UKERC
UK Energy Research Centre

Centre on Innovation and Energy Demand

Policy briefing

A UKERC/CIED Policy Briefing

Unlocking Britain's First Fuel: The potential for energy savings in UK housing

Dr Jan Rosenow, (University of Sussex)
Professor Nick Eyre, (University of Oxford)
Professor Steve Sorrell, (University of Sussex)
Pedro Guertler, (E3G)

Key findings

- Since 2004, improved energy efficiency has helped reduce the UK's total household energy consumption by one fifth, **saving the average dual fuel household £490** in 2015.
- Technically, **one half of the energy currently used in UK housing could be saved** by investing in a mix of current technologies encompassing improved energy efficiency, heat pumps and heat networks.
- Cost-effective investments to 2035 could **save around one quarter of the energy currently used,** an average saving of £270 per household per year at current energy prices.
- This saving is approximately **equivalent to the output of six nuclear power stations the size of Hinkley Point C**.
- Using Treasury guidance for policy appraisal, this investment has an estimated **net present value of £7.5 billion**.
- Experimental appraisal undertaken for this briefing estimates that the value of additional benefits from these investments – including improved health, additional economic activity and benefits to the electricity system – **could be up to £47 billion**.

1. Introduction

UK energy policy is at crossroads. The combination of ambitious carbon targets, aging energy infrastructure and rising fuel poverty warrant bold political decisions to ensure a successful and fair transition to a low-carbon economy.

> The long lifetime of energy infrastructure means that decisions made in the next few years will shape the trajectory of the UK energy system for decades. It is essential that the right choices are made if the UK is to have a sustainable, affordable and secure energy future.

Energy efficiency in homes can play a key role in delivering energy affordability, sustainability and security. In the past, improved energy efficiency has delivered significant benefits to consumers, society, the economy and to the environment. On average, UK households now use around 30 percent less energy than they did in 1970 (BEIS 2016; DECC 2012). The bulk of this decrease has occurred since 2004 and has largely been driven by energy efficiency policy (BEIS 2016; DECC 2012; CEBR 2011; Enerdata 2017) – lowering the average annual energy bill in a dual fuel household by £490 in 2015 (CCC 2017).

Total household energy use fell by one fifth (gas use decreased by 27 percent, electricity use by 13 percent) between 2004 and 2015. This is despite a 12 percent increase in the number of households and a 10 percent increase in population. Average household energy use fell by 27 percent over this time, despite a proliferation of household appliances and lamp fittings per household and higher in-home temperatures (BEIS 2016).

The bulk of this reduction derives from energy efficiency improvements delivered through public policy, in particular the major insulation programmes funded by successive 'supplier obligations' (i.e. ECO, CERT and their predecessors). Also important have been the requirement for condensing boilers within the UK Building Regulations and the progressive tightening of EU standards on the energy efficiency of electrical appliances (CEBR 2011). This demonstrates that market forces alone cannot deliver all cost-effective investment in this sector, owing to multiple and overlapping market barriers. Instead, policy intervention can be used to improve economic efficiency and increase social welfare. Macroeconomic modelling has demonstrated that a 10% improvement in the energy efficiency of all UK households leads to a sustained GDP expansion of around 0.15% (Turner, Figus, and Riddoch 2017).

As the UK government prepares its Clean Growth Plan, setting out its strategy for decarbonising the UK energy system, it is important to assess the remaining potential for improved energy efficiency in households. Accurately assessing and unlocking this potential is critical to ensuring the UK follows the most cost-effective path. Underestimating and neglecting this potential could cost the UK billions in wasted energy bills and higher cost energy supply.

In the past, multiple studies have demonstrated the large potential for improved energy efficiency in UK households. And this remains the case, despite the substantial improvements over the last 15 years. For example, in its impact assessment for the 5th Carbon Budget, the UK government concluded that 'the domestic buildings sector has the highest technical potential' for carbon abatement across the economy (DECC 2016b). Much of this is due to the potential for improved energy efficiency. The government's analysis is corroborated by the Infrastructure Transitions Research Consortium (ITRC 2016) whose evidence fed into the National Needs Assessment. The National Needs Assessment brought together a coalition including industry, investors, environmental, legal and professional bodies, and politicians and opinion formers to deliver a 35-year view of the changing demands on infrastructure services.

However, a more granular assessment is needed to understand exactly where this potential lies and what form it takes. Our analysis fills this gap. It is based on the best available evidence on the remaining potential for energy efficiency improvements within the UK's residential building stock.

> We demonstrate that there is a vast resource of untapped energy saving opportunities in homes in every part of the UK.

2. Basis for our analysis

The most comprehensive data on the potential for energy efficiency improvements within UK households is provided by the Committee on Climate Change (CCC 2016a), who collated and commissioned research from a variety of sources. For its 'central scenario' (which meets the UK carbon budgets), the CCC provides estimates of the deployment of different technologies in households between now and 2035, together with the associated energy and carbon savings. These estimates form the basis of the simple 'CCC dataset model' that we have employed for this briefing.

