Research
Discussion
Papers

PSI Research Discussion Paper 18

The social impacts of environmental taxes: removing regressivity

Economic Instruments for a Socially Neutral National Home Energy Efficiency Programme

Simon Dresner and Paul Ekins

Research Discussion Papers

ISBN: 0 85374 816 0
PSI Report No: 896

Policy Studies Institute
For further information contact:
Publications Dept., PSI, 100 Park Village East, London NE1 3SR
Tel: (020) 7468 0468 Fax: (020) 7468 2211 Email pubs@psi.org.uk

PSI is a wholly owned subsidiary of the University of Westminster

psi
Policy Studies Institute

Research Discussion Papers

ACKNOWLEDGEMENTS

The research reported in this paper was conducted under the project 'The Social Impacts of Environmental Taxes: Removing Regressivity', funded by the Joseph Rowntree Foundation under its Programme on Environment and Social Concerns. Our thanks go to the Joseph Rowntree Foundation (JRF) for supporting the research and to JRF's Alison Jarvis who monitored its progress and helped it along with many useful suggestions. We are also very grateful to the members of the Project Advisory Group, which met on a number of occasions to address the topics with which the research was concerned. We would like to give special thanks to Derek Osborn, who chaired most of the group meetings, and Nick Hartley who not only attended meetings most regularly but also gave us extremely useful written feedback.

We thank Holly Sutherland at the University of Cambridge who carried out extensive modelling for us, using her POLIMOD model of the tax-benefits system linked to the Family Expenditure Survey.

Abstract

The research reported in this paper was conducted under the project The Social Impacts of Environmental Taxes: Removing Regressivity, funded by the Joseph Rowntree Foundation under its Programme on Environment and Social Concerns. The project is investigating the social implications of environmental taxes and charges in relation to four environmental issues – the household use of energy, water, and transport, and the generation of waste. This is a report of the component on the household use of energy.

Energy use by, and carbon emissions from, UK households are rising. A contributing factor is that household energy prices are relatively low, so that households have little incentive to implement the energy efficiency measures which are cost effective even at these low prices. The hypothesis underlying the first stage of the research was that the incentives to implement these measures could be increased by imposing a carbon tax on the household use of energy, and that redistribution through the benefit system of some or all of the revenues from the tax could prevent low-income households being made worse off.

The research early established that there is enormous variation in household energy use within income deciles. In fact, those at the 80th percentile in the lowest decile consume nearly nine times as much energy as the 20th percentile of the decile, and more than twice as much energy as those at the 20th percentile in the highest decile (Table 2.2). The variation in carbon emissions is not as great, but is still very substantial. It also emerged that poor households pay substantially more per unit of energy than rich households: the median price for those in the tenth decile was 2.67p/kWh, compared to 3.66p/kWh, 37% more, for those in the first decile. A carbon tax imposed equally on rich and poor households, without any compensation for poor households, would therefore be very regressive and would add to the unfair price burden these households are already experiencing.

A variety of ways of compensating poor households was explored, using means-tested benefits, child benefit, adjustments to pensioners' Winter Fuel Allowance (WFA) and

varying the rate of carbon tax. The results of these various compensation scenarios, described fully in the text, are given in Table 3.16.

The first point to be made is that for the lowest decile all the tax plus compensation packages are progressive on average (that is, the average household is a net gainer). The amounts gained range from £1.77 per year to £118.14 per year. The same is true for Deciles 2 and 3, except in respect of one scenario when, not surprisingly, nearly all pensioner households lose out from the redistribution of some of their WFA to non-pensioner low-income households. Essentially these results substantiate the hypothesis on which this research was based, namely that it is possible to make a carbon tax such as that imposed progressive for the average household in the lowest deciles.

However, the enormously skewed distribution of energy consumption within the income deciles, noted above, means that the average result conceals great differences in net gains and losses within each decile. In fact, it can be seen from Table 3.16 that none of the compensation packages manage to reduce the proportion of losing Decile 1 households much below 20%, and the five that do get slightly below this figure all assume a 100% take up of the relevant means-tested benefits, which is clearly unlikely to be achieved. With the take up of benefits at current (partial) rates, none of the compensation methods reduces the proportion of all households in Decile 1 which lose out much below 35%.

This stage of the research has therefore shown that, although redistributing the revenues from a carbon tax through means-tested benefits would certainly be progressive overall, and would bring some households out of fuel poverty, it does not seem to be possible to devise a means of doing it that would not also worsen fuel poverty for those who are already most badly affected by it. This makes it politically problematic at best, and probably politically infeasible.

There are a number of Government programmes seeking to insulate the homes of low-income households in order to reduce, and ultimately abolish, fuel poverty. One response to the results reported above would be to continue with, or intensify, these programmes, and to return to the issue of imposing a carbon tax to incentivise the *take up of energy efficiency measures once the fuel poverty problem had been substantially addressed. This would amount to accepting a rise in household carbon emissions over at least the next ten years, which is hardly compatible with the ambitious carbon-reduction targets to which the Government says it is committed.*

An alternative approach would be to introduce incentives for non-fuel poor households to introduce cost effective energy efficiency measures. The paper explores a means of doing this through the Council Tax and Stamp Duty. Starting with the highest value houses in each region, the scheme set out would impose surcharges on the Council Tax of those households which failed to implement cost effective energy efficiency measures within a year of receiving a notification to this effect. A Stamp Duty surcharge adopting the same approach would encourage householders to install such measures when moving into a new home.

Implementation of such a scheme would save a minimum of 10% of household carbon emissions. The measures would cost householders £6.4 billion, but would save them a net present value of £19.7 billion. The average rate of return to householders would be 23%. A number of practical details of the scheme are discussed in the paper. Overall, it would result in the whole housing stock being brought up to a cost effective level of energy efficiency over 10 years, greatly reducing fuel poverty, as well as saving carbon emissions, in the process. Over the subsequent ten years a further programme could concentrate on hard-to-heat homes (such as those with solid walls) which would still be excessively energy intensive. The programme could be financed through a carbon tax imposed on those homes that had already been insulated (with redistribution through the benefit system now being able effectively to compensate those on low incomes). Twenty years after the beginning of the process the UK housing stock would have been brought up to the level of efficiency to match the rest of Northern Europe. Fuel poverty would be a phenomenon of the past. Carbon emissions would be substantially reduced. And most householders would be financially better off because of their more efficient use of energy, even taking the carbon tax into account.

Few other public policies have such a positive overall generation and distribution of economic, social and environmental benefits. It is an indication of the low political *priority that is still given to climate change that such a scheme is still not being given serious political consideration.*

1. Introduction

UK households in 2000 produced 23.4 million tonnes of carbon (mtc) emissions from their direct use of fossil fuels and another 18.0 mtc if emissions from their use of electricity are taken into account, giving a total of 41.4 mtc (DEFRA, 2002). Moreover, their energy use, and their carbon emissions are still growing, by 1.6% and 0.8% respectively in 2000 and by 3.9% and 4.6% respectively in 2001 (Cambridge Econometrics, 2002.). Between 1990 and 2000 their direct fossil fuel use grew by 13.3% (an average annual rate of 1.25% p.a.) and their carbon emissions from this source by 8.8% (a lower rate of growth because of the shift from coal to less carbon-intensive gas). Household electricity use grew by 16.5% over 1990-2000. Carbon emissions from this use of electricity fell, however, by 24.2%, because of the shift in power generation from coal to gas. With household energy demand still growing, and with limited possibilities for further fuel switching in either power generation or the direct household use of fossil fuels, household carbon emissions are likely to grow still further in future. A recent forecast from Cambridge Econometrics (2002) suggests that direct household emissions in 2010 will be 14.1% higher than in 2000, and those from household electricity use 6.1% higher. This is obviously problematic in terms of the Government's commitment to reduce carbon emissions by 20% from the 1990 value by 2010, and from a perspective that attaches any kind of importance to reducing the emissions that contribute to climate change.

In order to give incentives for households to increase their energy efficiency, a number of European countries have introduced household carbon or energy taxes. The four Nordic countries, Germany, the Netherlands and Italy all introduced carbon taxes on household energy during the 1990s.

However, the UK has a problem that is not faced by other North European countries: fuel poverty, a term used to describe a situation whereby a household would need to spend more than 10% of its income on heating in order to obtain an adequate level of warmth. A major contributing factor to fuel poverty is the poor thermal characteristics of the UK housing stock. It is because of a desire not to exacerbate fuel poverty that the present UK Government has made a repeated commitment (e.g. HMT 2002b) not to tax the household use of energy.

Rather than tax the household use of energy, the UK Government has implemented two major programmes to try to increase household energy efficiency. They are both focused either partly or entirely on tackling the problem of fuel poverty,. One, Warm Front (formerly called the New Home Energy Efficiency Scheme) is specifically targeted at households in receipt of an income-related benefit that are considered particularly vulnerable (elderly, disabled or with children). The other major scheme, the Energy Efficiency Commitment is targeted 50% at households on benefits. Targeting energy efficiency improvements at the poorest is a way of attempting to reach those most likely to be in fuel poverty, but the 'rebound' effect where much of the improvements in efficiency is taken in increased comfort means that only about half the efficiency gains translate into reductions in carbon emissions (Henderson et al. 2003). Neither EEC nor Warm Front will have any effect on the great majority of households. They have two flaws: they do not reach a large proportion of those in fuel poverty who are deemed insufficiently poor or vulnerable, and they do not reach many non-poor households, which are the ones that use most energy. It is clear that current Government policy will do little to curb the growth of emissions from households, much less reduce them.

At the same time it is also clear from research into previous energy efficiency schemes that much investment in household energy efficiency is cost effective at current energy prices. Cost effectiveness is defined by the government as payback within the lifetime of the measure with a discount rate of 7%. Figures from the Energy Saving Trust suggest that there is a huge potential for cost-effective measures that are not being taken up (EST 2001). However, despite the potential financial gains, households generally do not currently invest in the full range of cost-effective energy-efficiency technologies, for a range of reasons that have been extensively studied and are now generally well understood (EST 2002). It is clear that securing carbon emission reductions, rather than growth, from households to 2010 and beyond could result in net financial benefits rather than costs, but that these benefits will not materialise by themselves. Further policy measures will be needed to achieve them. It is the purpose of this paper to describe a policy approach which could have this result, and then keep carbon emissions stable or on a declining path, while seeking to ensure that those on low incomes are not unfairly affected. There are two aspects to that. The first is to avoid regressivity (a situation in which those on lower incomes are left proportionately worse off by a policy change than those on higher incomes). The second is to avoid worsening fuel poverty. There is a distinction between the two objectives, as will become clearer later.

The starting motivation for the research on which this paper is based was that it is important to do something to improve household energy efficiency and reduce carbon emissions from domestic energy consumption. The research was designed to examine whether and how a carbon/energy tax, and other economic instruments, could be used to achieve this, whilst ensuring that those on low incomes are not made worse off. It is not the purpose of this paper to give a lengthy justification for the reasons in principle for considering the use of economic instruments, as they are already well known.

In contrast to the UK Government's position, the initial hypothesis of the research was that a carbon tax could be used to incentivise the increase of household energy efficiency, encouraging householders to implement available cost effective energy efficiency measures. Furthermore, because the tax would fall on both the rich and poor, the research sought to show that the poor could be compensated by distributing the tax revenues, through the benefit system or otherwise, in such a way that the tax would not leave them worse off financially, and would therefore not increase fuel poverty. Because the poor would not be exempt from the tax, the compensation mechanism would not remove from them the tax's incentive not to waste energy.

The first research task was an investigation of the distribution by income decile of UK domestic energy expenditure, use and carbon emissions, the results of which are described in Section 2. Section 3 examines the workability of combining a carbon tax to encourage emission reductions with compensation through the benefits system or exemptions from the tax for low- income households. It comes to the conclusion that, because of the extreme variation in the energy use of low-income households, and contrary to the initial hypothesis of the research, it is *not* possible to provide effective compensation to low-income households for the tax in the way that had been envisaged. The corollary is that, if the issue of carbon emissions from non-poor households, as well as that of fuel poverty, is to be addressed, it will have to be through a different policy approach.

