Raising the SAP

Tackling fuel poverty by investing in energy efficiency

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Research summary

Consumer Focus commissioned the Association for the Conservation of Energy (ACE) and the Centre for Sustainable Energy (CSE) to investigate the impact of carrying out a major retrofit energy efficiency programme in England that would bring the properties of 'fuel poor' households up to a target SAP81 or Energy Performance Certificate (EPC) Band B standard. The information was required to provide evidence for a fuel poverty bill currently before Parliament, which seeks to tackle fuel poverty by improving the energy efficiency of homes. The bill proposes target standards of EPC band B, or in the case of 'hard to treat' properties, EPC band C. The standards were selected on the basis that they would ensure the vast majority of households living in improved properties could enjoy 'affordable warmth' and no longer live in fuel poverty. For this reason, the programme is referred to as 'fuel poverty proofing' properties.

This report presents the results of the research. The research uses modelled data from the 2006 English House Condition Survey. In brief, the research found that the proposed retrofit programme would almost entirely eliminate fuel poverty in England. It would also prevent the risk of fuel poverty re-occurring in the future. The main results are as follows:

- A retrofit programme that aims to bring properties in England up to a target standard of SAP81, or EPC band B, would remove 83 per cent of fuel poor households from fuel poverty.
- The setting of a high target EPC Band B standard for the proposed retrofit programme determines the type of energy efficiency measures required. They would include solid wall insulation and renewable measures. 73 per cent of properties occupied by the fuel poor would be brought up to EPC bands B or C by the retrofit programme, a dramatic improvement given that only 0.9 per cent currently fall into these bands.
- A similar programme targeted at all properties in England would bring 87 per cent of properties up to Bands B or C, a considerable improvement on the current 6.4 per cent that fall within these bands.
- The programme would reduce the fuel bills of the 'fuel poor' by, on average, 52 per cent (46 per cent for 'all' households) and their carbon emissions by 59 per cent (55 per cent for 'all'). Many fuel poor households would benefit from considerably larger fuel bill savings of up to 70 per cent.
- The proposed programme would cost, on average £6,860 per property if ultimately all properties are improved, or £8,820 if the programme stops with the fuel poor. This represents an annual expenditure of £3bn pa for a seven year period, based on the 2016 target date for fuel poverty elimination. This would require an estimated three fold increase in current annual expenditure.
- The proposed programme, based on a EPC Band B target, would bring properties up to an average SAP of 76 (Band C) if all properties are improved, and SAP 71 (Band C) if only those occupied by the fuel poor are improved.
- The lower average SAP achieved for properties occupied by the fuel poor reflects the extremely low standards of many of these properties. The average SAP for properties currently occupied by the 'fuel poor' is 36 or EPC Band F. This compares with SAP 48, or EPC Band E, for 'all' households. 87 per cent of homes currently occupied by the fuel poor fall into EPC Bands E, F or G.
- The average SAP of the 17 per cent of properties occupied by those remaining in fuel poverty after improvement would be 61 or EPC Band D – a substantial increase given that the current average for these 'extremely hard to treat' properties is 35 or EPC Band F. However, it is not sufficient to remove such households from fuel poverty.
- Policies for eliminating fuel poverty among the remaining 17 per cent of households might include installation of more expensive measures than those modelled, provision of additional benefits and

provision of social tariffs. It is also possible that CHP and district heating programmes would lead to further improvements.

- The proposed programme would provide £940m Gross Value Added benefits each year for seven years, lead to 35,700 direct jobs pa and provide considerably more indirect jobs due to increased disposable income from lower energy bills. It would therefore represent a major boost to the economy.

1 Introduction

Consumer Focus commissioned the research to investigate the benefits and feasibility of carrying out a major retrofit programme to improve the energy efficiency standards of the English housing stock. Consumer Focus wanted the research to inform its work, alongside a coalition of poverty and environmental organisations, to promote a fuel poverty bill currently before Parliament[1]. The original bill proposed setting a target standard of SAP 81[2] for improving the homes of fuel poor households. The bill was later amended to propose target standards of Energy Performance Certificate (EPC) band B, or in the case of 'hard to treat' properties, EPC band C. Consumer Focus considers the proposed programme would have the following benefits:

- It would raise the energy efficiency standards of housing to such a standard that occupants no longer live in fuel poverty. This is referred to as 'fuel poverty proofing' properties.
- The standard should be sufficiently high to protect most households from falling back into fuel poverty as a result of possible future fuel price rises. Band B (SAP81) is now considered the optimum standard required to 'fuel poverty proof' properties (Boardman, 2007). This corresponds with Energy Performance Certificate Band B and is the target standard for newly built properties.
- It would ensure that the Government's statutory duty to eliminate fuel poverty in England by 2016 is met.
- It would reduce consumers' dependence on fuel companies both by reducing their requirement for energy (through improved thermal efficiency) and by allowing many to generate their own energy (through the installation of renewable energy measures).
- It would make a major contribution towards meeting the Government's carbon reduction targets and hence towards addressing climate change.
- It would protect the fuel poor from any additional costs from climate change measures

The research therefore investigated two scenarios:

i) a programme designed to improve the properties of the fuel poor to a target SAP81/EPC band B standard by 2016; and

ii) a programme designed to improve all properties to a target SAP81/EPC band B standard by 2020.

Many fuel poor households do not require a standard as high as SAP81/EPC B, particularly those on the 'margins of fuel poverty' (those that need to spend between 10 and 15 per cent of their income on 'all fuel use' to maintain adequate warmth and meet other energy needs). However, Consumer Focus considers the proposed retrofit programme should aim to bring properties up to SAP81 or EPC B wherever possible (while recognising that EPC band C might only be achievable, particularly in the case of 'hard to treat' properties). By setting a stringent target, properties are improved to very high energy efficiency standards, even in cases where it is not possible to achieve SAP81/EPC B at reasonable cost.

