the CCC's Balanced Net Zero Pathway scenario, i.e. a scenario which successfully delivers its recommendations for the Sixth Carbon Budget, is to be achieved (Climate Change Committee, 2021). This is alongside £55bn of investment in energy efficiency measures to 2050, which is broadly in-line with the Government's ambition to spend £35-65bn upgrading as many homes as possible to EPC C standard by 2035. In the CCC's Balanced Net Zero Pathway, this £55bn equates to 15 million households receiving one of the main insulation measures (i.e. loft/wall/floor) and a further 8 million benefiting from draught-proofing. Combined, energy efficiency and behavioural measures within the Balanced Net Zero Pathway lead to a 12% reduction in heat demand by 2050

An ambitious deployment of low-carbon heating technologies, together with the implementation of energy efficiency measures in residential buildings, has the potential to improve the efficiency, and reduce the environmental impact, of the UK's housing stock, while at the same time creating jobs and economic activity and addressing issues of inequality and social inclusion.

The energy price crisis and the case for decarbonising heating

In the latter part of 2021, gas prices began to rise steeply due to a perfect storm of events including ongoing supply issues following the global rebound in demand following Covid lockdowns, the UK's low levels of natural gas storage capacity and problems with interconnectors. Russia's invasion of Ukraine in early 2022 and subsequent sanctions and geopolitical tensions have led to reduced gas supply to Europe, compounding the existing issues the UK faced in 2021, and further increasing prices.

It is expected that energy bills will continue to climb throughout 2022 in line with increases to the UK's energy price cap, which was revised upwards in April 2022[4]. At the time of writing, the Government's latest response has been to announce the Energy Price Guarantee[5], which limits the price suppliers can charge customers for units of gas for two years. UK households will now pay up to an average of £2,500 a year, which is substantially less than the £3,549 energy price cap which was previously expected to come into force in October 2022 but is nonetheless about double the energy price cap in force over the 2021/22 winter.

Increases in household energy costs are a key driver to the rising cost of living in the UK, affecting all households, but particularly vulnerable households who

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are already experiencing, or are at risk of falling into, fuel poverty. The evidence is clear that fuel poverty is becoming more widespread across the UK as energy bills become increasingly unaffordable for many; the national fuel poverty charity National Energy Action (NEA) estimates that the April 2022 increase in the energy price cap plunged a further 2 million households into fuel poverty, taking the total number in the UK to 6.5 million, representing a quarter of all UK households, and a 50% increase in just over six months (National Energy Action, 2022). With further rises in the price cap expected, the numbers facing fuel poverty are set to rise with research from the University of York suggesting that 50% of all UK households will be facing fuel poverty by January 2023[6] and over 80% of large families, lone parents and pensioner couples will be in fuel poverty at that time.

The cost-of-living crisis has brought about fresh questions about how best to support households with rising costs, while still achieving other Government priorities including decarbonisation and levelling up. The current energy price crisis the UK is facing is a stark reminder that we should be reducing our dependency on gas and exposure to volatile gas prices by upping the pace of electrification of heat and the decarbonisation of our energy system, while simultaneously reducing our demand for energy overall, through energy efficiency measures. Decarbonising heating provides multiple benefits in terms of lowering energy bills for households, therefore helping to address the cost-of-living crisis, while also generating economic benefits and contributing to the achievement of net zero goals.

Rationale for this report

This report provides a robust analysis of the potential macroeconomic impacts of deploying energy efficiency measures and low-carbon heating technologies in the UK's residential buildings. The report builds on work previously carried out by Cambridge Econometrics in 2021, before gas prices began to climb upwards. In this new piece of analysis, updated gas, electricity and heating oil prices have been incorporated into the economic modelling, along with new future trajectories to 2030, to reflect an updated outlook on prices. Incorporating these adjusted energy prices in the analysis allows us to provide a more accurate picture of the potential macroeconomic benefits of decarbonising heating.

Objectives

This report provides a robust analysis of the potential macroeconomic impacts of deploying energy efficiency measures and low-carbon heating technologies in the UK's residential buildings. The analysis is intended to highlight the potential return on action to increase take-up of such technologies and inform the debate on the policy needed to address the current cost-living crisis, while continuing to make the Net Zero transition happen.

[6] Fuel poverty: updated estimates for the UK | CPAG

1.2 Key terms

Various key terms are used throughout this report, which are defined in Table 1.1.