The CCC data indicate the relationship between technologies deployed and the energy and carbon savings achieved in each year to 2035.

> We use this data to estimate the impact of alternative scenarios for technology deployment at different scales and different mixes over time.

Using this data, supported by additional sources (such as those providing estimates of remaining technical potential - see Appendix I - and government policy impact assessments and projections), we develop three scenarios representing progressively more ambitious levels of technology deployment:

Technology deployment scenarios

1. **Limited ambition:** This includes all energy efficiency measures that can be installed by 2035 whose energy cost savings, discounted over the lifetime of the measures, exceed the associated capital costs. This level of deployment is broadly consistent with the Government's latest central projections for energy and emissions at time of writing.[1] The Committee on Climate Change considers 85% of the carbon savings in buildings from the government's projections to be 'at risk' (i.e. potentially not materialising) owing to low take-up of measures, less than full implementation of policies or poor enforcement of standards.
2. **Cost-effective:** This includes all energy efficiency measures deployable to 2035 that are estimated to be cost-effective according to criteria used by the UK government to appraise public policies and projects.[2] In addition to accounting for energy cost savings, this approach places a monetary value on improvements in comfort, air quality and reductions in carbon emissions. Measures are cost effective when the discounted sum of all benefits exceeds the associated capital costs. This level of deployment is broadly consistent with an overall approach taken across all sectors of the economy that meets the 5th Carbon Budget at least cost, based on the CCC's assessment of abatement costs and constraints in different sectors.
3. **Current technical potential:** This includes all measures examined – all of which are currently available and applicable to today's housing stock – without regard to their cost effectiveness. This does not include possible future deployment of new technologies.

[1] See 'Updated energy and emissions projections: 2015' (DECC 2016c). A 2016 version of the Updated energy and emissions projections was published in March 2017, where final energy demand in the residential sector in 2035 is 2.9% higher than in the 2015 version, mainly owing to lower than previously projected savings from efficient electrical appliances (BEIS 2017c).

[2] See 'Valuation of energy use and greenhouse gas (GHG) emissions – Supplementary guidance to the HM Treasury Green Book on Appraisal and Evaluation in Central Government' (BEIS 2017a); this uses government energy and carbon price projections, and a social discount rate of 3.5% for the first 30 years, followed by 3% for the next 45 years. Social discount rates for policy appraisal are markedly lower than effective private discount rates applied to individual project appraisal. For brevity, only central price projections have been included in this briefing's results.

3. Potential for individual measures

Estimates of energy savings are based upon estimates of the remaining potential for installing different energy efficiency measures across the UK housing stock. The sources for, and further explanation of, these estimates are presented in Appendix I. This includes the deployment of heat networks and heat pumps, since these technologies can significantly reduce final energy demand as well as carbon emissions.

Figure 1 illustrates our estimates of the potential scale of installations of 15 different measures within the present housing stock. It also indicates the estimated fraction of these that would be delivered under the 'limited ambition' and 'cost-effective' scenarios to 2035, together with the fraction that would remain.