The research also provided some comparable estimates for the cost of a retrofit programme that would only aim to bring properties up to EPC band C (SAP 69). The results for this target standard are given in Appendix 2. Consumer Focus would prefer a target EPC Band B programme, rather than Band C, on the following grounds:

[1] See http://services.parliament.uk/bills/2008-09/fuelpoverty.html

[2] The SAP(Standard Assessment Procedure) scale rates the energy efficiency properties of homes on a scale of 0 to 100, with some homes which export energy going above 100.

- For some households, a band C target may be less likely to remove them from fuel poverty today (2009) than 2006 (the year of the dataset used by the research), given the considerable increase in fuel prices that has occurred since 2006.
- A band B target provides more comprehensive protection against future fuel poverty than Band C, ie, it helps ensure households do not fall back into fuel poverty due to future price rises.
- Given the considerable home improvements required to achieve band C, it would make a lot of sense to improve homes to Band B at the same time, if feasible. It would be inefficient for builders to revisit properties at a later date to meet, for example, low carbon policy objectives.
- A household living in a band B property will pay, on average, a 36 per cent lower fuel bill, compared to band C, all other things being equal.

The research used data from the 2006 English House Condition Survey (EHCS) to model three levels of intervention, using ACE's T-Zero tool (see Appendix 1 for more details). Each level of intervention attempts to raise the energy efficiency standards of the English housing stock, particularly that section occupied by the fuel poor, to a target SAP 81/EPC B standard. The levels of intervention are based on the cost of improvement and range from low cost to higher cost packages of measures. The model did not involve any provision of measures for the small percentage of properties (below 1 per cent) already at SAP 81/EPC B. The research presents results for those properties occupied by 'fuel poor' households and for those occupied by 'all' households in England.

The modelling provided information on the following:

- total cost, bills, energy and carbon impacts
- average SAP rating of dwellings before and after intervention, broken down by region
- numbers in fuel poverty before and after intervention and SAP ratings of those households remaining in fuel poverty

2 The three levels of intervention

The development of the intervention packages, from low cost to higher cost, is explained below. The improved SAP rating is checked after the installation of each measure for each level of intervention, and no further work undertaken if SAP 81 is reached. The research erred towards caution with respect to the limitations it placed on measures that could be installed. For example, it did not allow the installation of certain measures to listed buildings. It may therefore have been possible to achieve a greater level of energy improvement if such limitations are overcome in practice.

Level 1: low cost
In this intervention package, compact fluorescent lamps (CFLs), draught proofing, loft and cavity wall insulation are installed wherever they are applicable in dwellings that have a SAP rating below 81/EPC B.

Level 2: medium cost
In this intervention package, all of the low cost measures in Level 1 are installed followed by:

- replacing old gas and oil boilers with condensing ones (either combi or normal, corresponding to the existing type)
- installing internal insulating lining into uninsulated solid or non-traditional wall dwellings, unless the building is listed
- installing solar water heating where the roof is appropriate, unless the dwelling is listed.

Level 3: higher cost
In this intervention package all of the measures in Levels 1 and 2 are installed:

Except

- Where the installation of internal insulated lining does not achieve SAP 81/EPC B, the following hierarchy of insulation measures is installed:
  1. internal insulation is installed, provided the property is not listed and the rooms are not small
  2. installs external insulating render, provided the dwelling is not listed
  3. installs external cladding, provided dwelling is not listed.

In addition

- Where heating is currently electric or solid fuel, the following hierarchy of heating measures is installed instead:
  1. ground source heat pump (and under floor radiator system), provided the dwelling is not listed and has a deep enough garden
  2. air source heat pump (and normal radiator system), provided dwelling is not larger than 60m^2 and is not listed
  3. biomass central heating system provided dwelling is physically suitable, one occupant of household is 60 or younger and the dwelling is not listed
- Double glazing is also installed if the dwelling is single glazed.

The Level 3 intervention package was found to meet the objective of 'fuel poverty proofing' properties for most fuel poor households. The report therefore present results for this level of intervention.

3 Caveats and limitations to modelling

Community level renewables, combined heat and power (CHP) and district heating were not included in the models. There is obviously great potential, largely yet unrealised, for installation of these technologies, as recognised by the Government's recent draft Heat and Energy and Saving Strategy (DECC, 2009a). Studies have indicated that scale is all-important to the cost effectiveness of CHP network provision (Boardman, 2007), making specific targeting of the fuel poor more difficult. Were CHP/district heating schemes included in the modelling, they would in some cases displace the modelled energy improvements and in some cases provide additional improvements.

The research only modelled measures of 'standard' specification. Measures with very high specification, for example super-insulation, were not included. Greater SAP improvements, energy savings and fuel bill reductions are therefore achievable than those shown in the three intervention packages[3]. However, they were not included in the models because of their particularly high costs at today's prices. Nonetheless, higher specification measures will inevitably become standard in the future as their technologies develop and their markets transform.

Micro-CHP and micro-wind turbines were also not included in the models due to uncertainties over their impact on reducing fuel bills (and hence uncertainty over how to model them).

[3] See www.sustainable-energyacademy.org.uk/pages/inspired/locator.php for examples.

RESULTS

4 Costs, fuel bills, energy and carbon

Table 1 below shows the impact of the proposed improvement (Level 3) programme on costs, fuel bills, energy and carbon.

