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Household Energy Use in Britain: A Distributional Analysis

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Esmée Fairbairn Foundation

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Preface

This work was funded by the Esmée Fairbairn Foundation (reference 11-2886) and by the Economic and Social Research Council (ESRC) through the Centre for the Microeconomic Analysis of Public Policy (reference RES-544-28-5001) at the Institute for Fiscal Studies. The authors are very grateful to Andrew Hood of IFS for providing the results of the tax and benefit modelling, and to him and James Browne of IFS for comments on Chapter 6. Thanks also to Simeon Thornton, who acted as an adviser to this project and provided very useful comments on earlier drafts, and to representatives from the Department of Energy and Climate Change for useful discussions. All views expressed are those of the authors alone, and not of IFS, Frontier Economics, the Esmée Fairbairn Foundation or the ESRC.

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Executive Summary

Government wants both to reduce carbon emissions and to reduce 'fuel poverty'. Energy prices have risen in part because of a multitude of policies aimed at reducing emissions. There are also multiple policies aimed at ameliorating these effects. Altogether, this leads to a complex policy landscape, inefficient pricing and opaque distributional effects.

In this report, we show the effects of energy price rises over the recent past, look at what current policies mean for effective carbon prices and their impact on bills, and consider the distributional consequences of a more consistent approach to carbon pricing, alongside possible changes to the tax and benefit system that could mitigate these effects.

Distributional effects of energy price increases

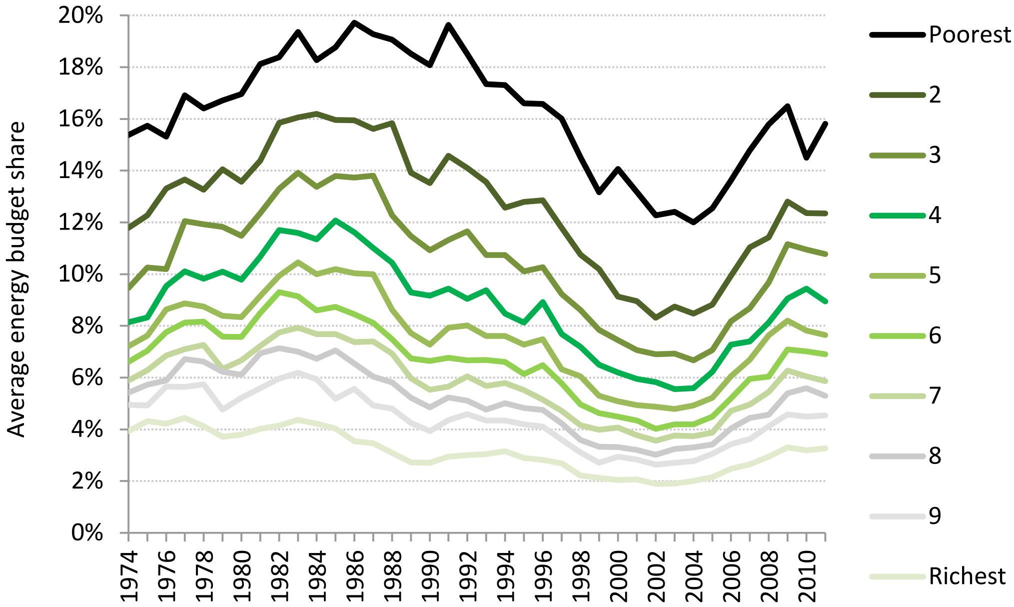
Energy prices have risen sharply in recent years. Relative to other prices, electricity and gas prices have increased by 60% and 110% respectively over the last decade, and reached historic highs in 2009. This contributed to increases in energy spending: adjusted for inflation, average energy costs peaked at over £1,330 per year in 2009 before falling back to £1,230 per year in 2011, compared with a previous peak of around £1,260 per year in 1986 (April 2013 prices).

Overall, energy makes up 8.1% of household spending. But while richer households spend more on energy in cash terms than poorer households, it is a less important part of their overall budget. In 2011, of 12 broad commodity groups, energy was the second largest for those in the poorest tenth of the spending distribution, making up 16% of their spending, but the smallest for those in the richest tenth, accounting for just 3% of their spending.

Since the early 2000s, total spending on energy has risen at every point in the distribution. Average real household spending was just £925 a year in 2000 (April 2013 prices), 25% less than in 2011. But it is also important to look over a longer timescale. As Figure ES.1 shows, despite sharp increases in recent years, energy spending takes a smaller share of total spending now than it did in the mid-1980s – 10% in 1985 compared with 8% in 2011 on average. For the poorest decile, energy spending now accounts for 16% of the total as against almost 20% over much of the 1980s.