Section 4 of the paper describes a possible National Home Energy Efficiency Programme that adopts such an approach, tackling fuel poverty through public spending (in an intensification of present programmes), and incentivising private investment in energy efficiency through economic policy instruments. The nature and effects of instruments that could improve household energy efficiency to a currently cost-effective level, and then maintain it at that level, are explored in detail, and the associated carbon emissions reduction calculated. Section 5 concludes.

2. The distribution of household energy expenditure

With a tax that raises revenues from both rich and poor households, it is clearly possible to compensate those on low incomes *on average* for the tax, but whether it is possible to compensate all those on low incomes depends on the distribution of their energy use. To explore this issue modelling has been conducted with two different datasets – the 1996 English House Condition Survey (EHCS) and the Family Expenditure Survey (FES) of 1999-2000 and 2000-2001. The EHCS provides information about the gas and electricity consumption of households; the FES provides more up-to-date data on households' expenditure on them. The FES data can be used in a model combining data about household expenditure and the tax and benefits system. It enables one to address the question of whether it would be possible to use the income raised from a domestic carbon tax to increase low incomes sufficiently that even those most in fuel poverty (i.e. needing to spend most on energy in relation to their incomes) would be no worse off financially than before.

The purpose of doing the work with the EHCS was in order to examine the distribution of energy consumption across the income deciles and compare it with the distribution of energy expenditure and the gross effect of a carbon tax before compensation mechanisms are incorporated.

There are two ways of comparing incomes across the deciles. The simplest way is to use the actual income, but it takes no account of household size. A fairer method is to calculate the 'equivalent' income, where each household's income is adjusted to so that it is considered equivalent to the standard of living that a two-adult household would have on the equivalent income. There are a number of equivalent income scales. PSI generally uses the Bradmill equivalent income scale, but calculations done for us with the POLIMOD model of the tax and benefits system used the McClements equivalent income scale. The two scales are only slightly different and give similar results.

Table 2.1 Income deciles in the English house condition survey 1996

Decile	Income £	Equivalent income[1] £
1	0 - 4633.55	0- 5799.80
2	4633.55 - 5773.52	5799.80 - 7030.11
3	5773.52 - 6936.00	7030.11 - 8008.31
4	6936.00 - 8260.00	8008.31 - 9023.25
5	8260.00 - 9927.90	9023.25 - 10148.73
6	9927.90 - 12213.58	10148.73 - 11694.36
7	12213.58 - 14863.38	11694.36- 13694.47
8	14863.38 - 18747.28	13694.47 - 16747.80
9	18747.28 – 24365.00	16747.80 - 21986.08
10	24365.00 -	21986.08 -

Source: EHCS 1996

2.1. Comparing household energy use and incomes

2.1.1 Non-equivalent incomes

Regression analysis using the EHCS shows that the correlation between energy use and household income is 0.171, so 17.1% of the variance in energy use is related to variation in household income.

Analysis also shows that the variation between the deciles is less than variation within the deciles, even when incomes are not adjusted for household size. A very small number of households with enormous energy consumption distort the mean, so medians are quoted instead. Table 2.2 shows that median energy consumption (total of gas and electricity) rises more or less steadily through the deciles from 11566 kWh in the first decile (those on lowest incomes) to 24176 kWh in the eighth decile and sharply to 29660 kWh in the ninth decile. However, the median masks enormous variation within the deciles. The median across the entire sample is 18244 kWh; nearly 30% of households in the first decile consume more, while over 30% of households in the ninth decile and nearly 30% of those in the tenth decile consume less. A startling fact to emerge from Table 2.2 is that those at the 80th percentile in the lowest decile consume nearly nine times as much energy as the 20th percentile of the decile, and more than twice as much energy as those at the 20th percentile in the highest decile.

Table 2.2 Household energy use by income decile in 1996 (non-equivalent incomes)

Energy use (kWh)

Decile	20th percentile	Median	80th percentile
1	2700	11566	23317
2	4132	12803	20539
3	4645	14675	23695
4	5156	16198	27422
5	7244	18719	30839
6	6794	18592	29729
7	5708	20187	29915
8	8407	21081	31974
9	12038	24176	34227
10	10296	29660	44330

Source: EHCS 1996

2.1.2 Equivalent incomes

When household incomes are adjusted for household size and composition in line with the Bradmill equivalent income scale, a rather different pattern emerges. The correlation between energy use and equivalised income is 0.081, so only 8.1% of the variance in energy use is explained by variation in equivalised income.

Table 2.3 shows that the median consumption starts at 16880 kWh in the first decile, bobs up and down slightly through the second to the seventh deciles, but rises sharply to 20009 kWh in the eighth decile and reaches 23272 kWh in the tenth decile. The pattern of the median through the deciles is remarkably flat, although it does rise somewhat in the higher deciles. Those at the 80th percentile in the lowest decile now consume nearly six times as much energy as the 20th percentile of the decile (as opposed to nine times in Table 2.2), but more than three and a half as much energy as those at the 20th percentile in the highest decile.

Table 2.3 Household energy use by income decile in 1996 (equivalent incomes)

	Energy use (kWh)		
Decile	20th percentile	Median	80th percentile
1	4978	16880	29729
2	4997	16679	28969
3	5394	17115	27832
4	5278	15961	27648
5	5910	16946	26287
6	7328	18703	29301
7	5421	17452	27964
8	6349	20009	32626
9	7742	21562	34692
10	8260	23272	38242

Source: EHCS 1996

2.2. Comparing household carbon dioxide emissions and income

2.2.1 Non-equivalised incomes

In order to examine the distributional effect of a simple carbon tax, the carbon dioxide emissions from households' electricity and gas consumption were examined. The carbon dioxide emissions were calculated using the appropriate conversion factors for the carbon dioxide emissions for each kilowatt-hour of gas or electricity consumption. Since poorer households are less likely to use gas for heating and gas is less carbon-intensive than electricity, it was expected that lower deciles' carbon dioxide emissions would be found to be more relatively higher than their energy consumption. It turned out that was not the case because electricity consumption tends to rise with income. Regression analysis gave exactly the same correlation between carbon dioxide emissions and income as between energy use and income – 0.182, so 18.2% of variance in carbon dioxide emissions is explained by variation in household income.

The median carbon dioxide emissions per household were 4470 kg. Without controlling for household size and composition, these rose steadily from a median of 3039 kg in the first decile to 5908 kg in the ninth decile and sharply to 7064 kg in the tenth decile. Again, nearly 30% of households in the first decile emitted more than the median across the entire distribution, while over 30% of households in the ninth decile and nearly 20% of households in the tenth decile consumed less than the median.

Table 2.4 Household carbon emissions by income decile in 1996 (non-equivalent incomes)

	Carbon dioxide emissions (kg)		
Decile	20th percentile	Median	80th percentile
1	919	3039	5118
2	1293	3069	4745
3	1659	3609	5440
4	1725	4163	6035
5	2373	4581	6796
6	2376	4606	6893
7	2306	4995	7170
8	2918	5182	7584
9	3323	5907	8305
10	3434	7064	10515

Source: EHCS 1996

2.2.2 Equivalent incomes

When household income was adjusted for household size and composition, a rather different picture emerged. The correlation between carbon dioxide emissions and equivalised income is 0.131, so 13.1% of the variance in carbon dioxide emission is explained by variation in household income. Median carbon dioxide emissions in the first decile were 4123 kg and stay around there, although bobbing down to 3967 kg in the fourth decile, then rising sharply to 4777 kg in the eighth decile, 5078 kg in the ninth decile and 5582kg in the tenth decile. In both Tables 2.4 and 2.5 the emissions of the 80th percentile in the lowest decile are substantially higher than those at the 20th percentile in the highest decile, but by a lower ratio than for energy use.

Table 2.5 Household carbon emissions by income decile in 1996 (equivalent incomes)

	Carbon dioxide emissions (kg)		
Decile	20th percentile	Median	80th percentile
1	1705	4123	6524
2	1780	4135	6262
3	1770	4256	6486
4	1915	3967	6558
5	2015	4100	6197
6	2149	4306	6702
7	1981	4361	6762
8	2586	4777	7522
9	2494	5078	8092
10	2702	5582	9287

Source: EHCS 1996

These results reveal that any attempt at a domestic carbon or energy tax in the UK would have to rely heavily on redistribution of the revenues through benefits increases and tax credits in order to avoid increasing fuel poverty.

2.3 Comparing household fuel bills and income (ehcs)

2.3.1 Non-equivalent incomes

The distribution of gas and electricity charges in the 1996 EHCS has been examined in order that they can be compared with the distribution recorded in the 1999-2000 FES.

The correlation in the EHCS between fuel bills and household income is 0.187, so 18.7% of the variance in fuel bills is explained by variation in household income. Median household energy bills were £563 in 1996. They rose from £424 for households in the first decile to £687 in the ninth decile and sharply to £793 in the tenth decile. About 25% of energy bills for households in the first decile were above the median for the entire distribution, while nearly 40% of bills in the ninth decile and over 30% of bills in the tenth decile were below the median. By comparing Table 2.6 with Table 2.2, it can be seen that wealthier households were paying less per unit for their energy (the median price for those in the tenth decile was 2.67p/kWh, compared to 3.66p/kWh, 37% more, for those in the first decile).

Table 2.6 Household fuel bills by income decile in 1996 (non-equivalent incomes)

	Annual domestic fuel bills (£)		
Decile	20th percentile	Median	80th percentile
1	219.35	423.55	629.92
2	237.77	421.68	603.81
3	301.75	467.87	688.02
4	307.69	527.37	717.85
5	392.80	580.48	815.56
6	349.78	571.93	805.28
7	359.28	591.43	814.03
8	410.27	637.19	872.10
9	435.28	687.06	896.46
10	505.32	793.23	1125.93

Source: EHCS 1996

2.3.2 Equivalent incomes

The effect is even clearer when incomes are adjusted for household size and composition. The correlation between fuel bills and equivalised income is 0.078, so 7.8% of the variance in fuel bills is accounted for by variation in equivalised income. Median energy bills in the first decile were £556, falling to £516 by the fourth decile, then rising very slightly, but sharply in the eighth decile to overtake the whole-sample median (£563) at £592 and reaching £654 in the tenth decile. Nearly half the bills in the first decile were above the median for the whole distribution.

Table 2.7 Household fuel bills by income decile in 1996 (equivalent incomes)

	Annual domestic fuel bills (£)		
Decile	20th percentile	Median	80th percentile
1	309.34	555.69	785.50
2	328.75	548.29	784.39
3	323.55	534.42	796.80
4	323.78	516.33	773.08
5	298.75	535.61	767.06
6	327.28	531.75	784.24
7	329.24	532.15	758.55
8	383.43	591.63	852.74
9	365.66	633.02	890.32
10	399.13	654.20	972.74

Source: EHCS 1996

2.4 Comparing household fuel bills and income (fes)

The 1999-2000 Family Expenditure Survey (FES) was analysed for its distributional pattern of household energy bills in order to see whether it was similar to that observed in the 1996 EHCS.

Table 2.8: Income deciles in the family expenditure survey 1999-2000

Decile	Income £	Equivalent income[2] £
1	0 - 4924.30	0- 6558.94
2	4924.30- 7262.16	6558.94 - 8849.08
3	7262.16 - 9718.86	8849.08 - 11065.22
4	9718.86- 12500.88	11065.22 - 13470.73
5	12500.88 - 15638.74	13470.73 - 15878.52
6	15638.74 - 19303.98	15878.52 - 18507.63
7	19303.98 - 23252.94	18507.63 - 21754.49
8	23252.94 - 28726.05	21754.49 - 26360.18
9	28726.05 – 36994.38	26360.18 - 34293.30
10	36994.38 -	34293.30 -

Source: FES 1999-2000

2.4.1 Non-equivalent incomes

The correlation between fuel bills and household income is 0.207, so 20.7% of the variance in fuel bills is explained by household income. Median household energy bills in the 1999-2000 Family Expenditure Survey were £540 (rather below the EHCS figure of £563 for 1996, before energy market liberalisation). They rose from £361 in the first decile to £768 in the tenth decile. Nearly 30% of energy bills for households in the first decile were above the median for the entire distribution, while about 35% of bills in the ninth decile and a little over 20% of bills in the tenth decile were below the median. The pattern is similar to that found in the 1996 EHCS.