Table 1: Costs, fuel bills, energy and carbon

	Fuel poor households	All households
Total cost[1]	£21,437m	£145,600m
Cost per household	£8,820	£6,860
Fuel bills before improvement[2]	£3.2bn	£21.8bn
Annual fuel bill saving	£1.6bn	£10bn
% reduction in annual fuel bills	52%	46%
Annual energy used before improvement (TWh)	85.3	593.9
Annual energy saving (TWh)	48.1	310.9
% reduction in energy used	56%	52%
Annual carbon emissions (MtC)	5.7	37.5
Annual reduction in carbon emissions (MtC)	3.3	20.7
% reduction in carbon emissions	59%	55%

[1] Table 2 and Appendix 1 gives details of how the research estimated the costs of measures, taking into account different built forms. In general, the average costs used in the research are similar to those for CERT. However, the original research calculated considerably higher average costs for external wall insulation than those quoted by the Government in its HESS consultation (DECC, 2009a). The findings presented in this report are based on the Government's average cost estimate of £4,500 for external wall insulation.

[2] Fuel bills are given at 2006 prices

Table 1 demonstrates the dramatic impact of a major energy efficiency retrofit programme on fuel poverty. It would slash the fuel bills of the fuel poor by a half, reduce requirements for energy by over a half and reduce carbon emissions by 59 per cent. The programme would therefore also make a major contribution towards the Government's climate change targets. For many fuel poor households, the programme would reduce their fuel bills by up to 70 per cent.

The current estimated annual expenditure on programmes that contribute to tackling fuel poverty is £910m. This consists of £320m under the Warm Front programme (including recently announced funding increases), £540m under the priority group element of CERT (assuming £1.9bn over three years and 85 per cent of this is spent in England) and £50m under social housing providers' decent homes programmes (DECC, 2009b; FPAG, 2007).

The proposed programme would cost, on average, £6,860 per property if all properties are improved, or £8,820 if the programme stops with the fuel poor.

The costs of two thirds of individual installations within the programme will fall within a range of £4,890 and £14,890, that is £5,000 plus or minus of the average cost.

The total cost of the proposed programme is £21bn with an annual cost of £3bn pa. Annual costs are based on a seven year programme to ensure that the 2016 target date for fuel poverty eradication is met.

The proposed retrofit programme would therefore require a three fold increase (approximately) in current annual expenditure on energy efficiency programmes that contribute to tackling fuel poverty.

The estimated costs of the retrofit programme do not take into account possible cost reductions arising from economies of scale or market transformation. Costs may further reduce through 'whole house' and area-based approaches, eg, use of scaffolding for installation of both solar thermal and solid wall insulation, reduced contractor travelling time due to systematic delivery of a programme on a street by street basis.

5 Details of measures installed

Table 2 below gives details of the measures that would be installed under the retrofit programme. It also compares these with current installation rates for measures, based on Warm Front and the Priority Group element of the CERT programme.

Table 2: Details of measures provided under improvement programme

Measure	Number of measures required		Annual installation rate (FP households)	Current annual installation rates[1]	Average cost of measures[2] £
	Fuel poor households	All households			
Loft Insulation	1,479,800	11,707,200	211,400	271,100	290[3]
Cavity Wall Insulation	833,700	8,121,600	119,100	225,200	380
Internal Wall Insulation	50,700	460,400	7,200	negligible	4,400
External Wall Insulation	1,001,100	5,692,300	143,000	7,600	4,500
Insulating Render	12,500	141,800	1,800	negligible	3,500
Flexible Insulated Lining	7,900	140,300	1,100	negligible	1,700
Double Glazing (16mm)	720,600	3,838,900	102,900	negligible	5,000
Draught Proofing	65,100	485,000	9,300	36,000	100
Gas replacement boiler	1,426,400	15,392,100	203,800	97,300	1,400
Oil replacement boiler	197,700	870,400	28,200	700	4,100
Biomass Boiler[4]	28,200	155,400	4,000	negligible	7,200
Air Source Heat Pump	160,700	1,123,500	23,000	negligible	5,900
Ground Source Heat Pump, inc. under-floor heating	96,500	268,900	13,800	negligible	11,400
Solar Water Heating	1,987,200	16,599,700	283,900	negligible	3,500
Compact fluorescent lamps	21,025,500	185,392,500	3,003,600	11,259,200	8[5]

Notes

[1] Based on installation rates for Warm Front and Priority Group element of CERT.

[2] Based on three-bedroomed semi. In the modelling, measure costs vary according to built form and size of dwelling. Most costs contain a fixed and variable cost component.

[3] Cost of installation for 'virgin' lofts; £260 assumed for loft top-ups

[4] Not installed in the properties of households where none of the occupants are 60 or younger.

[5] Model also assumed £4 for properties requiring 50 per cent CFLs.

Table 2 demonstrates that many of the measures required to 'fuel poverty proof' properties are currently not installed under existing programmes (with the possible exception of some social landlord improvement programmes). However, all of the measures are technically feasible and indeed commonplace in many European countries. Table 2 shows that renewable measures, particularly renewable heat, would play an important role in 'fuel poverty proofing' properties. These would also have the benefit of reducing households' dependence on fuel companies since they allow householders to generate their own energy.

Similarly, reduced demand for energy through improved insulation and more efficient heating also reduces householders' dependence on fuel companies.

6 Fuel poverty and energy efficiency

Table 3 below shows the impact of the proposed retrofit programme on the level of fuel poverty and SAP values of properties improved.

Table 3: Impact of programme on fuel poverty and SAP

	Average SAP		Proportion of FP h/hds lifted out of fuel poverty	H/hds in fuel poverty	Average SAP of h/hds remaining in fuel poverty
	Fuel poor	All Properties			
Before improvement	36	48	0%	2,432,000	35
After improvement	71	76	83%	415,000	61

Table 3 shows that the proposed improvement programme would reduce the number of fuel poor households from 2.432m households (based on 2006 EHCS data) to 415,000, a drop of 83 per cent. This represents a major reduction in fuel poverty and demonstrates how a policy of 'fuel poverty proofing' properties could almost eradicate fuel poverty.