Table 1.1 Key terms

	Abbreviation	Definition
Economic terminology		
Gross domestic product	GDP	A monetary measure of the market value of all final goods and services in the national economy.
Full time equivalent	FTE	An FTE represents one person's work for one year at regulated norms (e.g. 35 hours a week for 52 weeks a year, excluding holidays).
Direct impacts		Impacts that result from the change in the demand for goods and services directly related to the shift to low-carbon heating and energy efficiency in buildings (i.e. construction linked to building renovation, the manufacture and installation of heat pumps, the supply of electricity)
Indirect impacts		Impacts resulting from the change in the demand for goods and services produced by sectors that supply those directly involved in the transition to low-carbon heating (e.g. fuel extraction, manufacturing of materials and components that form part of heat pumps and renovation measures)
Induced impacts		Impacts resulting from households re-spending the additional income generated by the investment (i.e., new workers' wages spent on goods and services in the economy).
Other acronyms		
Air source heat pump	ASHP	Air source heat pumps absorb heat from the outside air and transfer the heat to water, which it then distributed around a building via radiators and underfloor heating systems.
Ground source heat pump	GSHP	Ground source heat pumps use pipes that are buried in the ground to extract heat. This heat is transferred to a fluid which is distributed around radiators and underfloor heating systems.
Input-Output table	IO table	An input-output table is a table which describes historical linkages between different actors in the economy; it captures purchases between industries, and how final demand for each industry is built up. In addition, it breaks down the components of output from the production side, including the proportion that is paid out in wages to employees.

2 Methodology and scenarios

This chapter outlines the methodological approach adopted in this analysis to estimate the economic benefits of heating decarbonisation. The scenario designed for this analysis is described in detail in the following sections, together with the main underpinning assumptions. The chapter also provides an overview of the major limitations to this approach and how these are tackled in the analysis.

2.1 Methodological approach

The quantification of impacts

The wider economic impacts of heat decarbonisation in the UK are estimated in this report using Input-Output (IO) analysis to estimate potential impacts in terms of GDP and employment. To do this, data from Climate Change Committee (CCC)'s Sixth Carbon Budget Balanced Net Zero Pathway is used to provide the investments required, and resultant changes in consumer demand, over the period to 2030 (Climate Change Committee, 2020a). Specifically, we used changes in demand and investments for the following products:

Energy Efficiency	High-carbon heating	Low-carbon heating	High-carbon fuels	Low-carbon fuels
• Loft insulation • Wall insulation • Floor insulation	• Gas boilers • Oil boilers	• Heat pumps • Electric resisitve heating • Electric storage	• Gas • Petroleum • Solid fuel	• Electricity • Bioenergy • Hydrogen

The changes in consumer demand and related investments are then used as inputs for the IO analysis, which traces how changes in final demand for these products alter demand for intermediate inputs and leads to changes in both employment and Gross Domestic Product (GDP). The mapping of overall investments to economic sectors is based upon expert judgement, and reflects inputs used in previous similar modelling exercises (Cambridge Econometrics 2021). Another key input into this analysis is the UK Input-Output table, the most recent of which is published based upon data for 2018, which shows interlinkages between sectors, and how these combine to meet final demand for industrial output (Office for National Statistics, 2021).

This approach relies upon the use of Type I and Type II multipliers from the UK Input-Output (IO) tables. The Type I multipliers capture both the direct and indirect impacts of shifting from fossil fuel heating to electric heating. For example, increased demand for electricity would be expected to lead to lower employment in the gas supply sector (this is known as the direct effect), but also in sectors which provide inputs to that sector, such as the extraction of natural gas (known as the indirect effect). Type II multipliers capture the follow-on impacts of changes in consumer spending through the economy, known as the induced impacts. This reflects changes in employment, and therefore in total wages across the economy, that occur through both the direct and indirect economic impacts (e.g., job losses at natural gas suppliers, or increased employment at electricity suppliers, leading to lower and higher aggregate wages in each respective sector), and the impacts of these additional wages being spent in the economy (and leading to increased demand for consumer goods and services, as well as further indirect and induced effects).

Utilising IO tables within economic research and for analysis such as the estimation of economic impacts of policy is common practice, and is recognised as valuable and insightful by Government, governing bodies such as the European Commission (European Commission, 2021) and the OECD (OECD, 2021).

Limitation of the approach

The input-output (IO) analysis approach relies upon a static input-output table. This implies that the economic structure of the economy (i.e., the inter-sectoral supply chain linkages) does not change over time. However, in most sectors this does not represent a major restriction in this analysis as the modelling is carried out for the short- and medium-term, over which period supply chains would not be expected to radically change.