Table 2.9 Household fuel bills by income decile in 1999-2000 (non-equivalent incomes)

	Annual domestic fuel bills (£)		
Decile	20th percentile	Median	80th percentile
1	162.24	361.40	650.00
2	241.28	468.00	759.10
3	267.38	456.30	749.53
4	281.42	503.88	759.72
5	315.64	528.32	814.32
6	327.08	534.04	796.12
7	363.48	573.82	845.62
8	439.09	628.94	879.84
9	431.60	639.60	912.08
10	520.00	768.04	1104.48

Source: FES 1999/2000

2.4.2 Equivalent incomes

When incomes are adjusted for household size and composition, median fuel bills are £520 in the first decile, falling to £460 in the second decile, then rise in the third decile to return to £520 in the fourth decile, then bob around between £530 and £563 in the fifth to eighth deciles, before rising to £588 in the ninth and £614 in the tenth deciles. The pattern observed here is slightly different from that in the 1996 EHCS, but not significantly so.

Table 2.10 Household fuel bills by income decile in 1999-2000 (equivalent incomes)

	Annual domestic fuel bills (£)		
Decile	20th percentile	Median	80th percentile
1	208.00	520.00	832.00
2	241.49	460.20	774.80
3	269.78	501.80	788.11
4	321.57	520.00	803.09
5	300.04	530.40	780.00
6	336.54	563.94	848.02
7	359.84	557.96	804.86
8	366.50	612.04	873.29
9	377.62	588.12	879.84
10	359.84	614.12	999.44

Source: FES 1999-2000

While the next section carries out some detailed calculations, it can be seen at once from the above distributions that a carbon tax has the potential to be very regressive indeed for high energy users in the lower deciles. The regressivity would hardly be addressed at all if the revenues were redistributed by reductions in, for example, labour taxes, because these are not paid by many on low incomes. An equal tax-free energy allowance to all households (sometimes called an ecobonus) could remove this regressivity *on average*, but the tax would still severely impact a large number of low-income households, because the increase in energy consumption or carbon dioxide emissions as household income increases is much less than the variation between households at the same income level. One way to attempt to address the problem would be through benefits increases, and tax credits for those in work on low incomes, to compensate for the carbon tax, as described in the next section.

3. Removing the adverse social effects of a household carbon tax

3.1 The direct effects of a household carbon tax

It was decided to model the effects of a carbon tax set at the standard rate of the existing Climate Change Levy on the non-domestic sector, which is 0.43p/kWh for electricity and 0.19p/kWh for gas. This is broadly equivalent to a carbon tax of £10 per tonne of carbon dioxide (£37 per tonne carbon).

Previous models of the effect of a carbon tax on the domestic sector have simply made the putative tax proportional to household bills (e.g. Johnson, McKay and Smith 1990), a simplifying assumption that distorts the results because standing charges account for a significant proportion of domestic energy bills and because many poor households are on prepayment meters, which are significantly more expensive than paying quarterly bills, while wealthier customers are more likely to pay by direct debit, which is instead slightly cheaper than paying quarterly bills. All these factors mean that making the assumed carbon dioxide output proportional to bills will tend to overstate the regressivity of a carbon tax. For this research, expected carbon dioxide output from domestic energy use was instead calculated for households in the FES. The reason for doing this when the data on energy expenditure in FES is less reliable than that in EHCS was so as to be able to link the calculations to POLIMOD, a model of the tax-benefits system devised by Holly Sutherland of Cambridge University, in order to calculate to what extent benefit changes could be used to compensate for adverse social effects of a carbon tax.

In order to take advantage of POLIMOD, it was first necessary to back-calculate the carbon dioxide emissions. Since 80% of households are still with their regional electricity company and 80% of households with gas are still with British Gas, those tariffs were used as a simplifying assumption given that there was no data about which utility each household was with. There was also no data about expenditure on off-peak electricity, but since discriminant analysis of EHCS data showed that the overwhelming determinant of an all-electric household being on an off-peak tariff was the size of bill, a proportion of all-electric households was sampled to reflect the pattern found in EHCS. The median proportion of off-peak electricity use among households on an off-peak electricity tariff is 62%, so that figure was used in the back-calculation.

The revenue collected from the carbon tax is £1.287 billion per year. This is just under £1 a week per household. The distributional effects of the carbon tax before any compensation measures are shown in Tables 3.1 a, b and c. The results below define losers as households losing £0.10 or more per week; and gainers as those gaining £0.10 or more. Households with very small carbon emissions (less than 0.52 tonnes of carbon dioxide, and therefore paying £5.20 per year or less) are not classified as losers.

Distributional results are shown in three ways: (a) according to the decile group of the household, defined using household disposable income equivalised by the McClements equivalence scale (which is used in POLIMOD); (b) according to whether the household contains children (child benefit definition); (c) according to whether the household contains pensioners (i.e. women over 60 or men over 65). Households with pensioners and children are considered by the Government to be two of the groups most vulnerable to fuel poverty.

Table 3.1a All households					
Deciles	%	annual change £	% of income	% losers	% losing > £2 pw
1	10	-36.92	0.51	81.7	2.7
2	10	-43.73	0.40	84.8	3.4
3	10	-40.25	0.31	86.6	2.9
4	10	-42.59	0.29	87.5	3.6
5	10	-48.20	0.27	91.7	5.5
6	10	-48.52	0.23	88.0	4.1
7	10	-53.46	0.22	90.9	5.8
8	10	-57.46	0.20	92.5	10.2
9	10	-58.03	0.17	92.8	8.1
10	10	-66.56	0.12	97.0	14.7
All	100	-49.56	0.22	89.4	6.1
N (million)	24.944				
n	6613				

Table 3.1b Households with children					
Deciles	%	annual change £	% of income	% losers	% losing > £2 pw
1	8.81	-40.46	0.35	77.2	4.9
2	12.5	-49.40	0.34	79.6	4.9
3	10.94	-45.19	0.26	84.4	4.2
4	9.82	-48.05	0.24	85.5	5.6
5	11.59	-56.99	0.24	93.5	6.4
6	11.5	-55.69	0.20	88.3	5.8
7	10.37	-63.18	0.20	92.9	8.3
8	8.44	-70.36	0.19	94.3	17.3
9	8.97	-68.54	0.15	94.5	8.9
10	7.06	-88.35	0.11	97.9	29.1
All	100	-57.30	0.20	88.4	8.6
N (million)	7.256				
n	2149				

Table 3.1c: Households with pensioners					
Deciles	%	annual change £	% of income	% losers	% losing > £2 pw
1	9.85	-44.77	0.65	95.6	3.4
2	14.26	-42.59	0.47	91.7	2.5
3	15.71	-39.47	0.37	90.3	2.7
4	15.95	-41.13	0.33	88.9	2.8
5	11.84	-45.76	0.30	91.4	7.2
6	10.36	-47.84	0.27	92.3	4.0
7	7.28	-55.38	0.28	93.3	7.2
8	6.87	-56.21	0.24	92.8	10.9
9	4.36	-70.56	0.21	88.1	21.7
10	3.42	-75.61	0.15	96.7	22.0
All	100	-47.22	0.30	91.7	5.8
N (million)	7.654				
n	2086				

As expected, all three tables clearly show the regressivity of an uncompensated carbon tax. On average, households in the first decile pay 0.51% of their income in tax, compared with 0.22% for those in the tenth decile; for households with children the figures are 0.35% compared with 0.2%; for pensioner households they are 0.65% compared with 0.3%. The disparities are even greater if the low-income households using most energy (those most likely to be in fuel poverty) are considered. This is presumably the kind of outcome that has caused the Government to rule out household energy or carbon taxes, as noted above.

3.2 Compensating measures

The effectiveness of using the tax-benefits system to compensate low-income households for a carbon tax was modelled[3]. The basic idea for the compensation measures modelled here was to concentrate on means-tested benefits as a way of targeting those most likely to be in need of assistance. There are income-replacement benefits such as Income Support (IS), Jobseeker's Allowance (the means-tested form of Jobseeker's Allowance is essentially the same as Income Support), and the rather more generous Minimum Income Guarantee (MIG) for pensioners. These benefits are all means-tested at the level of the individual or couple. There are also two benefits that are means-tested at the level of the household: Housing Benefit (HB), which helps with rent and with interest payments on mortgages taken out before 1996, and Council Tax Benefit (CTB), which helps with Council Tax. Finally, there are the means-tested tax credits that were introduced recently: Working Tax Credit (WTC), which boosts incomes for those working over 16 hours a week and Child Tax Credit (CTC), which provides an allowance for the cost of bringing up children and is the centrepiece of the government's plan to eliminate child poverty. These benefits are all withdrawn at different rates as additional income rises. They interact in complicated ways depending on individual circumstances. Experiments with different combinations of these benefits were used to explore how the benefits system could be used to provide compensation and how effective it would be.

3.2.1 Compensating low-income households with pensioners

For pensioners two possible ways of compensating households for the carbon tax are modelled. The first (called CTPens1) adds 90 pence per week to the pensioners' winter heating allowance. This reaches all households with pensioners (and also those with someone aged 60+ on MIG). Table 3.2a shows the distributional effect. (The 90p amount is chosen as the average weekly loss among pensioners due to the CO2 tax.) It can be seen that in the lower deciles, more pensioners gain than lose from the tax plus compensation, but in the higher deciles it is the other way round. However, even in the lowest decile, about a third of pensioners (32.1%) lose. Those in the lowest decile are also more likely to lose more than £2 pw (1.2%) than those in most other deciles.

Table 3.2a Pensioner households with winter heating allowance increased by 90p a week (CTPens1)				
Deciles	average net change £/year	% losers	% gainers	% losing > £2 pw
1	1.77	32.1	50.9	1.2
2	4.21	35.2	50.0	0.3
3	7.33	27.3	57.4	0.9
4	5.67	34.3	52.5	0.4
5	1.04	37.3	50.9	1.4
6	-1.04	41.7	44.6	0.9
7	-8.58	47.0	38.8	1.3
8	-10.04	50.1	40.1	1.9
9	-23.76	62.5	34.7	4.3
10	-28.81	58.5	35.9	8.4
All	-0.47	38.3	48.5	1.3

The second means of compensation (CTPens2) increases MIG, HB and CTB by £1.90 for a single person and £3.05 for a couple (for people aged over 60). Because of some degree of non-take-up of MIG this does not reach all poor pensioners. It also reaches no pensioners with income too high for MIG. Table 3.2b shows the distributional effect. The level of the increase is designed to redistribute the same amount of tax revenue as the heating allowance increase in CTPens1, but in this case richer pensioner households are effectively compensating poorer pensioner households for the tax. This measure has a rather different distributional effect to the previous one. The average net change is much more progressive (i.e. low-income households gain more), but the number of losers is consistently higher through the deciles (and is nearly half, 47.5%, in the lowest decile). The percentage of poor pensioners losing more than £2 pw is also much higher.

Table 3.2b Pensioner households with increase of MIG of £1.90/3.05 a week (CTPens2)				
Deciles	average net change £/year	% losers	% gainers	% losing > £2 pw
1	39.21	47.5	47.3	2.1
2	19.29	42.5	49.0	1.4
3	11.75	49.1	42.1	1.4
4	10.09	48.5	46.4	1.6
5	-13.16	67.3	28.7	3.5
6	-20.96	69.8	26.3	2.4
7	-24.54	68.2	29.3	6.7
8	-44.88	84.2	15.8	9.8
9	-68.28	85.9	14.2	20.0
10	-65.52	91.4	8.6	19.0
All	-3.74	59.0	35.0	4.2

3.2.2 Compensating households with children

For households with children two compensation methods have also been investigated, both of which amount to richer households with children compensating poorer households for the tax. The first (CTChild1) increases the family amount in the CTC, and also gives corresponding increases through HB and CTB. This increase will be received by most families with children up to the upper ceiling (when parents move onto higher rate income tax). The increase is set so the cost is the same in value as the CO2 tax collected from these households: £1 per week per family. Table 3.3a shows the distributional effects. 28.5% of households with children in the lowest decile are still losers from this tax plus compensation scheme and 1.0% lose more than £2 pw.