Figure 1

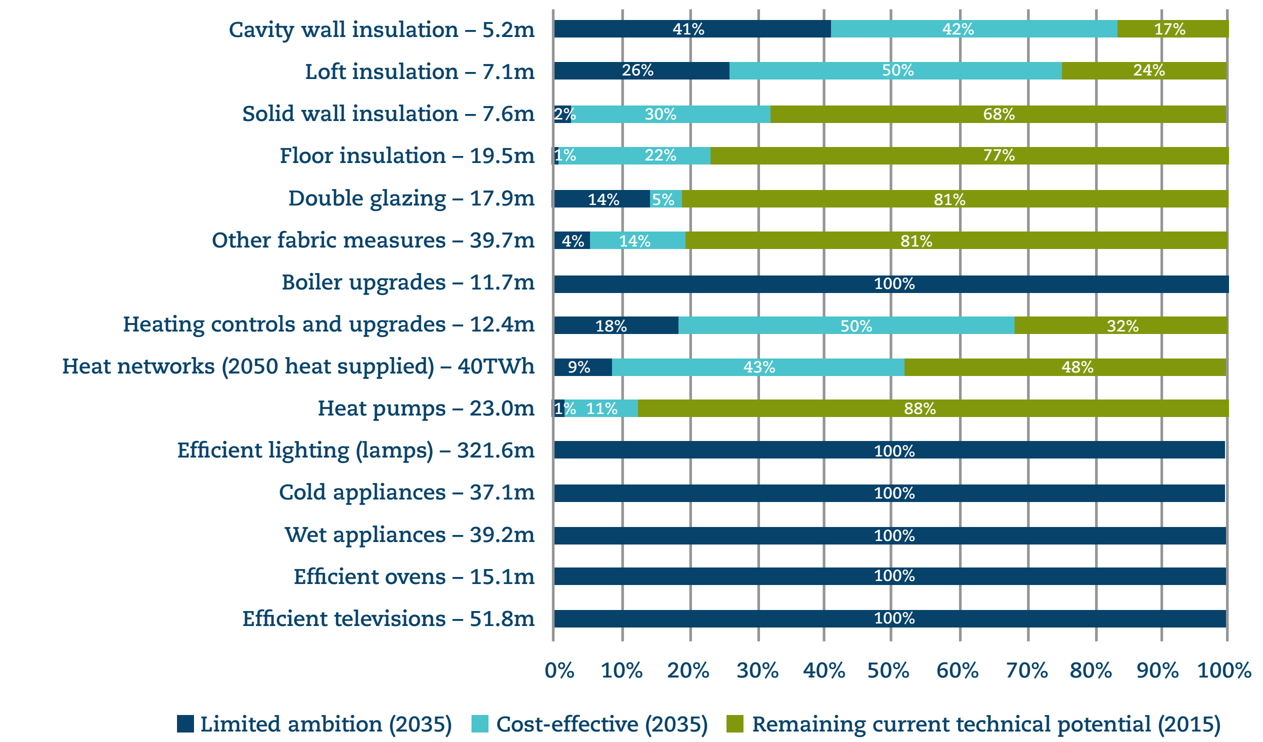

Figure 1: Total technical deployment potential at the end of 2015, and 'limited ambition' and 'cost-effective' deployment to 2035 (in existing dwellings). Sources: see Appendix I.

- Current policy is geared towards delivering the 'limited ambition' scenario by 2035, but much of this delivery is uncertain and at risk.
- In terms of the UK's carbon emissions targets, achieving the 'cost-effective' scenario is consistent with meeting the 5th Carbon Budget as well as staying on track to the deeper emissions cuts necessary by 2050, but will require a large increase in the pace of delivery.
- For 2050, going further and capturing most of the technical potential will also be necessary. We anticipate that much of this will be more cost-effective than reducing emissions in electricity supply, industry and transport. Also, a combination of rising energy prices and technological improvements will push the envelope of what is cost-effective in the future.

Based on the remaining potential of individual energy efficiency measures and their respective energy savings, the total energy saving potential for the housing stock can be calculated.

4. Potential for energy savings

For each scenario, we estimate the reduction in household energy consumption in 2035, relative to energy consumption in 2015 (see Figure 2). Energy savings equivalent to more than half of current household energy consumption could be achieved through a combination of energy efficiency improvements, heat pumps and heat networks. Using Treasury criteria, we estimate that half of this investment would be cost-effective in the period to 2035 (the 'cost-effective' scenario), giving a 25% reduction in energy consumption. At current energy prices (Ofgem 2017), this equates to energy cost savings of £270 per household per year. Considering only the direct energy savings to households (the 'limited ambition' scenario), a 12% reduction in energy consumption could be achieved. These estimates account for households taking some of the benefits of improved energy efficiency as increased comfort, rather than reduced energy bills.

Figure 2

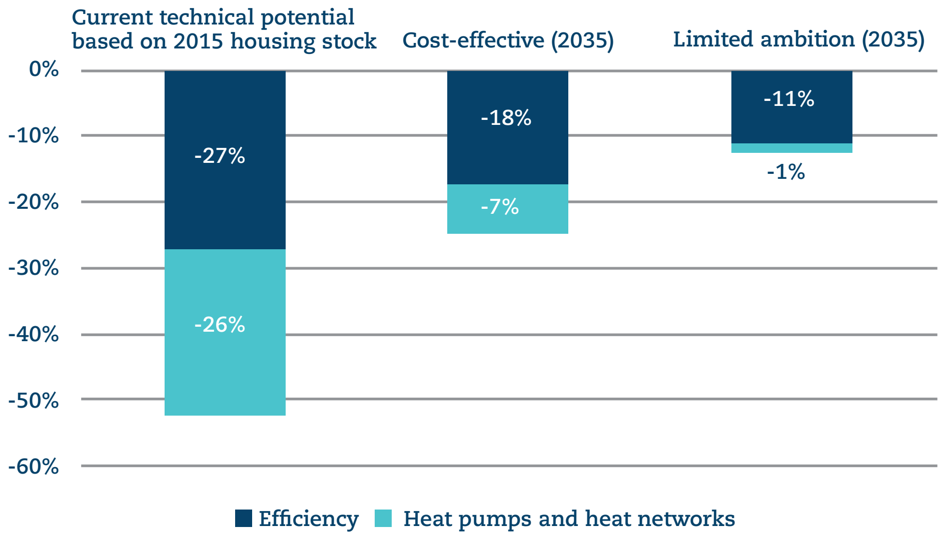

Figure 2: Potential energy savings in existing housing stock [as a percentage of 2015 final energy demand]