Furthermore, coefficients capturing the interlinkages across economic sectors are only available in historical data. Therefore, the modelling approach does not capture changes in interlinkages across sectors over time. For instance, suppose that because of technological change, the electrical equipment sector relies less on mining sectors and more on service sectors in future years. This would mean that, if the electronics sector is shocked in 2025, the approach would over-estimate the knock-on impacts on the mining sector and under-estimate the knock-on impacts on services sectors. However, changes in interlinkages across sectors are not a major limitation for this analysis as the forecast period does not extend very far into the future.

Similarly, the approach implies that the electricity system does not change over time. As a result, the supply chain linkages to the electricity sector in 2030 will resemble those of 2017, i.e. a substantial dependence on gas, and will still include some role for coal, even though coal will be regulated out of use by 2025. The analysis will therefore underestimate the potential impact that heat electrification will have on the demand for renewable electricity generation in the UK, and the resultant economic impacts through supply chains.

In this analysis, direct employment impacts draw on estimates of the labour intensity of the opportunities. However, the analysis assumes that labour intensity (and hence labour productivity) is constant over time. This is a simplifying assumption. In practice, labour productivity is likely to increase over time and therefore the employment impacts could be lower (all other things equal) in the future. Note that we've specifically introduced a treatment to adjust for the fact that higher current fossil fuel prices do not reflect any change in the underlying physical productivity of the provision of such fuels and are simply price changes. This is described in more detail in section 2.3.

Finally, the analysis shows impacts on the domestic natural gas extraction industry, as a reduction in demand for natural gas for heating leads to reduced demand for the extraction of this (as a portion of domestic demand is met from UK sources). However, there is substantial uncertainty around this impact; it is likely that, in the absence of domestic demand, the gas would still be extracted, and sold into export markets, assuming that there remained substantial demand in other overseas markets. As a result, the analysis may be over-stating the jobs lost in gas extraction and refining.

2.2 Scenario modelled

The scenario modelled in this analysis is based on the Balanced Net Zero Pathway from the CCC's Sixth Carbon Budget (Climate Change Committee, 2020a). This scenario includes a pathway for the UK to reduce emissions from buildings to zero by 2050. This is achieved through upgrading all buildings to EPC C standards within the next 10-15 years and delivering all new buildings with high levels of energy efficiency and low carbon heating from 2025. In this scenario the uptake of energy efficiency measures delivers a 14% reduction in household electricity demand by 2030, even though the sales of heat pumps reach just over one million per year by the same year. The average cost of installing a heat pump falls over time, from £9,490 in 2022 in line with the CCC's assumptions in the Balanced Net Zero Pathway.

Impacts of the scenario are compared to a 'no action' counterfactual, drawn from the CCC's Sixth Carbon Budget baseline.

2.3 Financing options

For the modelling, assumptions were developed to outline the amount of public and private investment required to finance decarbonisation measures in residential buildings; essentially, how much is paid for by Government, and how much by private homeowners.

In the scenario modelled, it is assumed that the UK Government offers a grant scheme to support the installation of heat pumps. The grant scheme is assumed to be fixed at £5,000 for every heat pump installed for the first three years from its introduction in 2022 (in line with the Boiler Upgrade Scheme); then the grant is assumed to reduce in value but hold constant as a percentage of the difference in costs between a heat pump and a gas boiler. This is done to follow the pathway established by the Plug-In Grant, which has declined in value as the price gap between battery electric and combustion engine vehicles has narrowed; it allows the value of the grant to decrease in line with the reduction in the cost of heat pumps over the period to 2030. In addition, it is assumed that Government finances 50% of the additional investment required for the implementation of building energy efficiency measures. This is in line with previous analysis carried out by EEIG (EEIG, 2021), which concludes the Government should finance 45% of investment needed in energy efficiency and includes an additional 5% financed by the Government in light of the VAT exemption to energy efficiency materials introduced in 2022. Crucially, in this analysis Government spending is not 'balanced', which is to say that it is not offset by an increase in tax rates (and therefore revenues) across the economy.