Table 3.3a Households with children, with increase in family element in CTC of £1a week (CTChild1)				
Deciles	average net change £/year	% losers	% gainers	% losing > £2 pw
1	12.58	28.5	63.7	1.0
2	3.33	31.1	60.5	1.4
3	6.86	34.8	54.9	1.2
4	3.95	38.8	50.7	1.4
5	-4.32	49.9	38.3	0.0
6	-3.12	47.6	39.9	0.7
7	-11.80	50.3	31.9	1.9
8	-23.92	67.5	25.1	6.1
9	-38.12	74.4	20.3	6.8
10	-81.38	95.1	1.5	26.9
All	-10.61	49.6	40.5	3.8

The second method of compensation (CTChild2) targets a larger increase on those with low incomes. The increase is on the amount per child in IS/HB/CTB (and would be channelled through the CTC payment). There is some degree of non-take-up assumed. £1.30 is added per child – an amount that costs the same as the first option. Results are shown in Table 3.3b. There is little change in the percentage of losers in the lowest decile, but now markedly fewer in the second and third deciles. However, the percentage of households losing more than £2 pw increases markedly.

Table 3.3b Households with children With increase in amount per child in CTC (and HB/CTB) of £1.30a week (CTChild2)				
Deciles	average net change £/year	% losers	% gainers	% losing > £2 pw
1	53.40	29.7	64.8	2.8
2	65.26	16.3	80.1	1.2
3	57.88	24.7	70.3	9.3
4	19.81	47.0	47.2	3.3
5	-27.09	72.4	22.5	5.0
6	-43.52	80.7	8.8	4.7
7	-59.28	90.5	2.8	7.9
8	-66.30	91.0	3.6	15.8
9	-66.30	94.1	1.3	8.5
10	-87.67	97.4	0.5	29.1
All	-10.87	62.0	32.5	6.8

3.2.3 Compensating all households on benefits (with partial take-up)

A compensation method (CTAllPT) was investigated which covers the whole population (though with some degree of non-take-up) and is channelled through means-tested benefits/credits as follows:

IS/MIG £2 per single person, £3.20 per couple (also in HB and CTB)
CTC £1 per child
WTC £2 per claim

This costs about the same as the total amount collected by the carbon tax. The distributional effects are shown in Table 3.4. The measure is progressive, and on average those in the lowest decile are over £1 per week better off, but there are still a large number of losers in the lowest deciles (over a third, 35.1%, in the lowest decile). 1.3% of households in both of the bottom two deciles lose more than £2 pw.

Table 3.4 All households: Increase in MTBs (CTAllPT)				
Deciles	average net change £/year	% losers	% gainers	% losing > £2 pw
1	69.32	35.1	57.1	1.3
2	76.23	28.7	66.3	1.3
3	55.02	37.3	56.8	1.0
4	29.64	45.4	49.4	1.9
5	-5.88	66.8	28.7	3.0
6	-23.66	72.3	19.7	2.8
7	-40.77	81.9	10.8	5.3
8	-47.89	87.1	7.4	9.2
9	-55.69	91.6	1.8	7.4
10	-62.97	94.8	5.2	13.8
All	-0.68	64.1	30.0	4.7

3.2.4 Compensating all households on benefits (with full take-up)

What is the distributional effect of the carbon tax if full take up of benefits is assumed, perhaps as a result of heightened awareness of tax/benefit issues at the time of the tax's introduction? The effect of the tax itself (shown in Table 3.5) is slightly different from that in Table 3.1a because the income distribution is different.

Table 3.5: Carbon tax effect on all households, with 100% take-up of benefits					
Deciles	%	annual change £	% of income	% losers	% losing > £2 pw
1	10	-38.22	0.48	82.9	3.2
2	10	-40.35	0.35	86.1	3.0
3	10	-43.52	0.33	86.0	3.1
4	10	-42.59	0.28	87.7	3.9
5	10	-48.00	0.26	90.7	5.3
6	10	-48.57	0.23	89.0	4.2
7	10	-53.40	0.22	90.5	5.9
8	10	-57.10	0.20	92.4	10.0
9	10	-58.03	0.17	92.8	8.1
10	10	-66.56	0.12	97.0	14.8
All	100	-49.66	0.21	89.5	6.1
N (million)	24.944				
n	6613				

If there was full take-up of benefits, then the following package could be funded with the revenues:

IS/MIG £1.65 per single person, £2.65 per couple (also in HB and CTB)
CTC £0.85 per child, WTC £1.65 per claim

With full take-up of benefits, the measure would be even more progressive on average, with households in the lowest decile gaining nearly £73 per year (Table 3.6). In addition, the number of losers falls sharply, but it still remains at about 20% in the lowest decile. There are also fewer households that lose more than £2 pw in the lower deciles, although even in the lowest decile 0.7% still do. Moreover, the losers among the poorest deciles will mostly be those who are already in the worst fuel poverty, although many of the less severely fuel poor would gain.

Table 3.6 All households 100% take-up, increase in means-tested benefits (CTAllFT, see text)				
Deciles	average net change £/year	% losers	% gainers	% losing > £2 pw
1	72.85	19.6	75.9	0.7
2	72.33	23.2	72.7	0.4
3	53.30	28.0	67.4	1.4
4	28.60	39.4	55.6	1.8
5	-6.19	62.2	32.3	2.7
6	-23.50	70.5	21.8	2.6
7	-39.73	79.6	12.6	5.3
8	-48.57	86.6	7.7	9.3
9	-55.28	91.2	1.6	6.9
10	-62.76	94.6	5.4	13.8
All	-0.83	59.5	35.0	4.5

3.2.5 Modifying the carbon tax

A way to try to help poorer households would be to follow the German example and only charge households with pre-existing off-peak electric heating half the normal rate of the carbon tax, so that they are effectively only paying slightly more per kilowatt-hour than a household heated with gas. Table 3.7 shows the distributional effect of the modified carbon tax, assuming partial benefit take-up. The revenue gain is £1.21 billion. The impact of the concession on regressivity is modest. The proportion of income paid in tax for the lowest and highest deciles is 0.49% and 0.21%, compared to 0.51% and 0.22% in Table 3.1a. The percentage of households in the poorest decile losing more than £2 pw remains at 2.7%.

Table 3.7: All households, modified carbon tax, partial take-up					
Deciles	%	annual change £	% of income	% losers	% losing > £2 pw
1	10	-35.93	0.49	81.7	2.7
2	10	-42.54	0.39	84.8	3.4
3	10	-38.90	0.30	86.2	2.8
4	10	-41.39	0.28	87.3	3.2
5	10	-46.70	0.26	91.7	5.3
6	10	-47.06	0.22	88.0	3.8
7	10	-51.95	0.21	90.9	5.7
8	10	-56.26	0.20	92.5	9.8
9	10	-57.04	0.17	92.8	7.9
10	10	-65.57	0.12	97.0	14.1
All	100	-48.36	0.21	89.3	5.9
N (million)	24.944				
n	6613				

Table 3.8 shows the effect of compensating as follows:

IS/MIG £2 per single person, £3.20 per couple (also in HB and CTB)
CTC £1 per child
WTC £2 per claim

The difference in the impact compared to the compensation package for the original carbon tax (see Table 3.4) is slight. Over a third of households in the lowest decile still lose out from the tax plus compensation package. The percentage of households in the poorest decile losing more than £2 pw remains at 1.3% as in Table 3.4.

Table 3.8 All households, modified carbon tax, partial take-up, increase in means-tested benefits (MCTAllPT, see text)				
Deciles	average net change £/year	% losers	% gainers	% losing > £2 pw
1	68.54	34.9	57.2	1.3
2	75.87	28.5	66.3	1.3
3	55.12	36.6	56.6	1.0
4	30.16	45.0	49.6	1.6
5	-4.63	66.8	28.9	2.7
6	-22.26	72.3	19.7	2.2
7	-39.31	81.9	10.8	5.1
8	-46.70	87.1	7.4	9.0
9	-54.76	91.6	1.8	7.2
10	-61.98	94.8	2.1	13.2
All	0.00	63.9	30.0	4.4

The impact of the modified carbon tax with 100% take up of benefits, but before any compensation, is slightly different again because the income distribution is different.

Table 3.9: All households, modified carbon tax, 100% take-up					
Deciles	%	annual change £	% of income	% losers	% losing > £2pw
1	10	-37.08	1.35	82.9	3.2
2	10	-39.31	0.38	85.9	3.0
3	10	-42.22	0.34	86.0	3.0
4	10	-41.34	0.30	87.3	3.5
5	10	-46.49	0.27	90.7	5.0
6	10	-47.11	0.23	89.0	3.6
7	10	-51.95	0.22	90.5	5.8
8	10	-55.90	0.21	92.4	9.7
9	10	-57.10	0.18	92.8	8.0
10	10	-65.57	0.13	97.0	14.0
All	100	-48.41	0.36	89.5	5.9
Number of households (N, million)				24.944	
Number in sample (n)				6613	

A scheme for redistributing the revenues from the modified carbon tax under the 100% take-up assumption (MCTAllFT) looks like this:

IS/MIG £1.65 per single person, £2.65 per couple (also in HB and CTB)
CTC £0.85 per child
WTC £1.65 per claim

This measure reduces the number of losers among the poorest deciles still further and increases progressivity (see Table 3.10). Less than 1% of households in the lowest two deciles now lose more than £2 per week from the tax plus compensation package. But around a fifth in each decile are still made worse off.

Table 3.10: All households, modified carbon tax, 100% take-up, increase in means-tested benefits (MCTAllFT, see text)				
Deciles	average net change £/year	% losers	% gainers	% losing > £2pw
1	73.94	19.0	76.3	0.7
2	74.83	23.0	73.1	0.4
3	54.55	27.1	68.0	1.4
4	30.32	39.1	55.8	1.4
5	-4.73	62.2	32.3	2.5
6	-22.05	70.5	22.1	2.3
7	-38.22	79.5	12.9	5.1
8	-47.32	86.6	7.7	9.1
9	-54.34	91.2	1.5	6.7
10	-61.78	94.5	5.5	13.1
All	0.0	59.3	35.2	4.3

Table 3.11 shows the impact on pensioners of the measure (MCTPensFT). The overall distribution is not much different from that for all households in Table 3.10, except that 1.0% of pensioners lose more than £2 per week, and there are more losers in the second lowest decile.

Table 3.11: Households with pensioners , modified carbon tax, 100% take-up, increase means-tested benefits (MCTPensFT, see text)				
Deciles	average net change £/year	% losers	% gainers	% losing > £2pw
1	42.38	19.1	78.8	1.0
2	31.15	34.4	59.4	0.3
3	27.04	36.9	55.9	1.4
4	19.86	38.5	55.6	1.4
5	-3.43	58.3	37.1	2.4
6	-10.92	60.8	35.9	2.3
7	-20.49	62.1	34.1	6.5
8	-40.35	81.5	14.1	9.7
9	-59.12	83.3	5.4	16.0
10	-64.90	91.4	7.4	19.0
All	5.18	49.0	45.8	3.6

3.2.6 Redistributing some of the winter fuel allowance

It was thought that redistributing some of the money from the Winter Fuel Allowance might help the situation by redirecting it through means-tested benefits onto those most in need.

The package modelled (MCTWFA1AllFT) was:

Reducing the winter fuel allowance (WFA) by £100 per year (i.e. halving it), and increasing:

IS/MIG £2.65 per single person, £4.35 per couple (also in HB and CTB)
CTC £1.40 per child
WTC £2.65 per claim

Table 3.12 shows that this turned out actually to increase both the number of losers (from 19% to 26%), and the numbers losing relatively large amounts (4.9% as opposed to 0.7% now lose more than £2 per week), even in low income groups and in spite of assuming 100% take-up of means-tested benefits (see Table 3.10 for comparison).

Table 3.12: All households, modified carbon tax, 100% take-up, reduce Winter Fuel Allowance by £100 pa and increase means-tested benefits (MCTWFA1AllFT, see text)				
Deciles	average net change £/year	% losers	% gainers	% losing > £2pw
1	117.42	26.2	67.9	4.9
2	103.12	33.0	64.2	10.7
3	68.54	38.1	58.1	16.5
4	25.58	47.8	47.1	18.0
5	-13.62	66.9	28.6	21.3
6	-39.31	75.2	17.1	20.2
7	-52.78	82.1	10.6	17.6
8	-63.28	87.1	7.8	24.1
9	-66.20	92.8	1.7	15.6
10	-69.94	93.7	3.6	20.4
All	0.0	64.3	31.7	16.9

Table 3.13 shows the same information as Table 3.12, but for households with pensioners (MCTWFA1PensFT). The proportion losing relatively large amounts, even at low income levels, is large for pensioners, rising in the lowest decile from 1.0% to over 15% (see Table 3.11 for comparison). The average net change is negative for all deciles except Decile 1, showing that for these households the loss in WFA plus the carbon tax payments are larger than the increased benefits.