[Sources: 2015 final (weather-corrected) energy demand (BEIS 2016); current technical potential derived from review of residential energy efficiency potential for CCC (Element Energy and Energy Saving Trust 2013) combined with heat pumps and heat networks potentials referenced in Appendix I; other potential savings produced using CCC dataset model and assessed for cost-effectiveness using the Interdepartmental Analysts' Group's toolkit for valuing changes in greenhouse gas emissions (BEIS et al. 2016)]

This analysis demonstrates the importance of treating energy efficiency opportunities in a similar manner to low carbon energy supply. The simplistic assumption that deployment can be left to 'the market' because householders benefit from the energy savings is incorrect. This is because of multiple obstacles including financial and non-financial barriers (Sorrell 2004). Also, energy efficiency delivers significant societal benefits ('positive externalities' such as savings for the NHS for example) that are usually not captured by individual households. Hence, even in a well-functioning market, investment in energy efficiency will be less than its societal benefits might arguably justify unless these externalities can be reflected through the internalisation of their costs and/or public policy.

Figure 2 also shows that the technical potential is significantly larger than the current cost-effective potential. Experience with low carbon technologies (most obviously solar photovoltaics) shows that increased deployment leads to falling costs and improving performance which makes such technologies increasingly cost-effective. Again, these 'learning economies' have wider social benefits that are not captured by individual investors. Policy support for deployment can therefore be justified and will bring the cost-effective potential closer to the technical potential. In short, the main rationales for policy support for low carbon energy supply are equally relevant to energy efficiency, but are largely neglected in current UK Government policy.

5. Energy savings over time

The energy savings of the 'cost-effective' scenario can be achieved in a more or less linear fashion over time. If progress stalls in earlier years, however, it may be difficult to recover this potential in later years.

Figure 3 compares the estimated energy consumption in the 'baseline' and 'cost-effective' scenarios, and illustrates the contribution of seven categories of measure to the total energy savings. Around 47% of the total savings by 2035 are achieved through building fabric improvements, boiler replacements and upgrades of heating controls within existing homes. A further 36% is achieved through heat pumps (half of which are in newly built homes[3]) and heat networks (with nearly all savings in existing homes). Energy efficient appliances and lighting provide 11% of the total savings and behavioural measures the remaining 6%. Thus, most of the energy savings can be achieved by 'traditional' energy efficiency measures.[4]

> However, to achieve deeper reductions in both energy consumption and carbon emissions, it is necessary to invest in new heating technologies such as heat pumps and heat networks.

In total, the analysis suggests that energy demand in 2035 can cost effectively be reduced by around by 140 TWh per year. This is approximately equivalent to the annual energy output of six nuclear power stations the size of Hinkley Point C.[5] From a policy maker's perspective, it is important to understand the costs and benefits of this scenario. These are explored in the next section.