Table 3 shows that the average SAP value of properties occupied by the 17 per cent of households remaining in fuel poverty after improvement is 61. This represents a dramatic improvement in standards but is obviously insufficient to eliminate fuel poverty altogether. Further policies would be required to tackle fuel poverty in these households. These might include the installation of more expensive measures than those modelled, provision of additional benefits and provision of social tariffs. It is also likely that combined heat and power (CHP) and district heating programmes would have an impact.

Table 3 shows that the average SAP of properties occupied by fuel-poor households before intervention is 36, compared to a significantly higher whole stock average of 48. The table demonstrates the particularly poor thermal efficiency standards of properties occupied by fuel poor households. It also explains why the average SAP value after improvement is lower for the properties of 'fuel poor' households than it is for 'all' properties (SAP 71 for properties of 'fuel poor', compared to SAP 76 for 'all' properties).

Further exploration of the characteristics of properties occupied by households remaining in fuel poverty after improvement found that the type of measures that could be installed were limited. The properties were disproportionately likely to be flats, built with solid or non-traditional walls and listed, although in the latter case the number of 'fuel poor' households living in such properties was fairly low. Other limiting factors included garden depth (for ground source heat pumps) and the suitability of roofs for solar water heating. Furthermore, the properties had low SAP ratings to begin with, tended to be 'harder to treat', and frequently households had very low incomes. Significant improvements in the SAP rating and fuel bill savings were achieved in every case, but not enough to lift the occupants out of fuel poverty.

Table 4 below gives a regional breakdown of the programme's impact on fuel poverty and SAP values.

Table 4: Regional impact of programme on SAP values and fuel poverty

	North East	Yorkshire and The Humber	North West	East Midlands	West Midlands	South West	East of England	South East	London	**TOTAL**
SAP before	40	37	38	34	34	30	37	35	42	**36**
SAP after										
Fuel poor households	72	71	71	71	69	68	71	70	73	**71**
All households	76	76	76	76	75	75	76	77	78	**76**
Fuel pov. before (000s)	179	273	415	236	304	256	224	291	254	**2,432**
% of households	*16.4*	*12.7*	*14.2*	*12.9*	*13.7*	*11.6*	*9.7*	*8.4*	*8.3*	***11.5***
Fuel pov. after (000s)	27	34	83	40	62	40	30	46	53	**415**
% of households	*2.5*	*1.6*	*2.8*	*2.2*	*2.8*	*1.8*	*1.3*	*1.3*	*1.7*	***2.0***

7 Impact of programme on EPC bands

Table 5 below shows the impact of the proposed programme on the Energy Performance Certificate (EPC) band ratings of improved properties. Results are presented for a programme that only targets the fuel poor and for a programme that targets all households.

Table 5: Impact of improvement programmes on EPC bands

		A	B	C	D	E	F	G	Total
Fuel poor only	Before	0	0	22,500	301,600	888,200	765,100	454,300	2,431,700
	%	0	0	0.9%	12.4%	36.5%	31.5%	18.7%	100%
	After	0	517,400	1,257,533	361,200	191,500	86,200	17,900	2,431,700
	%	0	21.3%	51.7%	14.9%	7.9%	3.5%	0.7%	100%
All h/hds	Before	0	24,000	1,336,700	6,134,000	8,923,600	3,914,100	888,300	21,220,800
	%	0	0.1%	6.3%	28.9%	42.1%	18.4%	4.2%	100%
	After	32,100	7,838,800	10,578,600	2,062,200	505,500	174,500	29,200	21,220,800
	%	0.2%	36.9%	49.8%	9.7%	2.4%	0.8%	0.1%	100%

Table 5 shows that the improvement programme would bring 73 per cent of properties occupied by households in fuel poverty to either EPC B or C. This represents a dramatic improvement, given that only 0.9 per cent of properties were in these bands before improvement. Table 3 earlier demonstrated that the improvement programme would remove 83 per cent of households from fuel poverty. This suggests that 10 per cent of the properties occupied by the former 'fuel poor' do not achieve EPC B or C but the improvement is still sufficient to remove these households from fuel poverty. These households are likely to have slightly higher incomes than other fuel-poor households and therefore do not require the same improvement in energy efficiency standards to take them out of fuel poverty. However, it is possible that these households would be more vulnerable to falling back into fuel poverty in the event of further fuel price rises.

A programme that targets all properties in England would bring 87 per cent of properties up to EPC B or C, compared to 73 per cent of properties occupied by the fuel poor. This demonstrates the particularly low energy efficiency standards of properties occupied by fuel poor households.

Table 5 also shows that 12 per cent of properties occupied by fuel poor households still fall into bands E, F and G, even after improvement (87 per cent of properties fell into these bands before improvement). The corresponding figure for 'all properties' is 3.3 per cent (after improvement). The installation of CHP and district heating, as envisaged in the Government's Heat and Energy and Saving Strategy, will make further inroads into improving SAP standards for properties occupied by both 'fuel poor' and 'non-fuel poor' households. As stated above, the research was not able to model the potential impact of CHP/district heating and community renewables. The lack of sufficient improvement for certain properties would suggest that a range of further policies are required to tackle this residual problem. These might include:

- Installation of more expensive measures
- Community and district heating and community renewables
- Provision of additional social security benefits, eg, heating additions (as existed before the social security reforms of 1988).
- The continued provision of social tariffs

Figures 1 and 2 below present the data shown in Table 5 graphically.