Table 3.13: Households with pensioners, modified carbon tax, 100% take-up, reduce Winter Fuel Allowance by £100 pa and increase means-tested benefits (MCTWFA1PensFT, see text)				
Deciles	average net change £/year	% losers	% gainers	% losing > £2pw
1	13.73	45.6	44.7	15.1
2	-22.05	61.2	35.8	24.8
3	-31.04	59.1	35.4	31.7
4	-43.63	58.9	34.9	36.1
5	-78.31	74.2	21.9	55.0
6	-89.39	78.1	17.6	58.2
7	-100.88	77.7	19.6	61.1
8	-130.88	87.2	10.2	80.4
9	-153.35	97.8	2.2	82.0
10	-159.69	94.3	5.8	88.4
All	-61.15	68.1	27.4	45.1

Table 3.14 shows the effect of concentrating the resources released by cutting the Winter Fuel Allowance and increasing Pension Credit, rather than increasing means-tested benefits for all households (MCTWFA2AllFT). This substantially reduces the proportion of losers in the lowest two deciles (from 26.2% to 18.5% in the lowest decile, see Table 3.12 for comparison), and the proportion losing more than £2 per week (from 4.9% to 3.8% in the lowest decile). However, it is still worse than keeping the WFA.

Table 3.14: All households, modified carbon tax 100% take-up, reduce Winter Fuel Allowance by £100 pa and increase means-tested benefits targeted on Pension Credit (MCTWFA2AllFT, see text)				
Deciles	average net change £/year	% losers	% gainers	% losing > £2pw
1	99.68	18.5	77.1	3.8
2	88.66	25.2	71.9	7.8
3	64.79	30.9	67.4	10.7
4	37.28	42.3	54.9	15.6
5	-14.92	63.2	32.3	20.5
6	-33.54	71.0	22.4	20.5
7	-47.68	80.1	13.2	17.6
8	-63.44	87.8	7.4	24.0
9	-66.14	92.5	1.8	15.9
10	-70.41	94.3	2.8	20.3
All	0.0	60.6	35.1	15.7

Table 3.15 shows the effect of a similar package (MCTWFA2PensFT) on pensioners. Again the proportions of losers in the lowest two deciles are reduced (from 45.6% to 18.9% in the lowest decile, see Table 3.13 for comparison), but 41% of households in the second decile remain worse off. The proportions in these deciles losing more than £2 per week also fall, but remains at 11.6% in the lowest decile.

Table 3.15: Households with pensioners, modified carbon tax, 100% take-up, reduce Winter Fuel Allowance by £100 pa and increase means-tested benefits targeted on Pension Credit (MCTWFA2PensFT see text)				
Deciles	average net change £/year	% losers	% gainers	% losing > £2pw
1	118.14	18.9	78.7	11.6
2	54.55	41.0	55.1	17.9
3	43.32	45.2	53.9	20.1
4	26.26	45.9	53.1	31.1
5	-34.89	61.3	37.2	52.8
6	-46.33	62.5	37.0	58.2
7	-61.62	64.6	35.5	61.3
8	-117.05	86.9	12.7	79.4
9	-146.74	92.9	7.1	84.1
10	-147.26	89.6	86.9	10.4
All	-3.12	53.9	44.8	40.9

3.2.7 Summary of results of compensation measures

Table 3.16 summarises the results of the various compensation methods for the bottom three deciles, households with equivalent incomes of less than about £11,000 per year.

The first point to be made is that for the lowest decile all the tax plus compensation packages are progressive on average (that is, the average household is a net gainer). The amounts gained range from £1.77 per year (CTPens1) to £118.14 per year (MCTWFA2PensFT). The same is true for Deciles 2 and 3, except in respect of MCTWFA1PensFT when, not surprisingly, nearly all pensioner households lose out from the redistribution of some of their WFA to non-pensioner low-income households. Essentially these results substantiate the hypothesis on which this research was based, namely that it is possible to make a carbon tax such as that imposed progressive for the average household in the lowest deciles.

Table 3.16 Summary of tax plus compensation results for first three deciles

Compensation Method (Table)	Decile 1				Decile 2				Decile 3			
	Av. net change £/year	% losers	% gainers	% losing > £2pw	Av. net change £/year	% losers	% gainers	% losing > £2pw	Av. net change £/year	% losers	% gainers	% losing > £2pw
CTPens1 (3.2a)	1.77	32.1	50.9	1.2	4.21	35.2	50.0	0.3	7.33	27.3	57.4	0.9
CTPens2 (3.2b)	39.21	47.5	47.3	2.1	19.29	42.5	49.0	1.4	11.75	49.1	42.1	1.4
CTChild1 (3.3a)	12.58	28.5	63.7	1.0	3.33	31.1	60.5	1.4	6.86	34.8	54.9	1.2
CTChild2 (3.3b)	53.40	29.7	64.8	2.8	65.26	16.3	80.1	1.2	57.88	24.7	70.3	9.3
CTAllPT (3.4)	69.32	35.1	57.1	1.3	76.23	28.7	66.3	1.3	55.02	37.3	56.8	1.0
CTAllFT (3.6)	72.85	19.6	75.9	0.7	72.33	23.2	72.7	0.4	53.30	28.0	67.4	1.4
MCTAllPT (3.8)	68.54	34.9	57.2	1.3	75.87	28.5	66.3	1.3	55.12	36.6	56.6	1.0
MCTAllFT (3.10)	73.94	19.0	76.3	0.7	74.83	23.0	73.1	0.4	54.55	27.1	68.0	1.4
MCTPensFT (3.11)	42.38	19.1	78.8	1.0	31.15	34.4	59.4	0.3	27.04	36.9	55.9	1.4
MCTWFA1AllFT (3.12)	117.42	26.2	67.9	4.9	103.12	33.0	64.2	10.7	68.54	38.1	58.1	16.5
MCTWFA1PensFT	13.73	45.6	44.7	15.1	-22.05	61.2	35.8	24.8	-31.04	59.1	35.4	31.7

(3.13)												
MCTWFA2AllFT (3.14)	99.68	18.5	77.1	3.8	88.66	25.2	71.9	7.8	64.79	30.9	67.4	10.7
MCTWFA2PensFT (3.15)	118.14	18.9	78.7	11.6	54.55	41.0	55.1	17.9	43.32	45.2	53.9	20.1

However, the enormously skewed distribution of energy consumption *within* the income deciles, which was showed in Section 2, means that the average result conceals great differences in net gains and losses within each decile. In fact, it can be seen from Table 3.16 that none of the compensation packages manage to reduce the proportion of Decile 1 households much below 20%, and the five that do get slightly below this figure (CTAllFT, MCTAllFT, MCTPensFT, MCTWFA2AllFT, MCTWFA4PensFT) all assume a 100% take up of the relevant means-tested benefits, which is clearly unlikely to be achieved. With the take up of benefits at current (partial) rates, none of the compensation methods reduces the proportion of all households in Decile 1 which lose out much below 35%. MCTAllPT gives the lowest result at 34.9% and 1.3% of Decile 1 households lose more than £2 per week.

It is of course a political judgement whether such an outcome - broadly progressive, with reduced carbon emissions, bringing some households out of fuel poverty but with a significant negative impact on the fifth of households that are likely to be deepest in fuel poverty - would be socially acceptable. It would of course be campaigned against by the representatives of those among the fuel poor who are made worse off. Possibly they would be joined in their campaign by the better off who might also not welcome the substantial overall redistribution in favour of the poor that a package like MCTAllPT represents.

In conclusion, the research has shown that although redistributing the revenues from a carbon tax through means-tested benefits would certainly be progressive overall and would bring some households out of fuel poverty, it does not seem to be possible to devise a means of doing it that would not also worsen fuel poverty for those who are already most badly affected by it. This makes it politically problematic at best, and probably politically infeasible.

3.3 Exemptions

An alternative to using the benefits system to compensate for a household carbon tax would be to identify vulnerable households that could be exempted from such a tax. A household with an exemption could receive a certificate with a unique identification number that they could quote to gas and electricity suppliers administering the tax in order to receive an exemption from the tax on their bills. This measure would have the advantage that an exemption would avoid penalising those low-income households that are already most in fuel poverty.

One way to attempt to do so might be to use benefits status to identify those in need of help. There are, however, a number of problems. Benefits status is not a reliable indicator of whether a household is in fuel poverty. The Energy Efficiency Commitment has found that about 30% of households in fuel poverty are not in receipt of benefits (Fuel Poverty Advisory Group 2003). Part of the reason is poor take up, but there are two other factors to consider: low wages and poor building fabric. There are holes in the safety net. For example, an adult without children with a part-time job may have an income above Jobseeker's Allowance/Income Support levels, but still have a very low income and not be eligible for any benefits. A probably more important factor is that many people in fuel poverty live in energy inefficient homes. It would cost about £1,000 per annum to heat a poorly insulated home at SAP 30 to an adequate standard (DETR 2000), so such a household would need an income over £10,000 per annum to avoid fuel poverty.

There are further practical problems. Most benefits, including means-tested benefits, are assessed at the level of the individual, not the household, so there can be wealthy households which have one member in receipt of benefits. The only benefits that are assessed at the level of the household are Housing Benefit and Council Tax Benefit. The complex rules that govern how much of each of these benefits a claimant receives mean that these two benefits run out at wildly varying incomes, typically between about £4,000 per annum and about £10,000 per annum, for reasons that have little to do with need and a great deal to do with the idiosyncracies of the way other benefits and tax credits are structured.

It would be possible to create a separate benefit to pay the exemption, but since the carbon tax would typically be around £50 and generally below £100, the administrative overheads on claims would be relatively large and the take-up of such a small benefit would be likely to be very poor.

Another idea would be to use the tax system to determine which households were eligible for benefits. The problem is that individual taxation means that each person's tax liability is assessed separately. Because 80% of taxpayers are only on PAYE, the Inland Revenue does not keep track of their address. Linking together the information on all the people at a particular address to determine whether it fell below the threshold for exemption would require an expensive overhaul of the way the Inland Revenue works.

It is therefore difficult to see how an administratively feasible carbon tax exemption system could be set up within current institutional structures. This reinforces the earlier conclusion that it is not possible to introduce a carbon tax on household energy use in the UK without worsening the situation of some people already in fuel poverty, particularly those likely to be in the worst fuel poverty. This means that such a tax could not be introduced until the problem of fuel poverty itself has been resolved. Probably the only feasible way to do that is through improvements to the housing stock.

4. A national home energy efficiency programme

4.1 The Role of Government Funding

The existence of large-scale opportunities for cost-effective household energy efficiency measures means that in principle the public policy problem could be regarded as one of securing investment rather than committing public expenditure. A National Home Energy Efficiency Programme, which sought over time to ensure that all cost-effective energy efficiency measures were in fact implemented throughout the UK housing stock could theoretically be financed by government, with the expenditure on the measures being subsequently recouped from households from their energy savings, while still leaving households better off.

The practical difficulties of putting this approach into practice (including setting up the repayment schedules for the newly energy-efficient households) mean that such a programme is unlikely to be implemented. A more promising approach would seem to be one in which households were incentivised to make their own cost-effective investments in improving their energy efficiency, all the financial benefits from which would then accrue to them. A scheme which takes this approach is proposed in the next section. Were such a scheme to be implemented, the result would be that at some point in the next decade, the great majority of the UK housing stock would be at a cost-effective level of energy efficiency.