In part, this fall in the share of spending arises from increases in total spending. But it also reflects falls in actual energy consumption. These have been possible even as average temperatures inside homes have risen, as both homes and methods of heating have become significantly more energy efficient over time.

Figure ES.1. Energy budget shares by expenditure decile, 1974 to 2011



Note and source: See Figure 3.9.

Distributional issues around energy efficiency policies

A number of policies are designed to support improvements to energy efficiency. These include obligations on energy suppliers (the current Energy Companies Obligation and previous obligations including the Carbon Emissions Reduction Target (CERT) and Community Energy Saving Programme), schemes to provide financing to pay for energy efficiency and heating measures (the Green Deal) and previous tax-funded measures providing free measures to vulnerable households (Warm Front).

Some of these policies to encourage energy efficiency are targeted on poorer households: for example, around one-third of households in the poorest income deciles were eligible for support under Warm Front, compared with only 2% of households in the richest decile. Those in the CERT priority group were also more concentrated among poorer households, though an age eligibility criterion meant that around 10% of those at the top of the distribution were also eligible.

Those eligible for such support were more likely to take up and own insulation measures. And policies delivered through energy suppliers have delivered larger benefits to poorer households than to richer ones. However, because they are paid for through higher energy bills, their overall distributional effect is uncertain. Also, we do not know to what extent energy companies have recouped the cost of the policies through increasing fixed standing charges as opposed to unit costs. One specific policy aimed at the household sector – feed-in tariffs designed to incentivise microgeneration of renewable energy – is clearly regressive because richer households are much more likely to take advantage of the subsidy provided.

Probably in part as a result of these policies, there is now little difference in energy efficiency between the homes of poorer and richer households. Using data from England in 2010–11, poorer households were more likely (or at least no less likely) to have a number of common insulation measures (double glazing, cavity wall insulation and thick loft insulation) than richer households, and average Standard Assessment Procedure (SAP) ratings were essentially the same across the distribution. There is no evidence that poorer households have more variable SAP ratings than richer households.

Evidence on the distributional effects of wider energy use and climate change policies is also limited. Policies that price carbon, such as the EU Emissions Trading Scheme (ETS), clearly raise energy prices. Electricity prices also increase as a result of policies aimed at supporting renewables, such as the Renewables Obligation. Official estimates suggest that policies increased electricity prices by 17% in 2013, and this will increase to 33% in 2020. The effects on household bills are less clear, and will depend on who benefits from energy efficiency policies and the way in which these policies are funded.

Distributional impact of policies supporting energy bills

Support for energy bills is delivered through three main policies: the winter fuel payment (WFP), a universal benefit for those aged at or above the female state pension age; the cold weather payment (CWP), paid to poor households in periods of very cold weather; and the warm home discount (WHD), paid as an electricity bill rebate to poorer households that apply to their energy companies (poorer, older households receive an automatic rebate).

Around 38% of households are eligible for a WFP now worth £200 (£300 for those aged 80 and over). The potential role of WFP in supporting payment of fuel bills has reduced dramatically over the last few years as its generosity has been reduced and as fuel bills have risen. At its peak in 2005–06, the WFP was worth about 46% of fuel bills for 60- to 79-year-olds and 76% for the 80+ group. These figures had fallen to about 13% and 22% respectively by 2013. Nevertheless, the payment is forecast to cost £2.1 billion in 2013–14.

Because older households have become relatively better off over time, the WFP has become less progressive. When introduced in 1997–98, 33% of the total payment was received by households in the poorest spending quintile compared with 10% in the richest quintile. By 2010–11, these figures had become 20% and 17% respectively.

Eligibility for CWP and WHD is much higher among poorer households than richer: around 35% of those in the bottom expenditure decile are eligible, compared with 1% of those in the richest decile. However, other than poor pensioners who receive it automatically, it appears that relatively few other eligible households actually receive a WHD rebate. Just 3.5% of households received a WHD rebate in 2011–12, compared with 11.5% that were eligible.

Combining all the policies, we estimate that in 2013–14 those in the poorest spending decile were eligible for bill support worth £151 per year, or 19% of their fuel spending. Those in the richest decile were eligible for support worth £71 per year, or 4% of their fuel spending.

Reforms to household carbon prices and compensation measures

Energy policy has a large number of (sometimes conflicting) objectives. One of the main aims of policy is to reduce carbon emissions. This typically increases the price of energy, which gives rise to important distributional concerns.