Figure 1: EPC ratings of properties before and after improvement (fuel poor households)

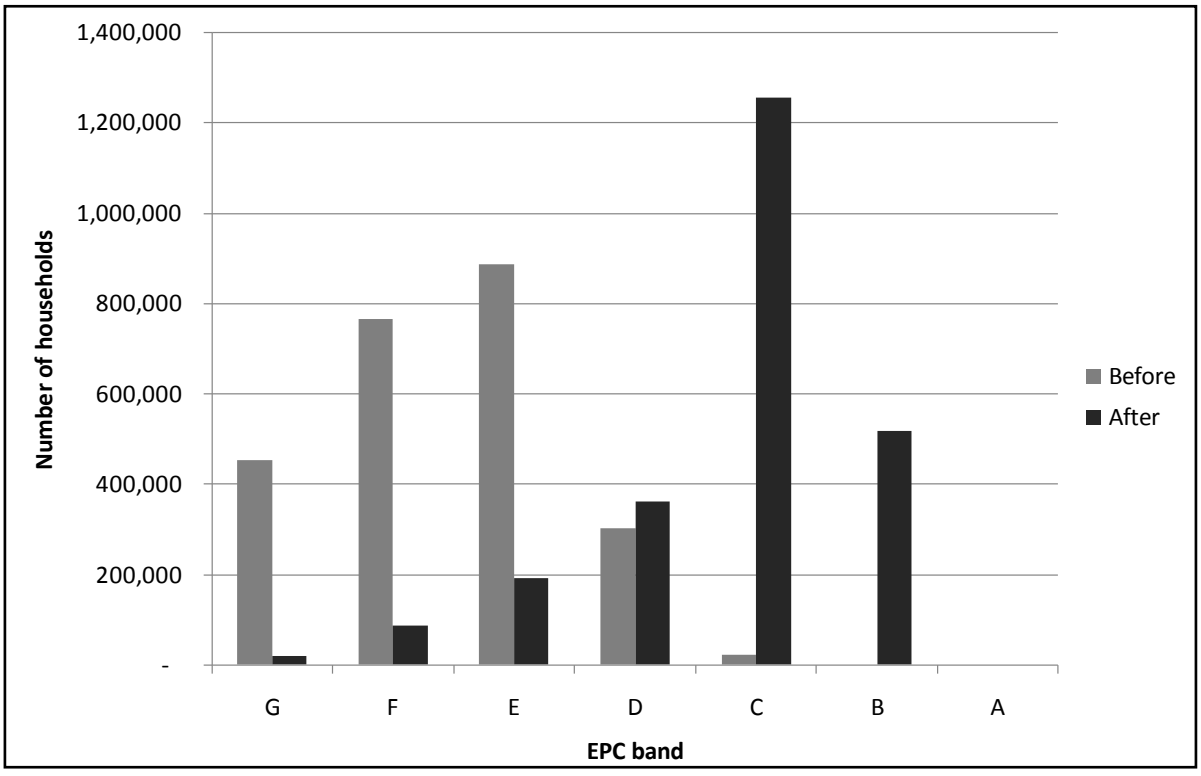
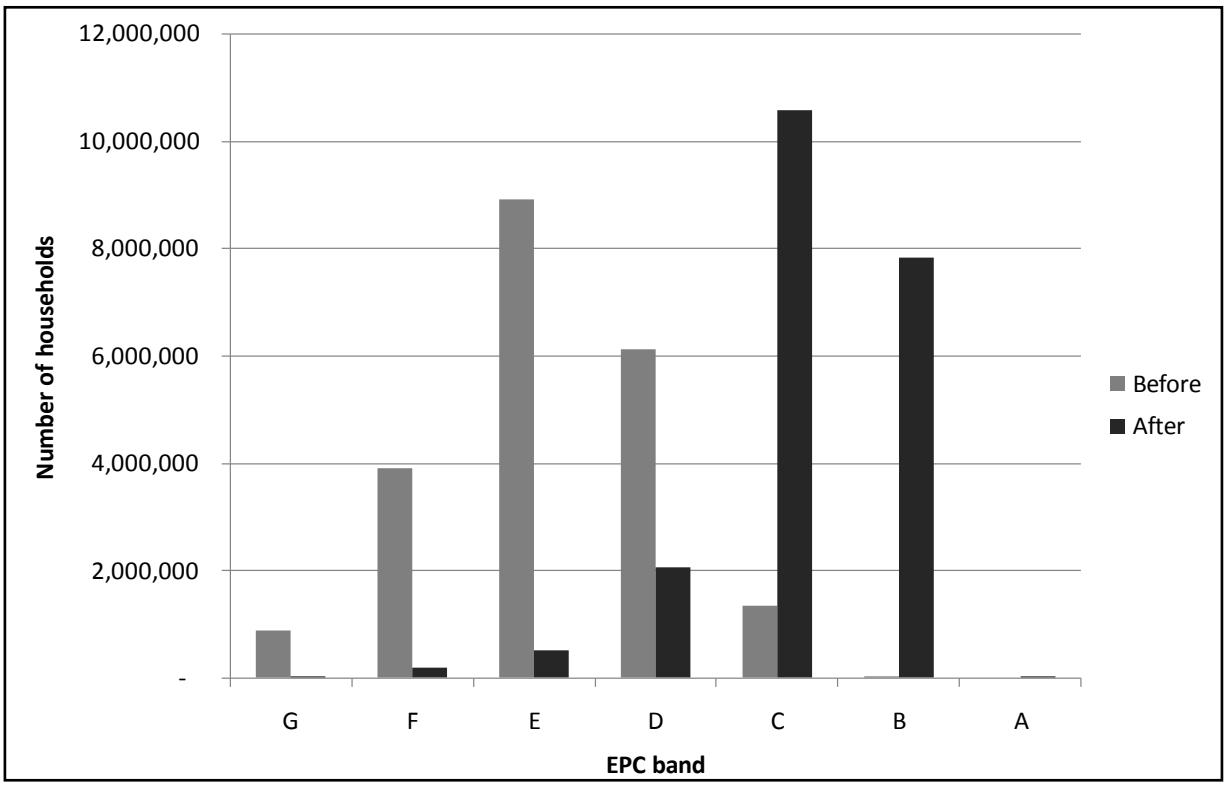


Figure 2: EPC ratings of properties before and after improvement (all households)



8 Impact of improvement programme on the economy

It is envisaged that the proposed improvement programme will have major economic benefits. The research estimated this by calculating the likely Gross Value Added (GVA) benefits that would arise from the programme. The research also estimated the likely number of direct jobs associated with the programme.