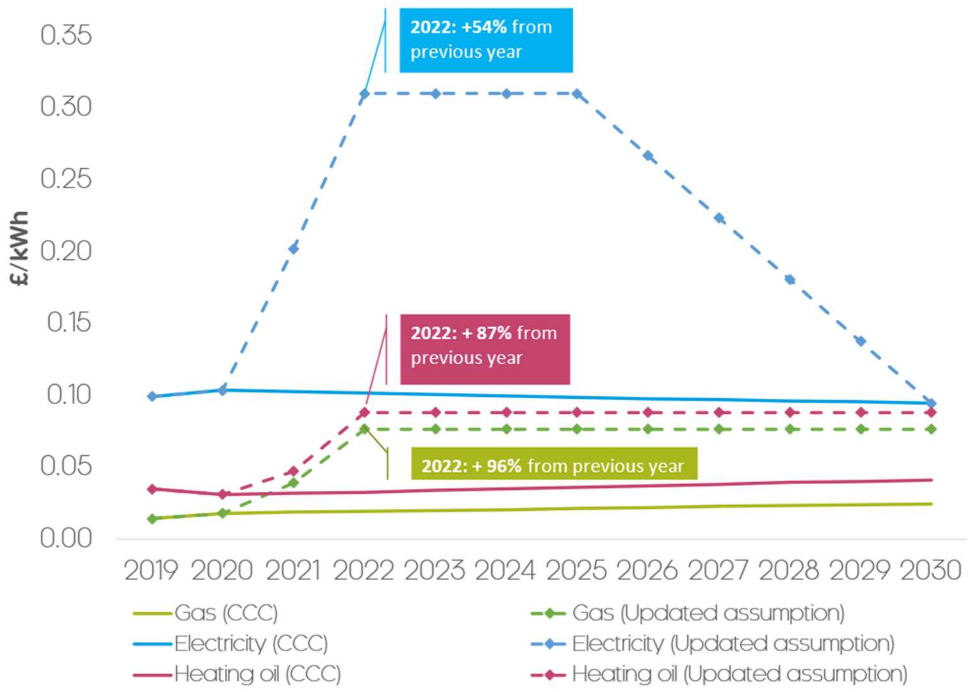
The remaining costs are assumed to be paid by households. This includes the remaining capital investments in energy efficiency measures and heat pump installation, capital expenditure for less efficient electric heating technologies (e.g. electric resistive heating), and the operational costs associated with running the heating system. Consumer spending on these is balanced out by reduced consumption of other goods and services; for the sake of simplicity, it is assumed that (at the aggregate whole economy level) capital costs are balanced by reduced expenditure *in the year in which the investment is made*.

In fact, many investments in new heating technologies and energy efficiency measures may be loan financed, which would serve to push repayment into later years. As such, our analysis may overestimate this “drag” on economic activity, more of which may in fact take place after 2030.

Incorporating updated energy prices

In the previous analysis Cambridge Econometrics carried out in 2021, gas and electricity prices were assumed to follow the trajectories set out in the CCC’s Balanced Net Zero Pathway. In this current, updated version of the analysis, new, higher, energy price assumptions up to 2030 are used, to reflect the hike in prices seen since the latter part of 2021, and an expectation that prices could remain high for the remainder of the decade. The differences between the trajectories of the previous prices used in the 2021 analysis and the current update are show in Figure 2.1 below.

Figure 2.1 Updated energy price assumptions used in the updated modelling



New energy price assumptions affect the consumer costs part of the modelling. The modelling results show that, when facing higher gas and heating oil prices, larger savings can be gained by consumers when they switch from fossil fuel-based heating systems to heat pumps. These savings outweigh the higher costs associated with running a heat pump system under higher electricity price assumptions.

Furthermore, in the updated modelling analysis, households pay a smaller proportion of the total up-front costs of installing a heat pump system compared to the previous analysis, as a result of the inclusion of the Boiler Upgrade Scheme, and therefore a smaller reduction in spending on other goods and services is required to counter-balance the initial investment in a heat pump. These consumer spending effects are reflected in the modelling and have important implications in terms of employment and economic activity (see Section 3.2).

3 The economic impacts of decarbonising household heating

This chapter sets out the analysis carried out on a potential transition in the heating of the UK's residential buildings over the period to 2030. The analysis is an update to a previous piece of work by Cambridge Econometrics, incorporating new energy price assumptions which reflect prices which have soared since the latter part of 2021.

3.1 Key results

Table 3.1 below shows the economic impacts of shifting to low-carbon heating and implementing energy efficiency measures. The economic impacts shown in the following table include direct, indirect, and induced effects.