As detailed in our companion piece (Advani et al., 2013), there is a real sense that current energy taxation is inefficient. Efficient emissions reductions would benefit from a uniform carbon price across users and fuels. Current policy does not reflect this, with households facing much lower prices than businesses. Domestic energy use is subject to a reduced rate of VAT of 5% and gives households an implicit subsidy for energy use. And while a number of policies add to the cost of electricity consumption, imposing an implicit carbon tax at a significant rate, domestic gas use is subject to far fewer taxes. This in combination with the VAT subsidy results in a negative carbon price for domestic gas.

The key barrier to moving to increase energy prices is, of course, distributional. Everyone would be left worse off, with poorer households proportionally worse affected than richer households. What we show in this report is that it is possible to levy additional taxes in such a way as to eliminate the VAT subsidy and impose an effective tax on gas and to use the money raised to mitigate the worst distributional impacts of such a reform.

The reform we look at involves an extension of the full rate of VAT to all household energy (from 5% to 20%) and a new tax of 0.8p/kWh (0.96p including VAT) on gas to equate implicit carbon taxes levied on household electricity and gas consumption. The reform is estimated as if it were introduced in 2013–14, and would increase electricity prices by 14% and gas prices by 34% (see Table ES.1). The resultant carbon price is very similar to the central carbon price of £59/tCO_2e for emissions not covered by the EU Emissions Trading Scheme (emissions not covered include domestic gas) estimated by the government to be consistent with meeting domestic emissions reduction targets.

Table ES.1. Impact of proposed reforms on domestic energy prices, 2013–14

	2013–14 unit price (p/kWh, estimate)	Effect of 20% VAT rate (p/kWh)	Effect of gas tax (p/kWh) including VAT	Post-reform unit price (p/kWh)	Change in unit price (%)	Pre-reform carbon price (£/tCO_2e)	Post-reform carbon price (£/tCO_2e)
Electricity	15.60	2.23	0.00	17.83	14.3%	5.92	58.65
Gas	4.83	0.69	0.96	6.47	34.0%	–18.92	56.05

Note and source: See Table 6.1.

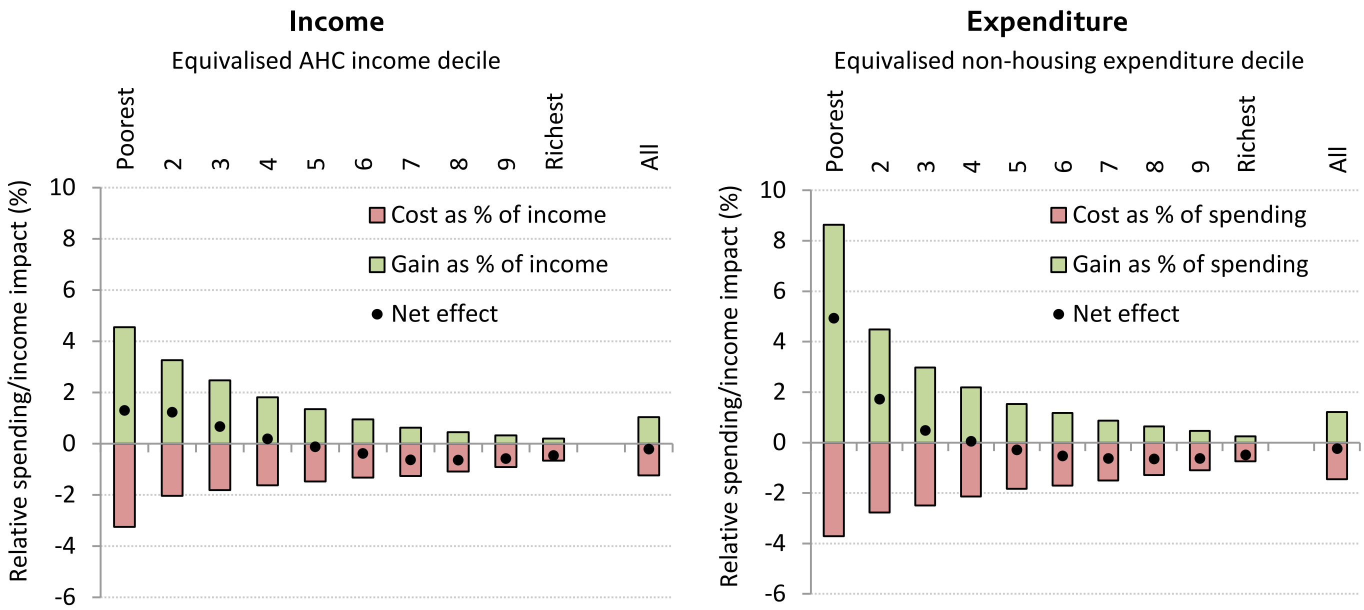
We estimate the reforms would raise around £8.3 billion per year (around 1.4% of total forecast receipts from all taxes in 2013–14) if households did not change their behaviour in response to higher energy prices. Revenues could fall by around £0.7 billion in the short term and perhaps by up to £2 billion in the long term as behaviour adjusts, based on estimates from the literature of the price elasticity of energy demand. This behaviour change could reduce CO_2 emissions by around 8.4 million tonnes in the short run (7% of emissions from households) and 25 million tonnes (20% of emissions) in the long run.