The research did not calculate the indirect effects that would arise from the programme, eg, due to increased disposable income from reduced fuel expenditure. These would be considerable, given that the programme would reduce the fuel bills of the fuel poor by £1.6bn per year. This latter effect could have particular benefits for the economies of deprived areas, since low income households spend a much higher proportion of their income in the local economy than higher income households. Table 6 below shows the estimated economic benefits that would arise from the proposed improvement programme.

Table 6: Economic impact of proposed retrofit programme (excludes CFLs)

	Total Measures	Total costs (£M)	GVA (£M)	Measures/ yr	Costs/yr (£M/yr)	GVA/yr (£M/yr)	Total Jobs per yr
Current (Eng) CERT PG & WF[1]	-	-	-	698,000	£460m	£140m	4,300
Proposed improvement programme	8,068,000	£21,437m	£6,600m	1,153,000	£3,062m	£943m	35,700

Notes

[1] This does not include the cost of measures under social housing providers' Decent Home programmes. The estimate is based on the value of measures, rather than total expenditure under the programmes (which includes administration and other costs). It also does not include the recent increases to the Warm Front budget nor the increases proposed under the current 'CERT plus' consultation.

Table 6 shows that the proposed programme would have considerable economic benefits. A 'fuel poor' only retrofit programme would add £6,600m GVA to the economy in total, or £940m pa over the seven year period. This would sustain 35,700 jobs per year, compared to the current 4,300 jobs sustained by the Warm Front and priority group element of the CERT programme, i.e. an eight fold increase in direct jobs. At a time of economic recession, this would represent a major boost to the economy.

It is useful to compare the estimated cost of £3.06bn per year for the proposed programme with the estimated current expenditure on energy efficiency measures of £7.57bn per year by all households. Appendix 3 gives more details of the latter estimate. It includes Warm Front, EEC 2 (priority group and non-priority group), local authority and housing association programmes (not supported by EEC) and householders' own expenditure. Current energy efficiency activity is estimated to contribute £2.48bn pa GVA to the economy and sustain 52,000 jobs per year. However, a programme that aims to improve all housing (with an initial focus on the fuel poor) would obviously contribute a considerably higher GVA and potentially sustain a very substantial number of jobs.

A number of recent reports have highlighted the benefits of an energy efficiency-based fiscal stimulus (eg, Impetus, 2009; Environmental Industries Commission, 2009; LGA, 2009, Killip, 2008). This report shows how a major energy efficiency programme, based on a target EPC standard and initially targeting the fuel poor, would eliminate the bulk of fuel poverty in this country, cut carbon emissions considerably and provide a major boost to the economy.

9 Conclusion

The research shows that the implementation of a major energy efficiency programme to 'fuel poverty proof' the homes of the fuel poor would eradicate the vast majority of fuel poverty in England. The inclusion of a challenging target, namely SAP81 or EPC band B, within the programme would act as a driver for the type of energy efficiency measures delivered under the programme. The research shows that the programme would improve three out of four properties occupied by the fuel poor to EPC band B or C and take 83 per cent of households out of fuel poverty. This would reduce their fuel bills by 52 per cent or £1.6bn per year, with many fuel poor households enjoying reductions of up to 70 per cent. Furthermore, these calculations are based on 2006 fuel prices. Given the considerable rise in fuel prices since 2006, the savings would be even higher today.

The programme would cost, on average, £6,800 per property if all properties in England are improved, or £8,800 if the programme only targets the fuel poor. The total cost of the programme would be £21bn, or £3bn pa based on the 2016 target date for fuel poverty elimination. Current annual expenditure on energy efficiency programmes aimed at the fuel poor is estimated at £910m. The proposed retrofit programme would therefore require a three fold increase in expenditure.

These figures are based on 2006 English House Condition Survey data. The Government estimates that fuel poverty increased by 1.1m households between 2006 and 2008 (to 3.5m households) (Defra & BERR, 2008). This suggests that the cost estimates would need revising upwards to take account of the increased incidence of fuel poverty, although the average cost per household would be lower. Furthermore, the cost estimates do not take into account the possible economies of scale that may be realised from a major programme, nor possible reductions arising from 'whole house' and systematic, area-based approaches to delivery.

The research does not address delivery, other than to outline the annual measure installation rates required to meet the 2016 deadline. In some cases, such as heat pumps and solid wall insulation, a dramatic

increase in installation rates is required. This is because programmes such as Warm Front and the priority group element of the CERT programme (and its predecessor EEC programme) have not delivered such measures at any significant scale, yet they are essential if 'fuel poverty proofing' is to be achieved. In broad terms, the programme would need to deliver measures to 500,000 fuel poor households per year in order to reach the 2016 target for fuel poverty elimination, ie, 3.5m households in total. While ambitious, this is less than the Government's proposal to provide 'whole house' energy efficiency measures to 7m properties by 2020, as described in the draft Heat and Energy Saving Strategy (DECC, 2009a).

Finally, the research suggests that the programme would bring about considerable economic benefits. It would add £940m GVA per year over the seven year period (£6,600m in total) and increase the number of associated jobs eight fold – to 35,700 jobs per year. It would therefore represent a very cost effective way of addressing the current recession and protecting the fuel poor from any price increase linked to climate change initiatives.

