Energy Policy 36 (2008) 4471–4474

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Energy, equity and the future of the fuel poor ☆

Simon Roberts *

Centre for Sustainable Energy, 3 St.Peter's Court, Bedminster Parade, Bristol BS3 4AQ, UK

ARTICLE INFO

Available online 23 October 2008

Keywords:
Fuel poverty
Energy expenditure
Energy equity

ABSTRACT

A warm and adequately-lit home is considered a basic need, together with access to energy-consuming appliances ranging from a fridge to a TV. An underlying tenet of sustainable energy is that such basic needs should be affordably met.

Yet low incomes, energy-inefficient housing and appliances and high energy costs mean that roughly 10 per cent of UK households, many of them elderly or with young children, fail to attain this basic standard. These households, which would need to spend more than 10 per cent of their income to attain adequate energy services, are officially defined as 'fuel poor'.

Their cold, poorly equipped homes lead to chronic cold-related health conditions, exacerbate social isolation, and may undermine educational achievement. In addition, rural areas have a disproportionately high incidence of fuel poverty.

This Review examines the current distribution of energy consumption, its social impacts, and the opportunities to address fuel poverty through improvements to the housing stock. It will then consider potential future developments.

1. The current distribution of household energy consumption and carbon emissions

Recent research undertaken for Defra by the Centre for Sustainable Energy (CSE) (Roberts et al., 2007) demonstrates a link between household income and household energy consumption. However, as Fig. 1 shows, it also exposes the fact that some low-income households have very high energy consumption and related carbon emissions.

The data, derived from detailed analysis of the Expenditure and Food Survey for 2005–2006 by CSE and the University of Surrey, is presented as a 'bubble chart'. The *X*-axis represents the income decile. The *Y*-axis represents the carbon emission decile. The diameter of the bubble represents the number of households, which have that carbon emission level and that income.

The correlation between income and carbon emissions is modest ($R = 0.25$) owing to the high level of variation between households with similar incomes. However, as might be expected given the highly regressive nature of fuel expenditure (see, for example, Fig. 1 in Roberts et al., 2007), the poorest 10 per cent of households produce only 45 per cent as much carbon dioxide emissions from their homes as the richest 10 per cent. There is a very strong correlation ($r = 0.98$) between median income by decile and average carbon emissions.

The implication of this distribution of carbon emissions is that policies designed to tackle carbon emissions, which lead to an increase in the cost of energy will have a regressive impact, disproportionately hitting lower-income households.

The households with low incomes and high energy-related household carbon emissions (the top left-hand corner of the chart in Fig. 1) can be characterised as "Low-income retired or near retirement unoccupied couples with larger than average homes, possibly with a history of fuel debt as indicated by the higher than average proportion (20 per cent) using prepayment meters" (Roberts et al., 2007).

These households are undoubtedly fuel poor in that they need to spend (and are spending) more than 10 per cent of their income on energy to meet basic requirements. But they are probably warm, since they buy and use a lot of energy. A large number of the lower-income, lower-emitting households (in the bottom left-hand corner of Fig. 1) will be fuel poor but cold as they are not buying enough energy to stay warm.

The datasets currently available (the Expenditure and Food Survey and the various national House Condition Surveys) do not combine accurate data on energy expenditure and household income with household energy performance. The English House Condition Survey collects income and energy performance, so that required energy expenditure can be derived. But it no longer collects actual energy expenditure, so we are not currently in a position to identify which low-income, low-energy consumption households are fuel poor and which are affordably

☆ While the Government Office for Science commissioned this review, the views are those of the author(s), are independent of Government, and do not constitute Government policy.