Figure 3

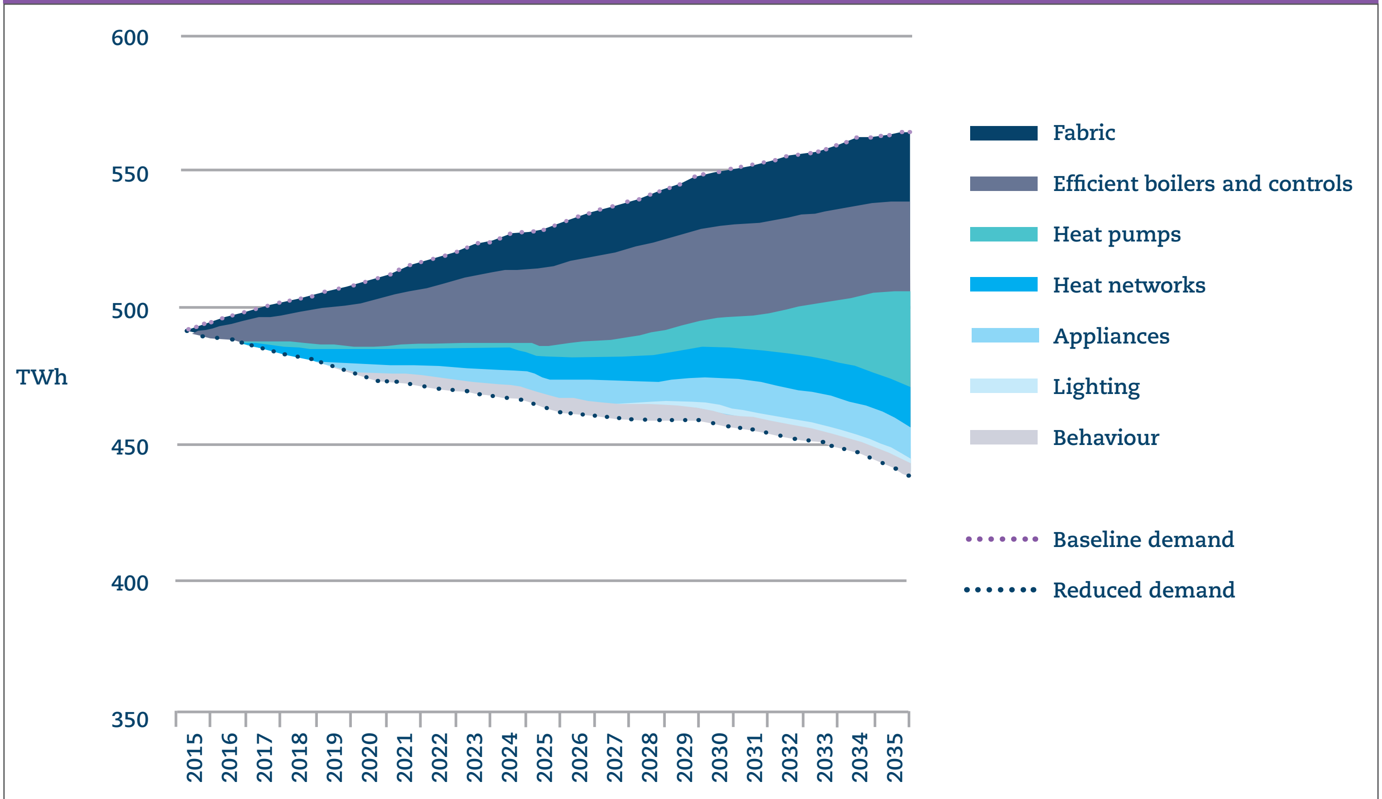

Figure 3: Household energy demand in the baseline and 'cost-effective' scenarios. [Source and notes: CCC dataset model. Baseline shows energy demand increasing without energy efficiency improvements in existing stock from 2015, and includes energy demand increases resulting from new dwellings and increased number of households (approximately 5m additional by 2035). CCC and government baselines normally include the impact of upgrades to condensing boilers from 2015. Here, these energy savings have been removed from the baseline and shown separately. Savings also include the impact of heat pumps and heat networks in new dwellings relative to the baseline assumption of gas heating]

[3] Heat networks achieve energy savings compared to conventional heating options in a variety of ways. For example, they may be combined heat and power-driven, or heat pump-driven using waste heat from power plants and industrial facilities, or latent heat from sewage or rivers.

[4] Although apportioned differently than shown in Figure 2, as Figure 3 shows savings relative to baseline rather than 2015 final energy demand.

[5] Hinkley Point C is expected to deliver about 25 TWh of electricity per year (CCC 2016b)

6. Costs and benefits over time

A wide range of benefits are associated with energy efficiency improvements in residential buildings, many of which are difficult to quantify and value. We have estimated the present costs of the measures deployed in the 'cost-effective' scenario, together with the present value of the associated benefits in the form of energy savings, emission reductions, improved air quality and improved comfort. Our estimates follow Treasury guidance for policy appraisal (BEIS 2017a) and are compiled with the help of a toolkit from the Interdepartmental Analysts' Group (BEIS et al. 2016). The results are shown in green in Figure 4. Taken together, we estimate the net present value of this scenario to be approximately £7.5 billion.

Figure 4 also includes estimates of some wider benefits (shown in green) that are not part of formal policy appraisal, although wider benefits such as these are sometimes included in annexes to government policy impact assessments as they add valuable detail for broader understanding of policy impacts. These benefits include improved health, benefits to the electricity system (for example avoided network investment and reduced line losses) and the gross value added of capital works.[6] Although these wider benefits are rather uncertain and may only be partially additional[7] to, or trade-off with, other benefits in the economy and the energy system, their value could be up to £47 billion.