The analysis finds that there are positive impacts on GDP, to the tune of an additional £6.8bn generated by 2030, associated with the adoption of low-carbon heating technologies, energy efficiency measures and the shift towards low-carbon fuels. Furthermore, the additional expenditure associated with installing low carbon heating technologies and energy efficiency measures, and the switch away from gas heating systems, leads to the creation of around 138,400 jobs in 2030. A comparison with the findings of Cambridge Econometrics earlier study which modelled the same scenario, with lower energy price assumptions, suggests that the economic impacts of the scenario are greater when higher energy prices are taken into account (to the tune of an additional £2bn of GDP and 53,800 jobs created when facing higher energy prices), meaning that shifting to low-carbon fuels and low-carbon heating technologies reduces the adverse impacts of high (and increasing) fossil fuel prices.

Table 3.1 The net economic impacts of the Scenario in 2025 and 2030

	2025	2030
GDP (£bn)	3.6	6.8
GDP (% change)	0.16	0.30
Employment (number of FTEs)	58,800	138,400

3.2 Detailed employment impacts

The analysis that follows decomposes the employment impacts of the transition to low-carbon heating and energy efficiency into five distinct effects:

- The deployment of additional energy efficiency measures in residential buildings
- Reduced demand for high-carbon heating technologies
- Increased demand for low-carbon heating technologies

- Lower demand for high-carbon fuels
- Higher demand for low-carbon fuels

Table 3.2 below considers each of these impacts in turn.

Table 3.2 Employment changes by spending component (FTEs)

	Employment (FTEs, numbers)	
	2025	2030
Enhanced energy efficiency	59,100	83,500
Switch away from high-carbon heating technologies	- 19,900	- 52,400
Switch towards low-carbon heating technologies	28,600	96,100
Change in demand for high-carbon fuels	- 3,100	-15,500
Change in demand for low-carbon fuels	1,000	5,300
Impact of spending reallocation	- 6,900	21,400
Overall impact on employment	**58,800**	**138,400**

Enhanced energy efficiency in buildings results in the creation of 59,100 full-time jobs in 2025 and 83,500 full-time jobs in 2030.

The modelling suggests that, in net terms the potential job gains from a **shift to low-carbon heating technologies** will create more jobs than are lost from the **shift away from high-carbon heating technologies**; in part, this is because the low-carbon technologies are more expensive than the low-carbon technologies that they are replacing, and the greater expenditure associated with manufacture and installation leads to greater job creation.

Conversely, more jobs are lost from **reduced demand for high-carbon fuels** than are gained from **increased demand for low-carbon fuels**, which reflects the fact that total energy demand is falling (as a result of energy efficiency measures), and the fact that heat pumps are more efficient than gas boilers in terms of the energy input required to meet a fixed level of heat demand. Even without the switch to heat pumps, the investment in energy efficiency measures would lead to fewer jobs in the high-carbon energy sectors, although this is more than balanced out by the jobs created in the manufacture and installation of the energy efficiency measures themselves.

There is a 'balancing' impact of household spending which changes over time. This is because, in 2025, consumer spending on the combination of energy efficiency measures, low-carbon heating technologies (which cost more than their high-carbon equivalents) and shifting fuel demand is greater in the scenario in the baseline – and as a result, households are assumed to reduce their expenditure on other goods and services across the economy, resulting in employment in affected sectors falling. Conversely, by 2030 total spending on low-carbon heating (including energy efficiency measures) is **lower** than in the avoided spending on high-carbon heating technologies and fuels, and as a result consumers are able to spend more on other consumer goods and services, increasing demand for these and ultimately increasing employment in these sectors.

Taking all these factors into account, the overall impact on total employment is positive in both 2025 and 2030.

3.3 Key takeaways

The findings of this analysis demonstrate:

- The shift away from high-carbon heating technologies can have a positive impact on the UK economy, in terms of GDP and employment.
- The economic impacts of shifting towards low-carbon heating and energy efficiency measures are even higher when accounting for the current high (and increasing) energy prices and greater government support for energy saving measures…
- …this means that by 2030 the costs of installing and running low-carbon heating technologies and energy efficiency measures is more than compensated by large savings made from switching away from gas for heating.

4 Further socioeconomic benefits

4.1 Introduction

The benefits of decarbonising heating in and improving the energy efficiency of residential buildings are not just limited to environmental and economic effects. Decarbonised heating can also cultivate positive social effects, alongside reductions in emissions, gains in employment and creation of economic output. Improvements to the energy efficiency and heating system of a home allow for warmer, more comfortable homes at a more affordable running cost. The knock-on impacts of warmth and more affordable heat include reduced fuel poverty, improved health and wellbeing, and greater educational attainment possibilities. Policies to address energy efficiency and the decarbonisation of heat thus have the chance to address issues of inequality simultaneously, which is essential for the transition to net zero to be considered fair and inclusive.