* Tel.: +44 117 934 1441; fax: +44 117 929 1410.
E-mail address: simon.roberts@cse.org.uk

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doi:10.1016/j.enpol.2008.09.025

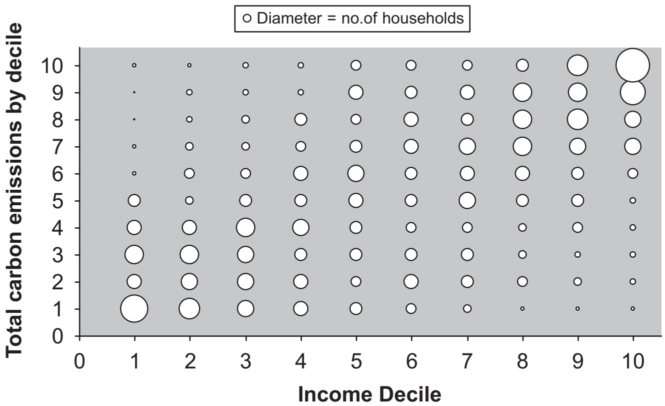

Fig. 1. Carbon emissions from household energy use by income decile (*Source*: Roberts et al. (2007)).

warm in a well-insulated home. This is a serious shortcoming which weakens the potential to design and target policies and programmes.

2. Addressing fuel poverty through improving the housing stock

Recent detailed modelling of 2004 English House Condition Survey data by CSE, the Association for the Conservation of Energy and Richard Moore Associates (Preston et al., 2008) has revealed the cost and scale of delivering energy performance improvements to the homes of the fuel poor in England. This modelling tailored the measures to each of the 2.5 million homes in England where the occupants were fuel poor, and applied just enough measures to lower the cost of required fuel expenditure to below the fuel poverty threshold of 10 per cent of the income of the household currently occupying the dwelling.

It showed that the cost of delivering all such measures is in the order of £4.6 billion (see Table 1 below).

The true cost would be higher because targeting would be imperfect. It is not possible to be certain a household is fuel poor without a detailed income assessment and a housing energy performance analysis such as SAP, so that targeting would have to be based on proxies. If instead an approach were taken of bringing all homes occupied by fuel-poor households up to a standard of SAP 65, the cost would be nearer £6 billion.[1] The cost will also grow if fuel prices grow faster than incomes since this will bring more households into fuel poverty (see below).

The cost does not take account of later servicing and replacement, which is particularly relevant for heating-related installations. Adding these costs may change the relative cost effectiveness of some of the heating measures.

In addition, the analysis focuses on proven measures to address heating and lighting needs, since these dominate the energy use of fuel-poor households. Additional energy savings might be available from improving the efficiency of household appliances and other end uses including water conservation measures, and by improving system controls.

The analysis by Preston et al. has also revealed that even these measures would leave some 730,000 households in England, 29.1 per cent of today's fuel-poor households, in fuel poverty. Thermal improvement packages cannot do enough to bring these households under the 10 per cent threshold, which defines them as fuel poor.

These households typically combine very low incomes with severe under-occupancy[2] and insufficient scope for improvements to the home. This could result from the criteria imposed, perhaps because a house has listed conservation status, or because it is hard to treat. This applies particularly to houses that are off the gas grid and have solid walls. Preston et al. show that these remaining fuel poor would require an additional £1.4 billion in income each year at end-2006 fuel prices to bring them out of fuel poverty.

Most of the households which would remain in fuel poverty after alleviation measures were applied were already in severe or serious fuel poverty before the application of these measures. Preston et al. briefly examined the potential to alleviate fuel poverty by reallocating housing and found considerable potential. As Table 2 shows, even without the installation of energy efficiency measures, 22 per cent of the fuel poor who owned their house outright in 2004 could be lifted out of fuel poverty by moving to a smaller dwelling. The fuel poor who own their house outright represent the largest proportion of any tenure group, with 63 per cent severely under-occupying their homes.

It would never be appropriate to force someone to move home, particularly as these householders are typically elderly persons living in the family home. But there is a real need to provide elderly householders with the opportunity to buy or rent well designed and managed sheltered accommodation.

3. Future developments: energy prices

One of the key issues governing future levels of fuel poverty is the relationship between increases in fuel prices and increases in incomes. If the income of the fuel poor increases more slowly than fuel prices, which almost all reasonable scenarios believe it will, fuel poverty will increase. Preston et al. (2008) modelled a medium scenario for fuel price increases which sees fuel poverty in England jump to four million by 2016 if improvements to the energy performance of the housing stock, and growth in the incomes of low-income households, are maintained only at current rates.