Figure 4

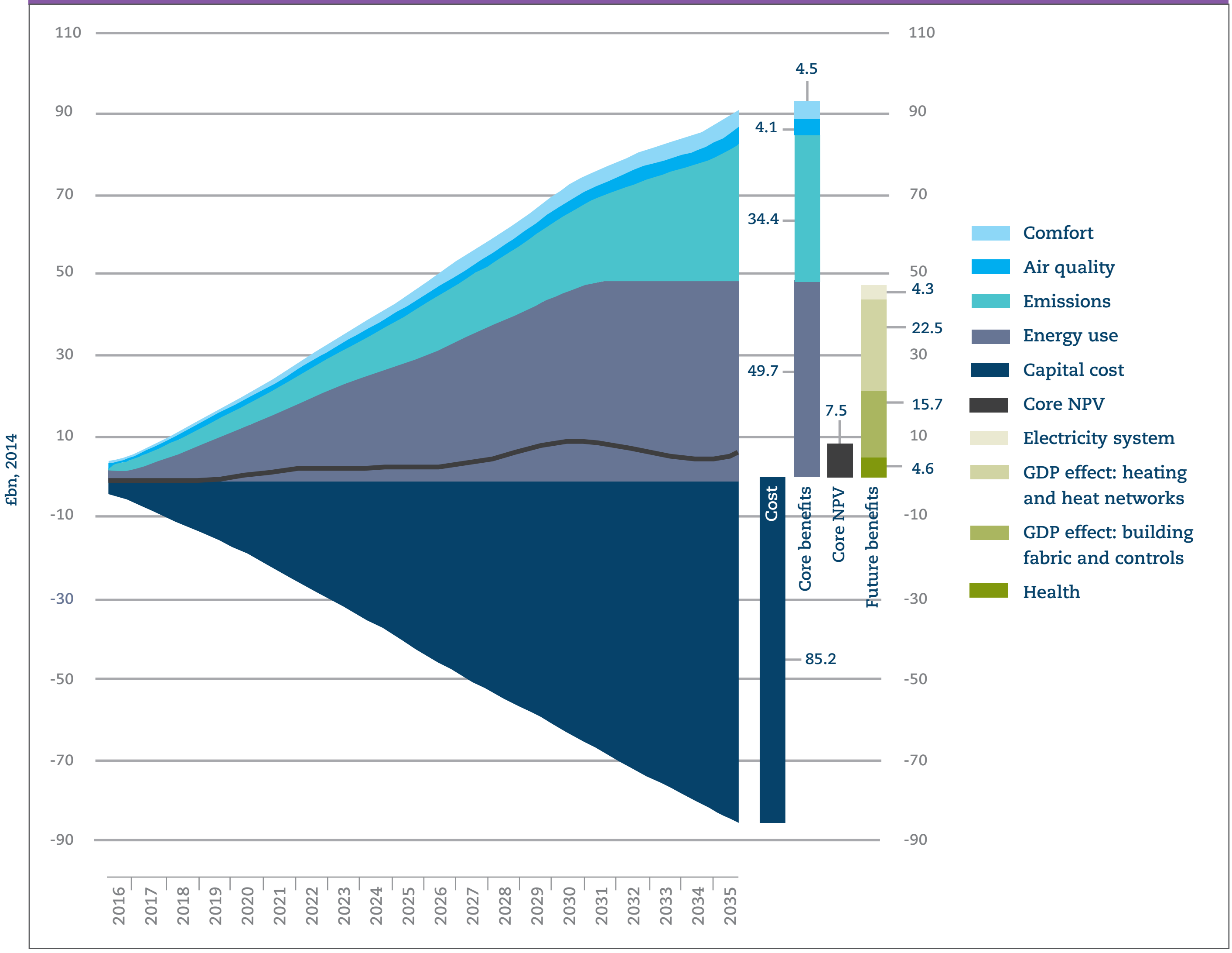

Figure 4: Cumulative present values of investment in the housing stock in the 'cost-effective' scenario [Source: produced from BEIS et al. (2016) using outputs from CCC dataset model]

[6] Assumptions underpinning this cost benefit analysis, including the nature and quantification of these wider benefits, are presented in Appendix II of 'Buildings and the 5th Carbon Budget' (Guertler and Rosenow 2016).

[7] For example, health benefits are known to overlap with comfort benefits, but the extent of overlap is not unknown.

7. The case for policy intervention

It is clear that there remains large untapped potential for energy efficiency improvements within UK housing. Using the best available evidence, our analysis demonstrates that:

- **one quarter** of the energy currently used in UK housing could be cost-effectively saved by 2035;
- allowing for falling equipment costs and including the wider benefits of energy efficiency improvements, it should be possible to cost-effectively **halve energy demand** in UK homes. With innovation in technology and delivery, appropriately supported by Government, it is likely we can go significantly further than this too.

> The evidence shows that the benefits of improved energy efficiency in UK homes are considerable and justify significant investment from both the public and private sectors.

In addition to energy savings, upgrading homes delivers a wide range of persistent benefits to the economy and society, such as improved health, better comfort, increased productivity, more skilled employment and reduced investment in electricity networks – all of which are hallmarks of a modern, low carbon infrastructure. These in turn can contribute to broader policy objectives, such as relieving pressure on the NHS, supporting households struggling to make ends meet, and reducing fuel poverty. These benefits reduce the cost of the transition to a low carbon economy.

> More so than carbon abatement in other sectors, the benefits from investing in homes accrue directly to people everywhere in the UK.

To leverage the necessary private investment for these benefits to be captured, there needs to be significant policy change and public investment. The most strategic high-level opportunities for signalling such a step change are the forthcoming Clean Growth Plan and National Infrastructure Assessment. In addition, as the UK Energy Research Centre has argued, there is a need for a new White Paper on heat and energy efficiency to fill the current policy vacuum (UKERC 2017).