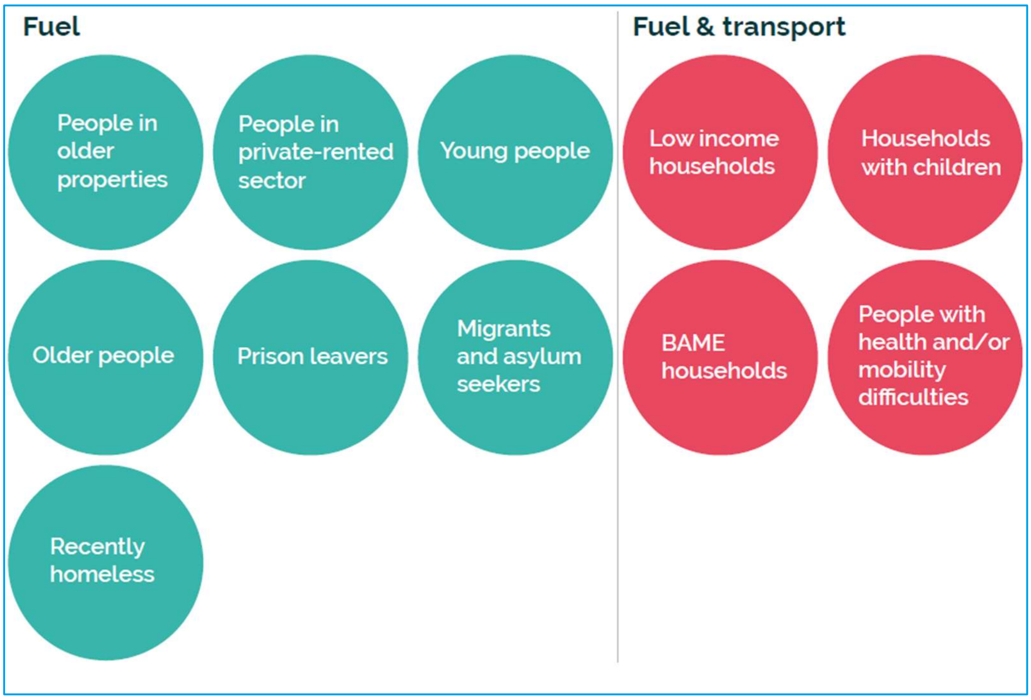
4.2 Reducing vulnerability to fuel poverty

Increased energy efficiency that results from measures such as improved insulation or double-glazed windows reduces the energy required to achieve a certain level of comfort, and households can enjoy lower energy bills as a result. Following savings on their energy bills, households may choose to increase the level of comfort in their home (i.e. increase their demand for energy and spend some of the money initially saved on more heating) or spend their increased discretionary income on other goods and services.

The first of these two options is particularly important when considering aspects of inequality. There are various groups in societies identified as being more vulnerable to fuel poverty, broadly defined in academic research as 'the inability to attain sufficient levels of domestic energy services' (Bouzarovski & Petrova, 2015). Focusing specifically on heating, fuel poverty occurs when a household cannot sufficiently heat their home to a comfortable level. A lack of comfortable heating can lead to a series of detrimental impacts on individuals, including reduced mental and physical health, reduced educational attainment and reduced employment opportunities.

There are many factors which can make a household vulnerable to fuel poverty; low household income (which can be a particularly prominent factor for single parents, elderly people and people with health conditions or disabilities), poor energy efficiency of the home and/ or heating system (a prominent factor for those living in older properties and people living in privately rented homes) and high energy prices (Boardman, 2013; Simcock et al., 2020). A recent review of academic research on the issue of fuel and transport poverty identifies the key groups in society who may be more likely to experience these factors, and therefore experience fuel poverty (Simcock et al., 2020) (see Figure 4.1).

Figure 4.1 The groups of people vulnerable to fuel or fuel and transport poverty



Source: Simcock et al., 2020

Impact of the energy price crisis

Rising energy prices and the broader cost-of-living crisis through the latter part of 2021 and 2022 have exacerbated fuel poverty and associated inequality issues. Increases in household energy costs will add to the rising cost of living in the UK, affecting all households, but particularly severely vulnerable households who are already experiencing, or are at risk of falling into, fuel poverty. For many vulnerable households who have low incomes and live in inefficient homes and/or have disabilities, an increase in their energy bill will force them to make difficult daily decisions about whether to heat their home, what food they can afford to buy, which meals they can afford to cook, and how often they can wash clothes or take a hot shower or bath. Increasing the energy efficiency of the homes of the most vulnerable groups in society and installing low-carbon heating technologies which are fit for the future would have an immediate and long-term impact on energy bills for these households. These households would be able to enjoy a more comfortable home with lower heating costs.