The modelling work on the existing housing stock undertaken by Preston et al. shows what can be done with currently available technologies to improve the energy performance of the housing of fuel-poor households. This does not mean that this will happen since the levels of installation envisaged by these authors are far in excess of current plans.

But even if these measures were all installed, the modelling shows that without further technological developments, or a significant drive to move the most fuel poor into the most energy-efficient housing, the impact of future fuel price increases on the fuel poor could only be alleviated through additional income or fuel subsidies.

4. Future developments: climate change and the need for affordable coolth

Over the next 40 years, warmer winters and warmer summers with more extreme heat may shift the problem of fuel poverty

[1] SAP 65 represents the thermal efficiency above which a household's likelihood of being in fuel poverty is principally caused by very low income or under-occupancy.

[2] To define under-occupancy, Preston et al. (2008) used the 1968 Parker Morris space standard for local authority housing with a nominal increase in the minimum adequate floor area of 25 per cent to reflect increase in space standards. This also addresses the fact that Parker Morris was a minimum standard designed principally to determine over-crowding rather than under-occupancy.

Table 1
Average and total cost of individual measures for all households

Individual measures	Average cost £	Total cost (£ × 1000)	Measures	
			Number	% of total
Insulation				
Low energy lighting (cfls)	25	35,636	1,426,321	29.3
Draught proofing (dp)	195	154,258	789,697	16.2
Cavity wall insulation (cwi)	239	63,390	264,745	5.4
Lost insulation (li)	406	305,190	751,817	15.5
Internal wall insulation (iwi)	2098	136,266	64,959	1.3
Double glazing (dg)	4205	263,049	62,558	1.3
Wall reform insulation (wri)	4242	3890	917	0.0
External wall insulation (ewi)	12,024	101,677	8,456	0.2
Heating				
Oil condensing boiler (ocb)	1255	23,482	18,715	0.4
LPG condensing boiler (pcb)	1256	20,193	16,072	0.3
Gas condensing boiler (gcb)	1503	981,471	653,213	13.4
Micro CHP (chp)	3174	164,486	51,825	1.1
Biomass boiler (bio)	3387	12,596	3,719	0.1
Air source heap pump (ashp)	4683	116,086	24,787	0.5
Ground source heat pump (gshp)	6076	561,248	92,368	1.9
Solar hot water (shw)	2573	1,627,764	632,585	13.0
Total measures		4,570,682	4,862,754	100.0

Source: Preston et al (2008).

Table 2
Effects of re-allocating fuel poor based on the 2004 EHCS (1000s of households)

Tenure	Not under-occupying	Severely under-occupying	Out of fuel poverty	Left in fuel poverty	Total (× 1000)
Owned with mortgage%	152	95	36	211	247
	61.5%	38.5%	14.6%	85.4%	100%
Owned outright	219	370	130	460	590
	37.2%	62.8%	22.0%	78.0%	100%
Privately rented	121	62	14	169	183
	66.0%	34.0%	7.5%	92.5%	100%
Rented from Local Authority	106	45	16	136	152
	70.1%	29.9%	10.6%	89.4%	100%
Rented from RSL	49	16	3	62	65
	76.0%	24.0%	5.1%	94.9%	100%
All tenures	648	589	199	1038	1236
	52.4%	47.6%	16.1%	83.9%	100%

Source: Preston et al (2008).

from one principally of inadequate heating in Winter to one which also features inadequate cooling in Summer.[3]

From an analytical point of view, increased average winter temperatures will only alter the numbers of homes assessed as being in fuel poverty as they feed through into degree day averages, which are a rolling 20-year average. Those defined as fuel poor would of course be less cold, but the assessment of their dwelling's required energy expenditure within SAP and the EHCS analysis, which underpins their fuel-poor status, will only gradually start to show the effect of higher temperatures.

Modelling the effect of increasing winter temperatures on required fuel expenditure would be help map the way in which climate change will alter the level and pattern of fuel poverty.