> The White Paper should set out the contribution of energy efficiency to achieving climate targets, the technologies to be deployed and the policy mix that will deliver this deployment.

The best available evidence shows that upgrading the UK's existing buildings can provide substantial energy savings while delivering large benefits to society. It should therefore be a central component of the low carbon energy transition.

8. Appendix I – Sources for remaining potential estimates

Measure	Technical potential in existing dwellings	Source(s)
Cavity wall insulation	5.2m	DECC (2016a)
Loft insulation[i]	7.1m	
Solid wall insulation	7.6m	
Floor insulation	19.5m	Element Energy and Energy Saving Trust (2013), less measures installed in 2014 and 2015 under the Energy Company Obligation (ECO) according to monthly government statistics (BEIS 2017b)
Enhanced double glazing[ii]	17.9m	
Other fabric measures[iii]	39.7m	
Boiler upgrades	11.7m	Element Energy and Energy Saving Trust (2013), less 2.6m upgrade boilers installed across 2014 and 2015 (HPM Magazine 2016) which replaced non-condensing boilers (assumed to be 80% of total UK boiler sales)
Heating controls and upgrades	12.4m	Encompasses sum total of situations in homes missing one or more of: thermostatic radiator valves, timer, thermostat and cylinder thermostat (Element Energy and Energy Saving Trust 2013), less measures installed in 2014 and 2015 under ECO according to monthly government statistics (BEIS 2017b)
Heat networks (2050 heat supplied)	40TWh	DECC (2013); and mid-point of central and high 2050 estimate from Element Energy, Frontier Economics, and Imperial College London (2015)
Heat pumps	23.0m	Frontier Economics and Element Energy (2013)
Efficient lighting (lamps)[iv]	321.6m	Element Energy and Energy Saving Trust (2013), less number in place by end 2015 in CCC 5th Carbon Budget dataset (CCC 2016a)
Cold appliances (A+++)	37.1m	
Wet appliances[v]	39.2m	
Efficient ovens (A+)	15.1m	
Efficient televisions (A++)	51.8m	

i Lofts with less than or equal to 125mm insulation present.

ii The majority of the technical potential here is for replacing pre-2002 double-glazing with more efficient windows.

iii 'Other fabric measures' encompasses the opportunities for insulated doors, reduced infiltration measures, and (improved) hot water tank insulation.

iv Encompasses opportunities to switch incandescent to compact fluorescent, and halogens to LEDs.

v Opportunities for replacement with A+++ washing machines, A-rated tumble driers, and A+ dishwashers

Bibliography

BEIS. 2016. "Energy Consumption in the UK." Department for Business, Energy & Industrial Strategy. https://www.gov.uk/government/collections/energy-consumption-in-the-uk.

– 2017a. "Green Book Supplementary Guidance: Valuation of Energy Use and Greenhouse Gas Emissions for Appraisal." Department for Business, Energy & Industrial Strategy. https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal.

– 2017b. "Household Energy Efficiency National Statistics." *GOV.UK*. https://www.gov.uk/government/collections/household-energy-efficiency-national-statistics.

– 2017c. "Updated Energy and Emissions Projections: 2016." Department for Business, Energy & Industrial Strategy. https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016.

BEIS, Defra, DfT, and HM Treasury. 2016. "IAG Spreadsheet Toolkit for Valuaing Changes in Greenhouse Gas Emissions (Version 2016)." Department for Business, Energy & Industrial Strategy. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/483281/IAG_spreadsheet_toolkit_for_valuing_changes_in_greenhouse_gas_emissions.xlsm.

CCC. 2016a. "Fifth Carbon Budget Dataset." Committee on Climate Change. https://www.theccc.org.uk/publication/fifth-carbon-budget-dataset/.

– 2016b. "Energy Policy Is about More than Hinkley, Says CCC | *Committee on Climate Change*." Committee on Climate Change. September 20. https://www.theccc.org.uk/2016/09/20/hinkleystatement/.

– 2017. "Energy Prices and Bills - Impacts of Meeting Carbon Budgets." London: Committee on Climate Change. https://www.theccc.org.uk/wp-content/uploads/2017/03/Energy-Prices-and-Bills-Committee-on-Climate-Change-March-2017.pdf.

CEBR. 2011. "British Gas Home Energy Report 2011: An Assessment of the Drivers of Domestic Natural Gas Consumption." London: Centre for Economics and Business Research. https://www.centrica.com/sites/default/files/bg_home_energy_report_110202_0.pdf.

DECC. 2012. "Energy Consumption in the United Kingdom: 2012 - Domestic Energy Consumption in the UK since 1970." Department of Energy & Climate Change.

– 2013. "The Future of Heating: Meeting the Challenge." Department of Energy & Climate Change. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/190149/16_04-DECC-The_Future_of_Heating_Accessible-10.pdf.