However, the measures described in the next section would not be sufficient to address the problem of low-income households that do not have the capital to make the necessary energy efficiency improvements to their homes. These groups need to continue to be addressed through programmes like Warm Front and the Energy Efficiency Commitment. However, it is apparent that the existing programmes are deficient in two ways. Firstly, their targeting needs to be improved. As noted above, of the order of half the households in fuel poverty are not eligible for Warm Front because they do not meet the narrow criteria of containing both vulnerable people and being in receipt of certain benefits. It is also worth noting that many of the households that do receive help are not actually in fuel poverty because they are already fairly well insulated (Fuel Poverty Advisory Group 2003). To resolve this problem the Fuel Poverty Advisory Group recommended that the eligibility requirements for the schemes should be changed to reflect fuel poverty rather than benefit status.

The second deficiency in the existing programmes is that they do not provide enough money to address fully the underlying causes of fuel poverty, which are of three different kinds. One is the level of prices, which is why carbon taxation is so problematic for fuel poverty, as shown in the previous section. A second is living in a badly insulated home. A household requires an income of about £10,000 a year to escape fuel poverty in a SAP 30 home. The third cause of fuel poverty is having a very low income. In 1996 a household on Income Support needed an energy efficient SAP 70 home to escape fuel poverty (DETR 2000). Benefit levels have increased since then and fuel prices have fallen slightly in money terms, but the SAP required to escape fuel poverty on Income Support would not be a great deal lower today. SAP 70 is the energy efficiency level typical of a home with an efficient boiler, loft insulation and cavity wall insulation (Pett 2002).

Houses that have cavity walls (almost all those built from the 1930s onwards) require only an efficient boiler (costing around £1000) and several hundred pounds' worth of insulation to bring up to around SAP 70. The big problem is houses with solid walls, which account for one-third of the building stock, essentially almost all those built before the 1930s. These houses lose a great deal of heat through their walls, reducing the impact of other measures that can be taken. The walls can be clad on the outside, but this costs about £4000 and is not allowed in conservation areas. The walls can be insulated internally, but that is not as effective, slightly reduces the internal dimensions of the rooms and requires redecorating afterwards. It costs around £1500 just for the insulation – redecorating costs extra, so it is usually done when complete redecoration is necessary anyway. Neither measure is quite cost-effective at present energy prices. The Fuel Poverty Advisory Group recommends that the most cost-effective approach for these homes is to install an efficient gas condensing boiler, 300mm of loft insulation and tank insulation. The energy bills for a semi-detached house achieving the recommended level of warmth would be about £500 per annum, so that a household would need an income of only £5,000 per annum to escape fuel poverty (Iles, 2002).

As is recognised, homes beyond the reach of the gas supply are much more difficult to bring out of fuel poverty. These houses are mostly heated electrically at the moment, which is both expensive and carbon-intensive. The best approach currently available is to install efficient central heating with a condensing oil boiler. This is not as good as a gas boiler, but is much cheaper to run than electric heating – costs to achieve the same standard of warmth are reduced by nearly half (Iles 2002). However, it requires a very large oil tank and so is not practical for homes with no garden or only a small one (Iles, personal communication). The only way to get the energy bills of these homes down to an acceptable level would be with full insulation, including solid wall insulation for those homes with solid walls. It should also be noted that oil heating reduces bills compared to electric heating, but it does not reduce carbon emissions much. If the aim is to reduce carbon emissions, there would have to be a focus instead on solid wall insulation even though it is not currently cost effective. Implementing such measures through Warm Front would require that its current upper limit on grants (£2000 at present) would have to be increased.

There are 2.5 million UK households currently in fuel poverty according the definition that includes housing costs and 3.2 million households according to the definition that excludes housing costs (Fuel Poverty Advisory Group 2003). It is estimated that bringing all of them out of fuel poverty would cost an *average* of £2000 each (ibid). That implies an upper figure for the elimination of fuel poverty of about £6.4 billion. That is about twice what the government plans to spend on the problem up to 2010. It therefore seems likely that resolving the fuel poverty problem by 2016, a commitment the Government made in the Energy White Paper (DTI 2003), will require about twice the financial resources that have so far been allocated to it, assuming perfect targeting.

4.2 Mobilising private investment in energy efficiency

The current focus of household energy efficiency measures on the poor makes sense in terms of social objectives but it has a very limited effect on carbon emissions because the rebound effect means that about half the efficiency gains are taken back in the form of increased comfort (Henderson et al. 2003). The fuel poor are only about 10% of households. If carbon emissions from households overall are to be reduced, the focus will have to be on the 90% of households which are not fuel poor, and for which, at present, energy efficiency seems to be a low priority. The policies described in this section propose the use of economic instruments purely to encourage householders to improve the energy efficiency of their households. The policies are not intended to raise revenue, and it will be important politically that this intention is clearly apparent. An important design principle of these policies is therefore that no penalty attaches to households that do improve their energy efficiency within a prescribed timescale.

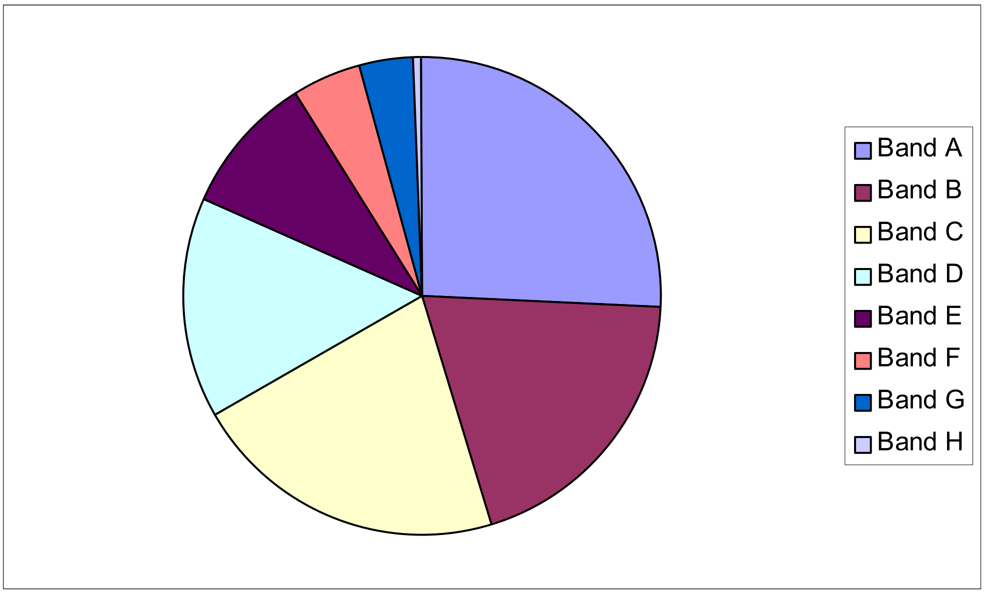
4.2.1 Giving incentives through the council tax

Council Tax is a tax levied on the occupiers of property to contribute towards the cost of providing local services. The properties are divided into a number of bands (A-H) related to their prices in 1991, when the tax was introduced Homes built after 1991 are placed in the same band as comparable properties in the area. The Council Tax is set annually. D-rated properties pay the standard charge. A-rated (lowest priced) properties pay two-thirds of the standard rate; H-rated (highest priced) properties pay twice the standard rate, with the other bands falling within this range. Table 4.1 shows the percentage of preperties in England in each Council Tax band, and Figure 4.1 illustrates this.

Table 4.1 Percentage of properties in England in each council tax band

Band A	*Band B*	*Band C*	*Band D*	*Band E*	*Band F*	*Band G*	*Band H*
25.9	19.3	21.5	14.9	9.3	4.9	3.5	0. 6

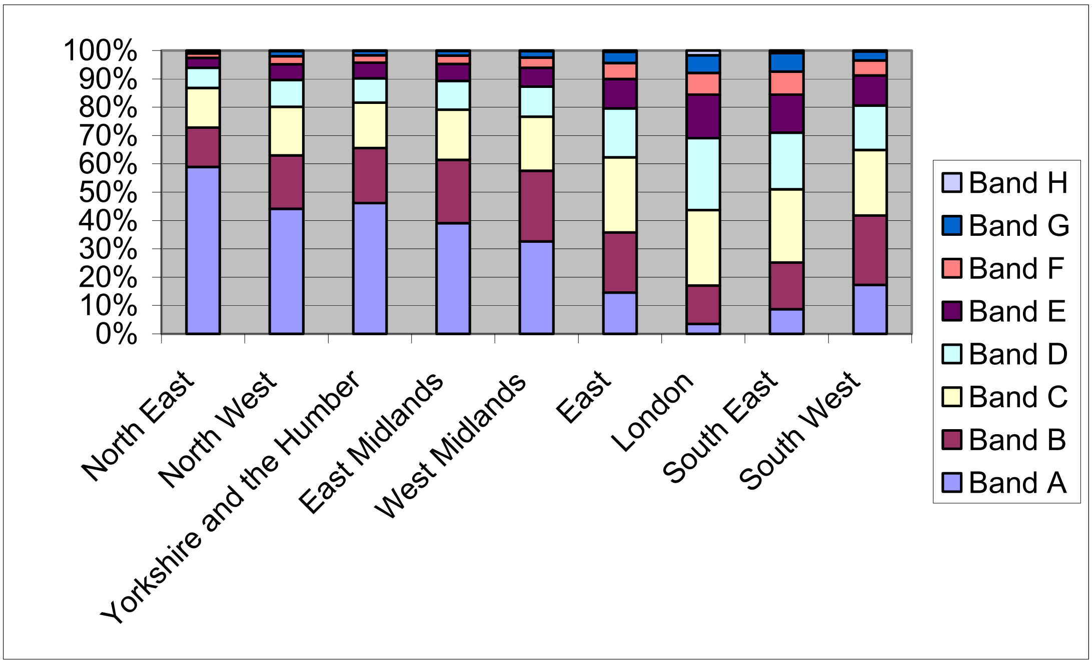
Figure 4.1 Pie chart of proportion of properties in England in each council tax band



The policy proposed and investigated here is the levying of a surcharge of 20% on the Council Tax of all households that do not implement all cost-effective energy efficiency measures within a year of notification. The surcharge would rise by 10% (to a maximum of 100%) in each succeeding year that the measures were not carried out.

Because not enough qualified installers of such measures exist to carry out this work all at once and it will take time to train sufficient installers to increase the current rate of energy efficiency improvements to the housing stock, it is proposed to implement the policy over ten years, starting with the highest Council Tax bands and working down the bands over the years. Because the proportion of households in each band varies significantly between regions and localities (see Figure 4.2), the bands which would be included for energy efficiency improvements in each year would need to vary from local authority to local authority. For instance, in most parts of London and the South East, the properties in bands G and H would be affected in the first year while at the other extreme, in most of the North East, properties in bands D to H would be involved in the first year. These bands account for about ten percent of households in the respective regions. Lower down the range, some bands account for much larger proportions of properties in each area. At the extreme, 60 percent of properties in the North East are in band A. Where more households existed in a band than could be improved in a particular year, some appropriate geographic division would need to be made in order to maximise the efficiency of the use of installers.

Figure 4.2 Percentage of properties in England in each council tax band by region



Cost-effective energy efficiency measures would be identified through already existing household energy audit procedures. Each year householders in the relevant band for that year would be notified that, if they wished to avoid a surcharge on their Council Tax in succeeding years, they would need to implement all cost-effective energy efficiency measures in their home. They would be advised how to obtain an energy audit of their home, which would deliver them a certificate listing all such measures. On completion of these measures by a qualified installer (chosen by the householder from a list of recommended installers), they would receive an implementation certificate, which they would send to their local Council Tax office to forestall or cancel the surcharge in the future. All households which implemented all cost-effective measures within a year of notification would therefore pay nothing on top of Council Tax. For most households, the financial savings following implementation of the measures would be substantial.

Householders already living in energy-efficient homes would have a proportion of the cost of the energy audit deducted from their Council Tax in the subsequent year (provided any remaining cost-effective measures had been implemented), depending on the financial savings which these remaining measures were estimated to have delivered. Thus any household with no cost-effective measures available would have rebated the whole of the energy audit cost.

A ring-fenced fund would be established, into which any Council Tax surcharges would be paid, to provide low-cost loans to carry out the measures for households on medium incomes. These loans would be recovered through the Council Tax mechanism in succeeding years, once the energy savings had started to materialise, at a rate calculated to reflect those savings. Depending on its resources, the fund would also pay grants to households eligible for the Warm Front scheme, or the measures could be carried out directly through the scheme.