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Appendix 1 - Methodology

The research methodology comprised of four stages:

1. Utilisation of the T-ZERO calculation tool
2. Matching up the EHCS dataset with modelled T-ZERO buildings
3. Improving the T-ZERO buildings through the application of Improvement measures
4. Feeding the proportional improvements under the T-ZERO tool back into the EHCS results to determine improvements in SAP, and implications for fuel poverty.

T-ZERO calculation tool

The T-ZERO modelling engine utilises the Government's Standard Assessment Procedure (SAP 2005) for assessing the energy performance of dwellings. SAP 2005 is an elaborate calculation that estimates, amongst other things, the energy demand and CO_2 emissions of a building, based on its material construction, thermal insulation, ventilation characteristics, heating system efficiency, solar gains, fuel mix, and the presence of renewable energy technologies. The rating itself is based on a scale of energy costs per m^2 of floor space. T-ZERO replicates this underlying calculation but narrows the range of permissible entries by defining 'base builds' and 'measures'; the presence/absence of which alter the values used in the calculations.

There are 84 'base builds' used in T-ZERO, each representing a combination of building type, wall type and floor area, with the latter approximated from the number of bedrooms (see Table A2-1). The built form determines the geometry of the building, as well as parameters such as the exposed wall area, glazed area, and roof area. This geometry is scaled according to the number of bedrooms selected, with each bedroom number representing a floor area for that built form. The selection under wall type determines both the underlying thermal performance of the facade and the appropriate improvement measures subsequently offered.

Table A1.1 – Base Build Options

Build Form	Wall Type	Bedroom Number
Top Floor Flat	Cavity Wall	1,2, or 3 if Build Form is Flat
Mid Floor Flat	Solid Wall	2,3 or 4 if Semi, Terrace or Bungalow
Bottom Floor Flat	Non-Traditional Wall	2,3,4 or 5 if Detached
Semi-Detached		
Detached		
Terrace		
End Terrace		
Attached Bungalow		
Detached Bungalow		

A series of optional 'measures' were defined to enable the performance of buildings that conform to the same 'base build' to be distinguished. There are eight categories of measures: loft insulation, wall insulation, glazing, draught proofing, CFLs, heating system, renewable technologies, and secondary heating system. The full list of options under these categories can be found in Table A2-2. The presence or absence of these measures impact upon the SAP 2005 calculation in different but logical ways; the presence of wall insulation reduces the U-value of the exposed walls depending on the type of insulation used for example.

Table A1.2 – Measure options

Loft Insulation	Wall Insulation	CFLs	Heating System	
25mm/None	Cavity Wall Insulation	None	Old Gas Boiler	Gas Combi-Condensing Boiler
100mm	External Wall Insulation	50% CFLs	Old Gas Combi	Oil Condensing Boiler
270mm	Internal Wall Insulation	CFLs	Old Oil Boiler	Oil Combi-Condensing Boiler
	Insulating Render		Old Oil Combi	Biomass Boiler
	Flexible Insulated Lining		Electric Storage	Air Source Heat Pump
Glazing		**Renewables**	Open Coal Fire	Ground Source Heat Pump
Single Glazing	**Draught Proofing**	Solar Hot Water	Electric Underfloor Heating	
6mm Double Glazing	None	Photovoltaics	Gas Condensing Boiler	**Secondary Heating**
16mm Double Glazing	Draught Proofing	Micro Wind Turbine		Log Stove

Each measure is assigned a floor-area and built form dependent installation cost (and a maintenance cost if appropriate), with the cost of all measures added to create a total cost for the combination of base build and measure – a combination we term a 'package'. The SAP 2005 calculation is run for each 'package' permutation, except in cases where the measures are not appropriate for the built form – most notably, the combination of loft insulation, renewable technologies and certain heating systems within flats. In total there are more than four million package permutations. For each package, current fuel costs are used to estimate the fuel bills. Each package has the following key results:

- CO_2 emissions
- Energy demand
- Package installation cost (and maintenance cost)
- Fuel bills
- EPC rating

Matching EHCS with the T-ZERO calculation tool

To determine the measures requiring installation in the housing stock, the buildings in the English House Conditions Survey (EHCS) were incorporated into the T-ZERO tool. The equivalent EHCS variable for each T-ZERO parameter was established, and logic functions used to resolve the appropriate measure to be applied in T-ZERO. This created a 'copy' of each EHCS building within the T-ZERO engine.

Improving the T-ZERO buildings

Within the overall constraint – SAP 81 – measures were applied to each building in order to improve its SAP rating. For each level of intervention (see section 2), the different applicable improvement measures and the order of their installation (hierarchy) were determined. Macros were written to perform the following steps:

- Copy the initial T-ZERO building and its performance results into a new sheet
- Identify if that building achieves SAP 81; if so, retain that building without further improvement

- If not, improve the building through the addition of the first measure in the hierarchy, if that measure is not already applied.
- Identify if building now reaches SAP 81; if so, record the improved building and the measure applied.
- If not, improve the building through the addition of the second measure in the hierarchy, if that measure is not already applied... etc.

... all of this subject to additional constraints flagged up in the EHCS dataset (such as appropriateness for ground source heat pumps, etc).

For each level of intervention, the hierarchy was based on adding the most cost effective measures first, with the exception of the application of insulation in Level 3.

Following the completion of the macro, the energy consumption and fuel costs across each fuel type were known for each building before and after improvement, together with a list of the measures installed.

Feeding the results back into the EHCS

The proportional savings for each building as determined in T-ZERO were then applied back into the EHCS results with a recalculation of the fuel costs per household. This information was then run through a SAP 2005 calculation to determine the final SAP of the property. The fuel costs were also utilised to work out the numbers of households now spending more than 10 per cent of their income of fuel bills, and hence remaining in fuel poverty. Proportional kWh and CO_2 savings in T-Zero were applied in a similar manner to the EHCS dataset. This was only possible after applying the official methodology for deconstructing fuel expenditure in the EHCS into kWh consumed of each fuel, taking account of standing charges.