– 2016a. "Household Energy Efficiency National Statistics, Detailed Report 2015." London: Department of Energy & Climate Change. https://www.gov.uk/government/statistics/household-energy-efficiency-national-statistics-detailed-report-2015.

– 2016b. "Impact Assessment for the Level of the Fifth Carbon Budget." London: Department of Energy & Climate Change. http://www.legislation.gov.uk/ukia/2016/152/pdfs/ukia_20160152_en.pdf.

– 2016c. "Updated Energy and Emissions Projections: 2015." Department of Energy & Climate Change. https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2015.

Element Energy, and Energy Saving Trust. 2013. "Review of Potential for Carbon Savings from Residential Energy Efficiency." London: Committee on Climate Change. https://www.theccc.org.uk/wp-content/uploads/2013/12/Review-of-potential-for-carbon-savings-from-residential-energy-efficiency-Final-report-A-160114.pdf.

Element Energy, Frontier Economics, and Imperial College London. 2015. "Research on District Heating and Local Approaches to Heat Decarbonisation." London: Committee on Climate Change. https://documents.theccc.org.uk/wp-content/uploads/2015/11/Element-Energy-for-CCC-Research-on-district-heating-and-local-approaches-to-heat-decarbonisation.pdf.

Enerdata. 2017. "Odyssee Decomposition Facility." *ODYSSEE-MURE*. http://www.indicators.odyssee-mure.eu/decomposition.html.

Frontier Economics, and Element Energy. 2013. "Pathways to High Penetration of Heat Pumps." London: Committee on Climate Change. https://www.theccc.org.uk/wp-content/uploads/2013/12/Frontier-Economics-Element-Energy-Pathways-to-high-penetration-of-heat-pumps.pdf.

Guertler, Pedro, and Jan Rosenow. 2016. "Buildings and the 5th Carbon Budget." London: Association for the Conservation of Energy. http://www.ukace.org/wp-content/uploads/2016/09/ACE-RAP-report-2016-10-Buildings-and-the-5th-Carbon-Budget.pdf.

HPM Magazine. 2016. "UK Boiler Sales Fall by 1.9% in 2015." *Heating & Plumbing Monthly Magazine (HPM)*. January 18. http://www.hpmmag.com/news/uk-boiler-sales-fall-by-1-9-in-2015.

ITRC. 2016. "National Needs Assessment (NNA) - ITRC Interim Report: Analysis of Strategic Options for the NNA." Oxford: UK Infrastructure Transitions Research Consortium.

Ofgem. 2017. "Infographic: Bills, Prices and Profits." *Office of Gas and Electricity Markets*. https://www.ofgem.gov.uk/publications-and-updates/infographic-bills-prices-and-profits.

Sorrell, Steve. 2004. *The Economics of Energy Efficiency: Barriers to Cost-Effective Investment*. Edward Elgar.

Turner, Karen, Gioele Figus, and Fiona Riddoch. 2017. "So Which Households Can Benefit from Energy Efficiency and Is There an Argument to Fund from the Public Purse? Research Briefing 04," January. https://pure.strath.ac.uk/portal/en/publications/so-which-households-can-benefit-from-energy-efficiency-and-is-there-an-argument-to-fund-from-the-public-purse-research-briefing-04(4e817f38-46cd-402f-a082-a3a8e8ad0015).html.

UKERC. 2017. "UKERC Calls for Urgent Action on UK Energy during This Parliament." *UK Energy Research Centre*. January 9. http://www.ukerc.ac.uk/news/ukerc-calls-for-urgent-action-on-uk-energy-during-this-parliament.html.

Centre on Innovation and Energy Demand

About Centre on Innovation and Energy Demend (CIED)
The Centre on Innovation and Energy Demand (CIED) sits at the forefront of research on the transition to a low carbon economy. We investigate new technologies and new ways of doing things that have the potential to transform the way we use energy and achieve substantial reductions in energy demand. CIED is one of six centres on End Use Energy Demand, funded by the Research Councils Energy Programme.

www.cied.ac.uk **Follow us: @CIEDresearch** Jubilee Building, Brighton BN1 9SL CIED@sussex.ac.uk +44(0)1273 877237

UKERC
UK Energy Research Centre

About UKERC
The UK Energy Research Centre (UKERC) carries out world-class, interdisciplinary research into sustainable future energy systems.
It is a focal point of UK energy research and a gateway between the UK and the international energy research communities.
Our whole systems research informs UK policy development and research strategy. UKERC is funded by The Research Councils Energy programme.

www.ukerc.ac.uk **Follow us: @UKERCHQ** 11 Princes Gardens, London SW7 1NA ukercpressoffice@ukerc.ac.uk +44 (0) 207 594 1574

CIED and UKERC are funded by
the Research Councils Energy Programme.

Research Councils UK Energy For a Low Carbon Future