Regression analysis shows that the correlation between income and Council Tax band is 0.396, so 39.6% of the variance in income is reflected in Council Tax band. The correlation is strong, but not overwhelming.

The distribution of Council Tax band according to income decile among English households in the Family Expenditure Survey 2001 was as in Table 4.2

Table 4.2 The distribution of council tax bands by income decile

	Band A	Band B	Band C	Band D	Band E	Band F	Band G	Band H
Decile 1	34.4%	22.5%	21.1%	10.6%	6.4%	2.8%	2.3%	0%
Decile 2	34.1%	23.5%	15.5%	15.9%	6.6%	2.7%	1.8%	0%
Decile 3	28.6%	16.4%	24.8%	12.2%	10.1%	4.6%	2.1%	0.8%
Decile 4	25.9%	24.4%	23.7%	13.5%	6.0%	2.3%	3.4%	0.4%
Decile 5	29.3%	21.4%	19.9%	16.5%	5.3%	4.9%	1.5%	0.8%
Decile 6	24.5%	26.0%	19.7%	14.4%	8.5%	3.8%	3.1%	0%
Decile 7	21.4%	24.6%	17.8%	19.6%	8.3%	5.3%	2.1%	0.9%
Decile 8	20.5%	21.4%	23.3%	17.1%	6.8%	5.3%	3.7%	0.6%
Decile 9	18.4%	20.2%	17.2%	20.6%	11.7%	5.2%	5.2%	1.2%
Decile 10	11.5%	14.1%	21.1%	23.7%	15.9%	8.9%	4.2%	0.5%

The percentages recorded for the higher bands are clearly not very reliable because they are subject to random sampling error. It can be seen that even quite a large proportion of wealthy households live in homes with low Council Tax bands, while very few poor households live in homes with high Council Tax bands.

Table 4.3 shows the distribution of income deciles according to Council Tax band among English households in the Family Expenditure Survey 2001:

Table 4.3 The distribution of income deciles by council tax band

	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10
Band A	10.9%	11.2%	9.9%	10.0%	11.4%	11.4%	10.5%	9.6%	8.7%	6.4%
Band B	7.9%	8.6%	6.3%	10.5%	9.2%	13.4%	13.4%	11.2%	10.7%	8.7%
Band C	7.8%	5.9%	10.0%	10.7%	9.0%	10.7%	10.2%	12.7%	9.5%	13.7%
Band D	4.7%	7.3%	5.9%	7.3%	8.9%	9.3%	13.4%	11.2%	13.6%	18.5%
Band E	5.4%	5.8%	9.3%	6.2%	5.4%	10.4%	10.8%	8.5%	14.7%	23.6%
Band F	4.3%	4.3%	7.9%	4.3%	9.3%	8.6%	12.9%	12.1%	12.1%	24.3%
Band G	5.6%	4.5%	5.6%	10.1%	4.5%	11.2%	7.9%	13.5%	19.1%	18.0%
Band H	0%	0%	12.5%	6.3%	12.5%	0%	18.8%	12.5%	25.0%	12.5%

The figures given for the higher Council Tax bands in Table 4.2 should be treated with extreme caution as there were too few households in those bands to give statistically reliable results. However, it can be seen that the correlation between income and Council Tax band is not as high as might be expected. It can be seen that rich households are only somewhat under-represented among households in the lowest bands, while poor households are very under-represented among households in the highest bands.

Regression analysis shows that the correlation between Council Tax band and energy expenditure is 0.261, so 26.1% of the variance in energy expenditure is reflected in the Council Tax band. The relationship between Council Tax bands and energy expenditure is described in Table 4.4.

Table 4.4 Annual fuel bills by council tax band

	Annual domestic fuel bills (£)		
Council Tax band	20th percentile	Median	80th percentile
A	242.35	443.04	699.92
B	300.04	510.12	728.21
C	355.68	545.48	780.00
D	384.28	593.84	851.24
E	468.58	672.36	942.03
F	564.20	800.28	1115.92
G	600.08	900.12	1333.44
H	633.78	1116.44	2352.48

It can be seen that energy expenditure (and hence carbon emissions) rises quite rapidly through the Council Tax bands. Even so, there is not insignificant overlap between the highest bills in Band A and the lowest bills in Band H. It must be borne in mind that less than 10% of households live in properties in the top three bands. Nonetheless, the Council Tax incentive scheme would tend to apply first to households with higher bills, and therefore present greater opportunities for early cost-effective energy-saving measures.

Thirty percent of Council Tax payers in England are tenants (ODPM, 2002). It would not be fair to expect them to pay for energy efficiency improvements to the properties they live in or for them to have to pay a Council Tax surcharge because their landlord did not pay for the necessary improvements. One solution would be to give tenants the right to deduct any imposed Council Tax surcharge from their rent. In that way, the responsibility for making the improvements would be transferred from the tenants to the landlords with whom it should belong.

Once houses had been made energy efficient there would be little continuing rationale for the winter fuel payment to those over 60. It is currently £200 per household per annum or £100 per person if more than two eligible people live in the household. It could be linked into the energy efficiency programme by providing all eligible households with a one-off maximum grant of £2000 towards the cost of energy saving measures at the time when their home fell under the requirement to institute all cost effective measures. Thereafter, those living in the house would not be entitled to the payment, the effect of which would be that winter fuel payments would gradually be phased out.

The carbon savings which would results from implementing all cost-effective household energy efficiency improvements are summarised in Table 4.5.

Table 4.5 Carbon savings from all cost-effective energy efficiency measures in households

	Potential households (millions)	CO2 saving (MtC/year)	Additional to business as usual by 2010
Cavity wall insulation	9	2.9	2.5
Low E glazing	20	0.6	0.6
Loft insulation	7.5	0.9	0.5
Tank/pipe insulation	9	0.5	0.4
Draught-proofing	6	0.2	0.2
Boilers	15	2.5	2.5
Heating controls	7	0.7	0.6
TOTAL		8.3	7.3

(derived from EST 2001, p.18)

Low E glazing (which has recently been incorporated into building regulations) and double glazing in general are only cost effective when windows have to be replaced anyway. Upgrading boilers is also only cost effective near the end of life of boilers. It has not been possible to determine to what extent such measures could be included in the incentive scheme. Secondary glazing is cost effective, but it has not been possible to obtain figures for the cost. Taking these measures out, the other measures total 4.2MtC/year, equivalent to 10% of household carbon emissions.

In addition, it is estimated that there is the potential for 0.7 MtC/year of reductions from compact fluorescent lightbulbs (CFLs, assuming 4 bulbs per household) and 1.5 MtC/year from more efficient appliances. These measures probably could not be included in the scheme because of enforcement difficulties, but information about them and illustrative potential financial savings could be made available through the audit and, perhaps, CFLs made available for purchase at the time any improvements were being made.

The costs, savings and rate of return of all cost-effective measures that could be implemented at any point are summarised in Table 4.6.

Table 4.6 Financial implications of implementing all cost-effective energy efficiency measures in households

	Potential households (millions)	Cost per measure (£)	Total investment (£million)	Saving per measure (£/year)	Total savings (£M/ year)	Rate of return[4] (%)	Lifetime energy bill savings[5] (£million)
Cavity wall insulation	9	300	2700	96	864	32	11892
Low E glazing	20						
Loft insulation	7.5	200	1500	40	300	20	4130
Tank/pipe insulation	9	35	315	15	135	42	1803
Draught-proofing	6	85	510	10	60	5	482
Boilers	15						
Heating controls	7	200	1400	21	147	6	1427
TOTAL			6425		1506	23	19734

(derived from EST 2001, pp. 19-20)

The measures would cost householders £6.4 billion, but would save them a net present value of £19.7 billion pounds. The average rate of return to householders would be 23%.

The limiting factor for the implementation of such measures is the capacity of installers. It would be necessary to have a great many more installers than there are at present. The current supply of installers more or less matches present demand. However, it does not take a long time for someone to be trained, so an increase in demand could be expected to quickly lead to an increase in supply. The experience of the Energy Efficiency Standards of Performance (EESOP) scheme was that one job-year involved costs of £45,000 (£25,700 for labour costs plus £19,300 materials costs) per direct job, or £39,000 per job when indirect jobs are included (Association for the Conservation of Energy, 1997). These figures are from 1997, so a reasonable estimate would be that about £55,000 of expenditure would generate one direct job. If a £6.4 billion programme of work was conducted over ten years, that would be £640 million a year, implying about 11,500 direct jobs. When indirect jobs are included, the number of jobs would rise to about 13,500. However, about £1.3 billion of expenditure could be expected over ten years under business as usual (EST 2001), or £130 million a year, so the net number of direct jobs created (and additional installers required) would be about 9,000 and the net number of direct and indirect jobs would be about 11,000.

Economic instruments should not be used to the exclusion of other measures. There is a case for increasing the efficiency standards of domestic boilers and other heating systems. A number of factors hold back the use of condensing boilers in the UK compared to other countries like the Netherlands and Germany, but the main problem is a lack of suitably trained installers. There need to be subsidies to promote the training of installers, as in the Netherlands. Condensing boilers are more difficult to install than non-condensing boilers and they cannot be installed in all homes. However, the standards for non-condensing boilers could be increased.

Through the above incentive scheme the great majority of homes in England and Wales (and Scotland and Northern Ireland if their devolved governments decided on similar schemes), which are currently among the most energy inefficient in northern Europe (Royal Commission on Environmental Pollution 2000), could be brought up to cost-effective levels of energy efficiency by the middle of the next decade. Fuel poverty would be reduced to a fraction of its current level and confined to houses which were very expensive to make energy efficient. Carbon emissions from household energy use would be likely to be reduced by 10% from current levels, at no net cost to the taxpayer (apart from the small administrative cost of the scheme) and with very considerable financial benefits to most householders. The only losers would be those householders who wished to continue to exercise their right to use energy in their homes inefficiently, or those whose dislike of the process of upgrading their home (and the inevitable administration and possible disruption this might cause) exceeded the net financial benefit they would receive. Their costs might be considered justified in the light of their excess contribution to climate change.

Few other public policies have such a positive overall generation and distribution of economic, social and environmental benefits. It is an indication of the low political priority that is still given to climate change that such a scheme is still not being given serious political consideration.

4.2.2 Stamp duty

Home improvement measures are often carried out when people move house. This would therefore often be a convenient time for householders to carry out energy efficiency improvements. The Council Tax incentive described in the previous section could be supplemented by a similar incentive (only applicable to properties which were not already certified as energy efficient) imposed through Stamp Duty at the time of sale.

Stamp Duty is levied at the time of sale of a property dependent on the value of the property. The threshold is £60,000. Properties worth between £60,000 and £250,000 are taxed at 1% of the value. Properties worth between £250,000 and £500,000 are taxed at 3% of the value. Properties worth over £500,000 are taxed at 4% of the value. The Energy Saving Trust has proposed (EST 2002, p.14) that households which carry out specified energy efficiency improvements within 12 months of the sale completion should receive a rebate on their Stamp Duty. Such a proposal both seems to run counter to the Polluter Pays Principle (which has a presumption against subsidising polluters to reduce their pollution) and does not take account of the fact that the improvements will actually save the households money.

The proposal put forward here is that all house sales would attract a surcharge on Stamp Duty equivalent to 1% of the value of the property, which would become payable a year after the sale was completed, unless the householder could provide an energy efficiency certificate showing that all cost-effective energy efficiency measures had been carried out in the intervening year (in a similar process to the Council Tax proposal). During this year the householder would not be subject to any Council Tax surcharge which might have been inherited from the previous householder, although this would be imposed without a further notification period if the measures were not carried out by the time the Council Tax was set following the payment of the Stamp Duty surcharge (which of course would only itself be paid if the measures remained unimplemented for 12 months).

The advantages of combining this measure with that involving Council Tax are as follows:

- It accelerates the process of increasing household energy efficiency, especially for households in lower-priced properties. This might be important with reference to the achievement of the Government’s 2010 carbon emissions targets.
- It provides an incentive to implement energy-efficiency measures at a convenient time, irrespective of the Council Tax band (otherwise band A properties, for example, will not have such an incentive for several years).
- It provides a means of giving a year to achieve energy efficiency without a surcharge, when people move house, irrespective of when they move in relation to the Council Tax year, without giving a new period of Council Tax surcharge-free notification for houses which have already attracted a surcharge.