Appendix 2 – Impact of reaching EPC band C target

	Band C target	Band B target
Total cost (Government EWI cost estimates)	£12.9bn	£21.4bn
Cost per household	£5,290	£8,820
% reaching band C or better	58%	73%
% removed from fuel poverty (2006 fuel prices)	77%	83%
	Band C property	Band B property
Average annual fuel bill (2006 fuel prices)	£780	£500
Average annual fuel bill (2008 fuel prices)	£970	£620
% difference		36% lower

The table suggests that a band C target achieves fairly impressive results at a much lower cost than a band B target. However, as stated in the main report, it would have the following disadvantages:

- For some households, a band C target may be less likely to remove them from fuel poverty today (2009) than 2006 (the year of the dataset used by the research), given the considerable increase in fuel prices that has occurred since 2006.
- A band B target provides more comprehensive protection against future fuel poverty than Band C, ie, it helps ensure households do not fall back into fuel poverty due to future price rises.
- Given the considerable home improvements required to achieve band C, it would make a lot of sense to improve homes to Band B at the same time, if feasible. It would be inefficient for builders to revisit properties at a later date to meet, for example, low carbon policy objectives.
- A household living in a band B property will pay, on average, a 36 per cent lower fuel bill, compared to band C, all other things being equal.

Appendix 3: Economic impact of energy efficiency activity – all households

Table A3.1: Number of measures delivered in each sector (2006/7)

Measure	Warm Front England	EEC2 PG	EEC2 Non PG	Non EEC supported LA / RSL	Private Sector	All Sectors
CFL	225,549	11,033,641	18,233,854			29,493,044
Hot Water Tank Jackets	8,495	18,887	26,780			54,162
Cavity Wall Insulation	35,979	189,268	194,653			419,900
Draughtproofing	31,449	4,544	2,184			38,177
Loft Insulation	58,569	212,492	148,858		139,117	559,036
Radiator panels	-	7,930	3,153			11,083
Solid Wall Insulation (ext)	-	7,578		1,096	862	9,536
Solid Wall Insulation (int)					1,293	1,293
Gas Central Heating Package	24,200	8,103	23,088	98,031	236,383	389,805
Gas Boiler Replacement		97,304	469,867	78,695	274,908	920,774
Oil new CH	652			2,663	16,786	20,102
Oil Boiler Replacement		714	56,682	231	42,908	100,534
Electric Boiler Replacement/new CH				13,014	29,078	42,092
Soild Fuel Boiler Replacement/new CH				3,250	13,800	17,050
Night Storage Heaters (full/partial)	5,239			35,940	110,295	151,474
Heating Repairs and Replacements	59,888					59,888
Gas Wall Heating	356			75,974	508,008	584,338
Solid Fuel Fire Cassettes	1					1
Improved controls	-	216,938	425,550	355,637		998,125
TRVs*						-
FIDIHWT	435					435
Fuel Switching	613	13,686	8,725	28,512		51,537
Double Glazing	-			116,556	801,205	917,761
Energy efficient cold appliances	-	228,451	849,907			1,078,358
Energy efficient wet appliances		279,218	1,038,775			1,317,993
Ground Source Heat Pumps					86	86
Air Source Heat Pumps					78	78
Biomass boilers					86	86
Solar PV					483	483
Solar hot water					4,740	4,740
Wind Turbine					86	86
Micro CHP					6	6
LPG Boiler Replacement					17,237	17,237
Insulating render			2,557			2,557
Flexible insulated lining					2,155	2,155

Table A3.2: GVA and jobs associated with energy efficiency activity – all households (2006/7)

Measure	Total Measures	Installer (FTE)	Ancillary staff (FTE)	Total costs	GVA	GVA/FTE
Low energy light bulbs	29,493,044	10	6	£23,594,436		
Hot water tank jacket	54,162	15	10	£541,616	£27,081	£1,060
Cavity Wall Insulation	419,900	954	630	£153,764,365	£61,505,746	£38,825
Loft insulation	559,036	794	524	£133,500,608	£38,047,673	£28,864
Draught proofing	38,177	65	43	£3,673,709	£367,371	£3,401
Double Glazing	917,761	15,644	10,325	£3,943,712,500	£1,380,299,375	£53,153
External wall insulation	9,536	596	393	£62,803,179	£15,700,795	£15,870
Internal wall insulation	1,293	44	29	£4,630,467	£1,157,617	£15,823
Central heating systems	389,805	6,644	4,385	£1,442,278,715	£432,683,615	£39,229
Replacement boilers	920,774	5,232	3,453	£1,258,882,230	£377,664,669	£43,487
Oil new CH	20,102	343	226	£81,758,092	£24,527,428	£43,122
Oil Boiler Replacement	100,534	571	377	£412,459,224	£123,737,767	£130,495
Ground Source Heat Pumps	86	6	2	£979,069	£293,721	£36,911
Air Source Heat Pumps	78	2	0	£442,199	£132,660	£68,801
Biomass boilers	86	4	1	£620,536	£186,161	£38,016
Solar PV (pv)	483	11	3	£2,654,517	£796,355	£58,080
Solar hot water (shw)	4,740	162	40	£16,590,732	£4,977,220	£24,640
Wind Turbine	86	1	0	£275,794	£82,738	£67,584
Micro CHP	6	0	0	£30,165	£9,049	£84,480
LPG Boiler Replacement	17,237	98	65	£34,474,249	£10,342,275	£63,614
Insulating render	2,557	116	77	£9,065,025	£2,266,256	£11,748
Flexible insulated lining	2,155	37	24	£2,455,577	£613,894	£10,069
				£7,589,187,005	**£2,475,419,465**	

Raising the SAP
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