By way of contrast, the anticipated increase in extreme summer temperature will create a need for affordable coolth in the same way that cold winters drive the need for affordable warmth. This need may be particularly acute in urban heat islands for vulnerable elderly living in thermally poor dwellings. Options such as planting for shading and reduced exposure could be considered alongside improvements to the thermal performance of the dwellings and other means of delivering coolth.

Again, it would be extremely useful to undertake modelling of the housing stock, for example using EHCS data, from the perspective of its capacity to keep cool and the temperatures at which it would need specific cooling interventions to maintain healthy and safe temperatures.

5. Future developments: technology

The thermal performance of the existing housing stock is a core component of fuel poverty and therefore of the distributional impacts of energy price rises. Policy interventions which ensured that the packages of measures identified by Preston et al. (2008) were installed would markedly reduce these impacts, but would not eliminate them. Key developments relevant to future levels of

[3] Note that some predictions of climate change impacts on the UK raise the possibility of significantly colder winters caused by a change in the behaviour of the Gulf Stream. Clearly if this occurred, there would be an increase in the number of households unable to afford to heat their homes and growth in the number and cost of energy conservation measures required to reverse this situation.

fuel poverty which could improve the thermal performance of the existing housing stock still further include:

- The potential for other renewable energy and low carbon technologies to become cost effective. In Preston et al., photovoltaics did not pass this test as they did not pay for themselves in their lifetimes at 2006 prices. If (and only if) further development of photovoltaics was successful in reducing costs considerably, they might provide fuel-poor households with essentially free electricity for part of their needs.
- The development of insulation techniques appropriate to conservation-grade and other hard-to-treat dwellings: It remains doubtful whether there are enough of these houses to drive technology development. Further improvements in the quality, and reductions in the installation and fuel costs, of biomass boilers could help reduce heating costs for fuel-poor homes in rural areas without access to gas.

There is also potential, documented elsewhere in the SEMBE programme, to improve the efficiency of other energy-using technologies in homes such as lighting, appliances, and electronic equipment and their control systems. These developments are unlikely to be driven by the needs of the fuel poor but could contribute to improving the affordability of their energy services.

6. Future developments: policy on housing and the elderly

Unless fuel prices increase very dramatically relative to incomes, it is unlikely that anyone living in a dwelling built to current and near-future standards will be at any risk of being in fuel poverty. So it would be sensible to ensure that those at risk of being in fuel poverty, particularly the elderly on low incomes, are encouraged or cajoled to move into such new, purpose built accommodation.

With an ageing population (see SEMBE paper A7), the likelihood is that under-occupancy as a cause of fuel poverty is likely to increase without such intervention.

As Boardman et al. (2005) have pointed out, a significant increase in demolition rates targeted on the least thermally efficient dwellings, and their replacement by more efficient ones, would have a disproportionately beneficial effect on the fuel poor, who are most likely to occupy these dwellings. But with housing demand outstripping supply there are no market pressures to increase demolition at present or in the foreseeable future.

7. Conclusions

To understand how equity aspects of domestic energy consumption will map out in the future requires further modelling. This is particularly true of the problems associated with fuel poverty—not being able to afford sufficient energy services to meet basic needs. The analysis described here shows what is known about how to improve the thermal efficiency of the homes currently occupied by the fuel poor, and what impact it will have. It is possible to do much through this approach, and more could be done with the development of techniques for hard-to-treat homes and if the costs of photovoltaics reduce considerably in future.

However, the other factors—fuel prices, low incomes and under-occupancy—which combine with housing thermal performance to cause fuel poverty will require specific policy interventions to avoid adverse consequences for future levels of fuel poverty. This could involve supporting incomes, subsidising fuel expenditure and developing housing policies, which discourage under-occupancy and encourage those most at risk of fuel poverty to move into thermally efficient, correctly sized dwellings.

Quite apart from market conditions, most government interventions to tackle the threat of climate change are likely to drive up energy prices. Governments will have to make specific efforts to ensure that such interventions do not have serious negative impacts on the most vulnerable households in the UK.

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