This policy measure is likely to become little used once the Council Tax surcharge has been in place for a number of years and very few properties that can cost-effectively be made energy efficient remain.

The proposal is attractive because it is less intrusive than the Council Tax measure, but it cannot be relied upon as the main measure because much of the housing stock is surprisingly slow moving. People change mortgages on average every seven years, but the average length of stay is 13 years. It is 14.6 years in the owner-occupied sector, 11.5 years in the social rented sector and 5.7 years in the private rented sector (Royal Institute of Chartered Surveyors, personal communication). However, some homes tend to change hands much more frequently than others. The Survey of English Housing shows tenure varies as follows:

Length of residence	
Less than 1 year	7%
1-3 years	14%
3-5 years	9%
5-10 years	16%
10-20 years	26%
20-40 years	22%
More than 40 years	6%

It takes over 10 years for more than half of households to move, over 20 years for 75% to move and about 35 years for 90% to move.

Over the ten years of the Council Tax measure, it can be expected that about 27% of households would be reached by the Stamp Duty measure before they are reached by the Council Tax measure (assuming that properties of different values are equally likely to change hands). It will on average bring forward measures in those households by two years – equivalent in terms of carbon saving to the ten-year programme being completed in 9.5 years.

It is not only the building fabric that could be addressed through economic instruments. They could be used to promote other forms of household energy efficiency. In July 2002, the Treasury launched a consultation on economic instruments to improve household energy efficiency (HM Treasury 2002). A tax on domestic energy was ruled out, but suggestions were invited for other economic instruments that could be used to improve household energy efficiency. A number of submissions suggested the use of incentives based around Stamp Duty and Council Tax, but in the Treasury's follow up consultation document on specific measures, published in August 2003, it dismissed using Stamp Duty as 'administratively complex and giv[ing] weak signals' (HM Treasury 2003, p. 9). The suggestion of a variation in Council Tax was not even mentioned in the second consultation document. Instead, the focus was on reducing the rate of VAT for energy efficient products and measures and a tax allowance to encourage private landlords to insulate properties. Such measures could complement a more comprehensive scheme such as that described above, but by themselves they would do little to meet the Government's carbon reduction targets and are not further discussed here.

4.3 Beyond the ten-year programme

The ten-year programme described in the previous sections would address fuel poverty through an expanded and better-directed Warm Front scheme and would address the energy efficiency of the rest of the national housing stock through the measures related to Council Tax and Stamp Duty. Combined with improvements in the standards for the efficiency of boilers (which have an average lifespan of about 15 years) that are scheduled for 2006 so that condensing boilers take over the market, it would bring most of the housing stock up to quite a high standard, of around SAP 70.

However, two problems would remain. The first is that the one-third of houses with solid walls would not have been brought up to such a high standard. Whereas the indicative fuel costs for a typical semi-detached home with cavity walls and a gas supply that has undertaken all the measures are around £400 a year, the indicative costs for a similar home with solid walls (and no wall insulation) are around £500 a year. However, this assumes the installation of an efficient condensing boiler. If electrical heating is the only practical option then bills would still be over £900 a year with all conventional insulation measures. Solid wall insulation would bring bills down to around £600 a year, which is about the same as a similar house with electrical heating and filled cavities (Iles 2002). The elimination of fuel poverty is going to require not only insulation, but the replacement of electric heating with central heating.

However, at the end of the ten-year programme, all the solid walled and electrically heated houses will have been identified. Presently, there is no way of knowing who is in fuel poverty because nothing is known about the thermal characteristics of a particular address. The data collected by local councils in the ten-year programme will be used to create a national database about the thermal characteristics of every address in the country. It will then be a simple matter to match this with every benefit and tax credit claim and target those households with electric heating for gas central heating if possible and those in solid walled homes for wall insulation measures.

The second problem concerns how to prevent household energy use and carbon emissions from increasing with rising incomes, following the completion of the ten-year programme of energy efficiency improvements. In the absence of rising energy prices this problem could only be addressed through an escalating domestic carbon or energy tax, to ensure that increases in energy prices matched growing incomes.

Such a tax would have the further advantage of providing revenues which could be used to upgrade hard-to-heat homes, as described in the previous paragraphs. At the same rate as the Climate Change Levy, a household carbon tax would raise revenues of around £1 billion per annum which could be hypothecated to home energy efficiency measures. Low-income households in hard-to-heat homes prior to upgrading could be allowed to claim for a temporary exemption from the carbon tax until the necessary measures had been carried out. The Council Tax and Stamp Duty schemes could also continue for another round. By that time, technology would have advanced and this and the carbon tax would have made further household energy efficiency improvements cost-effective.

The second round of the programme could also use the revenues from the carbon tax to fund solid wall insulation and/or central heating for low income households and provide subsidies for those on medium incomes, bearing in mind the expensiveness of these measures.

At the end of the second round of the programme, over another ten years, almost all homes would be close to the SAP 70 standard. The housing stock would have been raised to such a standard that fuel poverty would be almost impossible except in cases of severe under-occupation.

5. Conclusion

The first major conclusion of this project is that, contrary to the starting hypothesis on which the first stage of the research was based, it is not possible to use the benefits system to compensate low-income households for any household carbon tax that might be introduced to reduce CO2 emissions. The reason for this is that there is too wide a variation in energy use in the low-income deciles. Even though a compensation scheme can be constructed which *on average* is very progressive (i.e. makes the average low-income household better off), a minimum of a fifth of these households remain losers (even assuming full take up of benefits), of which a significant proportion will be pensioners and households with children. These are the households with the highest fuel expenditures in the low-income deciles (i.e. they are those deepest in fuel poverty), and those with pensioners and children are especially vulnerable to this condition. A policy that worsened their condition would not be perceived as fair, and would be most unlikely to be considered either socially desirable or politically feasible.

One response to this situation would be to say that little can be done to incentivise households to improve the energy efficiency of their dwellings until the fuel poverty problem has been resolved. To date this appears to have been the Government's approach to this issue. Certainly policies to encourage household energy efficiency overwhelmingly focus on fuel poor, rather than non-fuel poor, households. That is not the response suggested in this paper.

Rather, the paper proposes using two taxes - Council Tax and Stamp Duty - to encourage households to install all cost-effective energy efficiency measures. The suggested approach, implemented over ten years, would yield significant environmental, economic and social benefits. It would save a minimum of 10% of household carbon emissions, and could stimulate about the same savings again (from efficient boilers, appliances and lightbulbs) if the information provided through the approach, complemented by other policies, caused significant take up in these other areas, which lie outside the actual scheme that is suggested. Such carbon savings would ensure that households contribute to the achievement of the Government's carbon reduction targets, rather than to their non-achievement, as seems likely at present.

Economically, the scheme proposed would result in £6.4 billion of investment by households in energy efficiency measures, which would have an average payback period of about four years and, over their lifetime, save £19.7 billion (in present value terms) in household energy expenditures. The proposed scheme therefore yields substantial economic benefits.

A social benefit of this investment would be that many households currently in fuel poverty would be brought out of it. A further social benefit would that the households where fuel poverty remained would be identified, as they are not at present. This would provide the information base for the second ten-year programme, which would tackle the energy inefficiency of hard-to-heat homes (e.g. those with solid walls), using the revenues from a carbon tax on the energy use of those households which were already energy efficient. The carbon tax would also encourage the upgrading of home energy efficiency, as new technologies became available, and both discourage continually rising carbon-based energy consumption, and encourage the installation of non-carbon household energy technologies (such as solar water heating or photovoltaic panels). Because the implemented energy efficiency measures would have greatly reduced the amount of energy required to keep warm, it would be possible in this case to compensate low-income households through the benefit system for their carbon tax payments, to ensure that they were not made worse off.

After twenty years of these policies, the problem of fuel poverty would be resolved, because the UK housing stock would be of an energy efficiency that would render it effectively impossible (as is the case, in terms of political perception at least, in mainland northern Europe). Household energy would be considerably more expensive than it is now. But household expenditure on energy would be lower, both because households would need to use much less to obtain their desired level of service (especially because of houses' far greater retention of heat, but also because of the penetration of more efficient appliances) and because far more households would have installed domestic solar technologies (the energy from which would, of course, carry no carbon tax).

In summary, therefore, for the first ten years the above strategy would be financially neutral or positive for nearly everyone. The poor would be protected and far fewer people would be in fuel poverty. Everyone would be making energy efficiency investments which saved them money and made them more comfortable. The UK housing stock, over a period of a decade, would stop being a national efficiency disgrace. Household carbon emissions would be significantly lower than they are now (rather than higher, as they seem likely to be on current policies). After twenty years, even with the introduction of a carbon tax, the great majority of people would still be better off (depending on how fast the carbon tax was increased and how people responded to it), and the poor would still be protected. Fuel poverty would have been eliminated and the UK housing stock would be among the most energy efficient (instead of the least efficient) in northern Europe.

It is a measure of the lack of public awareness of the threat of climate change, and of a commitment to mitigate, that even a policy approach with such wide economic, social and environmental benefits would not be politically uncontentious. In particular, the penalties for not implementing energy efficiency measures, and perhaps the disruption involved in doing so, would be likely to be resented. Probably there needs to be greater public awareness of climate change, and a greater willingness to address it, than there is now for the long-term gains of the policy outlined here to be regarded as surely worth any inconvenience in the transition as the works are actually carried out.

References

ACE (Association for the Conservation of Energy) 1997 *Direct and Indirect Job Creation from the Standards of Performance for Energy Efficiency Programme*, June, ACE, London

Cambridge Econometrics 2002 *UK Energy and the Environment*, July, Cambridge Econometrics, Cambridge

DEFRA (Department of the Environment, Food and Rural Affairs) 2002 *Digest of Environmental Statistics*, October, DEFRA, London

DETR (Department of the Environment, Transport and the Regions) 2000 *English House Condition Survey 1996: Energy Report*, The Stationery Office, London

DTI (Department of Trade and Industry) 2002 *Digest of United Kingdom Energy Statistics*, July, DTI, London

DTI (Department of Trade and Industry) 2003 *Our energy future: creating a low carbon economy*, February, The Stationery Office, London

EST (Energy Saving Trust) 2001 *Towards an Energy Efficient Strategy for Households to 2020*, October, EST, London

EST (Energy Saving Trust) 2002 *Fiscal Incentives: Home Energy Efficiency*, EST Submission to HM Treasury on Improving Household Energy Efficiency, November, EST, London

Fuel Poverty Advisory Group 2003 *First Annual Report 2002/3*, DTI, London

Henderson, George, Dan Staniaszek, Brian Anderson and Mark Phillipson (2003) 'Energy savings from insulation improvements in electrically heated dwellings in the UK', ECEEE Summer Study proceedings

HM Treasury 2002a, *Economic instruments to improve household energy efficiency: consultation document*, July, HM Treasury, London

HM Treasury 2002b *Tax and the Environment: Using Economic Instruments*, November, HM Treasury, London

HM Treasury 2003, *Economic instruments to improve household energy efficiency: consultation document on specific measures*, August, HM Treasury, London

Iles, Peter 2002, *Hard to Treat Homes*, December, BRE, Garston

Johnson, Paul, Steve McKay and Stephen Smith 1990, *The Distributional Consequences of Environmental Taxes*, Institute for Fiscal Studies, London

ODPM (Office of the Deputy Prime Minister) 2002 *Housing Statistics 2002*, December, ODPM, London

Pett, Jackie 2002 *Affordable Warmth for 'Hard to Heat' Homes: Finding a Way Forward*, March, ACE, London

Royal Commission on Environmental Pollution 2000, *Energy: The Changing Climate*, June, The Stationery Office, London

Endnotes

[1] Using the Bradmill equivalent income scale where the equivalent income expresses a standard of living equivalent to a two-adult household with the income shown.
[2] Using the Bradmill equivalent income scale where the equivalent income expresses a standard of living equivalent to a two-adult household with the income shown.
[3] The authors gratefully acknowledge the assistance of Holly Sutherland at Cambridge University in the use of her POLIMOD model of the tax-benefits system linked to the FES.

[4] Internal rate of return
[5] Present value, discounted at 6%