Addressing fuel poverty has therefore become an increasingly urgent issue in recent months, driven by rising energy prices and the broader cost-of-living crisis.

4.3 Improved health and wellbeing

Retrofitting and improving the energy efficiency of homes can alleviate some of the associated mental health impacts, such as stress, anxiety and depression, which can be associated with thermal discomfort (IEA, 2019b). Similarly, an improvement in the thermal comfort of the home is associated with improved physical health, since colder houses place greater physical stress particularly on the elderly, infants and the sick. Exposure to cold has been associated with increased risk of respiratory problems linked to damp (Clark et al., 2004) and circulatory conditions, cardiovascular problems, and arthritic and rheumatic illnesses besides exacerbating existing health conditions, including common flu and cold, and allergies. According to a report published by the CCC, 'the health cost to the NHS of conditions exacerbated by poor housing is currently estimated to be £1.4-2bn per year in England' (Climate Change Committee, 2019) Other studies suggest a similar annual cost. Across the entire UK population, and including estimates for the cost of GP consultations, associated treatments, days in hospital and referrals caused by housing-related factors, the cost to the NHS of cold homes is estimated to be up to £1.4bn a year according to (Nicol S. & Roys M., 2010). While the aforementioned studies focused on a wide definition of poor housing conditions, which included dangers such as unsafe stairs, fire hazards and poor sanitation, the hazards of excess cold and falls on stairs were considered to be the most impactful on health. Fixing the problem of excess cold offered by far the most savings to the NHS, some £848m per year compared to £207m of savings to be made from improving stairs. While it is difficult to separate and quantify the health benefits of more affordable warmth, (Liddell, 2008) estimated that the avoided health costs for the NHS amounted to 42p for every £1 spent on reducing cold through the Warm Home Scheme. Clearly, improved energy efficiency and warmth of homes can lead to substantial social benefits in terms of improved health and wellbeing.

Furthermore, from a government revenue perspective, evidence suggests public funding of energy efficiency pays off, when all benefits are considered. A study conducted in New Zealand found the combined energy and health benefits associated with improving the energy efficiency of homes outweighs the costs of energy efficiency programmes (Grimes et al., 2012), therefore creating a compelling case for investment in such programmes. While the schemes investigated in this study contained many components aimed at improving the energy efficiency of homes, the study finds that 'the dominant benefits (gross and net) of the programme are attributable to the insulation component of the scheme'.

4.4 Greater educational attainment and employment opportunities

Indoor temperature is linked to productivity (IEA, 2019b), and can therefore impact upon the ability of school-age children to carry out homework or study for exams at home, which can have a knock-on effect on their educational attainment, and ultimately their employment opportunities. In some cases, the link between warmth and productivity is further exacerbated by the fact that a household may prioritise heating only some rooms in a home, reducing the possibility that there is a quiet place to study, away from other household activities. Improved energy efficiency or lower heating costs allows families the ability to affordably heat a larger area of the home, effectively increasing the space available to a family, reducing tensions arising from space restrictions, and providing more private and comfortable spaces for activities like homework and studying.

There is evidence that other links between educational attainment and warm homes exist. For example, according to the Energy Saving Trust (Payne et al., 2015), avoidance of physical (particularly respiratory health in children) and mental stresses through warmer and more comfortable homes has been linked to decreased absenteeism from school by children and from work by adults; with potential impacts on academic performance, labour productivity and earning power.

Living in an energy inefficient home is costly, and the poorest housing is often occupied by the most vulnerable people, and households experiencing fuel poverty face difficult decisions about how much to spend on heating and how much to spend on food (End Hunger UK, 2018). A more energy-efficient home could therefore lead to better nutrition for people vulnerable to fuel poverty - by making fuel bills more affordable a ‘heat or eat’ situation can be avoided. Improved nutrition could subsequently lead to improved concentration and improved chances of educational attainment for school-age children, and better performance (and therefore future employment opportunities) for adults.

4.5 Financial benefits to occupiers and property-owners

Air source and ground source heat pumps offer low-carbon and low-maintenance ways to heat a home, allowing homeowners to generate heat from electricity and save money on their annual heating costs, when compared to using a conventional gas boiler heating system. Furthermore, increasing the energy performance of a UK property (specifically moving from an EPC rating of G to B), through energy-saving methods such as installing low-carbon heating technologies, better insulation or double-glazing, typically increases its value by 14%[7](Department of Energy & Climate Change, 2013). Other international studies also suggest that improving the energy efficiency of a property may increase its value, for example (Jensen et al., 2016) concludes that the energy performance ratings of buildings have an impact on property sales prices in Denmark and that this positive market response provides an incentive to perform energy upgrades to a home. Similarly, evidence from Ireland suggests energy efficiency has a significant, positive effect on property values (Hyland et al., 2013).

In the case of rental properties, although the ‘split incentive’ exists, whereby a landlord may be reluctant to invest in a low-carbon heating technology or energy efficiency measure as they pay the up-front costs and do not benefit from the lower energy bills, they may benefit financially in other ways. First, individuals may be more willing to pay a higher rent for property with improved energy performance (Eichholtz et al., 2011). Second, improved energy efficiency has the potential to increase the satisfaction of the renter with the property, thereby reducing vacancy periods and tenant turnover (Department for Business, 2021; IEA, 2019a).

4.6 Improved local air quality

Improved energy efficiency has the potential to reduce outdoor concentrations of air pollutants, and the subsequent improvement in air quality generates positive health impacts. Increased energy efficiency reduces the demand from gas boilers, which is directly beneficial for local air quality. Replacing gas boilers with low-carbon alternatives such as heat pumps would provide further scope for improved outdoor air quality (Department for Environment, 2020).

[7] For an average home in the UK, improving its EPC rating from band G to B.

5 Key recommendations

The current high (and still rising) fossil fuel prices have highlighted the vulnerability of households to volatile imported fossil fuels. This analysis has demonstrated that, **in addition to substantially reducing the environmental impact of the UK's housing stock, the decarbonisation of residential heating combined with energy efficiency improvements would also be beneficial for the UK economy, with an overall net positive impact on jobs and GDP**.

With the growing cost-of-living crisis in the UK perpetuated not just by the rising energy prices but also tax rises and general price increases, urgent consideration should be given to where this leaves households (particularly those vulnerable to fuel poverty) and how the Government should respond. The cost-of-living crisis has brought about fresh questions about how best to support households with rising costs, while still achieving other Government priorities including decarbonisation and levelling up. To help with the immediate difficulties faced by households in 2022, the Government introduced the Energy Bills Rebate in February followed by a revised set of support measures in May (HM Treasury, 2022a). The revisions in May offered more targeted support for vulnerable households than the original Energy Bills Rebate package, somewhat addressing the urgent issue of rising fuel poverty, but once again did not address other major priorities like decarbonisation, of homes in particular. Subsequent price rises (such as that due to come into force in October) will require further action to avoid wide-scale increases in the incidence of fuel poverty across the country, in addition to contributing to longer-term goals.

Longer-term solutions to the crisis should instead go hand-in-hand with an accelerated and fair approach to net zero. Addressing high energy bills, which are likely to persist for the foreseeable future, through increased **financial support for the decarbonisation of homes is one such solution**. Improving the energy efficiency of a home and installing low-carbon heating technology would **not only have an immediate positive impact by reducing energy consumption and lowering bills, but these positive impacts would be long-lasting.** It is also an approach which could also reduce the UK's dependence on fossil-fuels, thereby **increasing energy security** and vulnerability to global oil and gas price volatility.

This report sets out numerous social co-benefits which may be brought about by Government investment in the decarbonisation of domestic heating, including reducing vulnerability to fuel poverty. To help realise the additional social co-benefits described, it is important to clearly **identify the groups in society who are most vulnerable to fuel poverty and target and/or prioritise Government funding for heating decarbonisation accordingly**. Thus, the decarbonisation of **social housing and older properties should be prioritised**, and measures to **improve standards or provide incentives for landlords** to improve efficiency of homes for tenants could be considered.

A final recommendation relates to the practicalities of increasing ambition for the decarbonisation of heating. A large proportion of jobs created are highly likely to remain local, given that installations of low-carbon heating technologies and energy efficiency measures are likely to be carried out by local tradespeople. However, to avoid bottlenecks occurring within the construction and manufacturing sectors, and to maximise the potential economic benefits of an ambitious deployment programme, Government should **ensure that UK workers are equipped with the right mix of skills and qualifications to carry out new and changing occupations** linked to heat pump production and installation, and the manufacture and installation of energy efficiency measures.

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