In isolation, the reforms are regressive. The cost of living for those in the poorest spending decile would rise by just under 4%, compared with less than 1% for those in the richest decile. There would also be a lot of variation in the impact within decile: one in ten of the poorest decile would see their cost of living rise by 8.7% or more and one in ten would see it rise by less than 0.4%.

Using a model of the tax and benefit system, we consider a number of packages of measures to compensate households for the energy price increases. All the packages start with an 'automatic' compensation, which arises when price increases feed through into increases in benefit rates and tax thresholds. We add significant increases in the rates of means-tested benefits. The total cost of the most generous compensation package is around £7.2 billion per year, around £400 million less than the revenue from the higher taxes allowing for short-run behavioural responses.

The average net impact of the combined package is strongly progressive (see Figure ES.2), whether we rank households on the basis of income or spending. On a spending basis, in fact, the average net gain is around 5% of total spending for the poorest decile, compared with a net cost of around 0.5% to 0.7% of spending

Figure ES.2. Average net impact (relative to total income/spending) of package



Note and source: See Figure 6.7.

for those at the top of the distribution. Overall, households in the bottom four deciles of income or spending are net gainers on average.

There would still be some net losers among poorer households. In the bottom spending decile, 14% of households would lose at least £1 per week in cash terms, though around three-quarters of households are net gainers (gaining at least £1 per week). Such losses are unavoidable when making changes of this sort and reflect the very different levels of energy spending among households with similar incomes. It is for policymakers to judge whether such effects make any change undesirable, or impossible to implement. More than half of the households in the bottom two income and spending deciles are net gainers, and almost half are net gainers in the third. Some additional revenue could be used to support the installation of efficiency and insulation measures. For example, £2 billion would fund all the low-cost cavity wall and loft insulation potential estimated to remain in domestic properties. Even a modest outlay of £0.5 billion per year could pay for 300,000 hard-to-treat cavity wall insulations, 50,000 external solid wall insulations or 200,000 boiler replacements.

It is particularly important to stress that planned policy will cause large rises in energy prices over the next few years. Unlike our modelled increases, these price increases will not be accompanied by any financial compensation package and will have a regressive impact.

Obviously, there are very many different ways in which one could compensate households for an increase in energy prices and there are different routes to a more coherent system of energy taxation and carbon pricing. One has to take account of work incentive and other effects as well as distributional effects in designing a compensation package. One might well want to introduce change gradually.

But wherever one ends up, there is a strong case for a system of energy and carbon taxation that is more coherent, consistent and transparent than the one we have at the moment. And where prices are being raised by policy, governments should make explicit choices over how to use the tools at their disposal within the direct tax and benefit system to mitigate distributional consequences. The current policy mix is not as effective as it could be in taxing carbon emissions, nor does it address the distributional consequences of policies that are put in place.

1. Introduction

The government has set itself a number of objectives relating to the use of energy. Rolling carbon budgets set five-year targets to reduce overall carbon emissions, with combustion of fossil fuels for heating and electricity generation an important source of emissions. There is a separate but related target to increase the proportion of renewable energy as part of EU legislation. At the same time, although currently under review, there is also an objective to reduce the incidence of 'fuel poverty', defined as a situation where households simultaneously have both relatively low income and high fuel costs.

Targets on fuel poverty form part of a broader concern about the distributional implications of increases in energy prices. Given targets on carbon emissions and renewable energy, both of which are likely to require higher energy prices, there is an obvious tension between the various energy-related objectives facing policymakers. Partly as a result of this tension, a complicated set of policies have emerged towards energy use.

An analysis of these policies is given in a companion piece to this study (Advani et al., 2013). A notable finding is that effective prices on carbon, arising from a mix of policies which raise energy prices at the margin, are much higher for energy used by businesses than by households. This is undoubtedly related to concerns about the distributional effects of energy costs, but also leads to a substantial efficiency cost in terms of meeting carbon reduction objectives, where consistency in carbon prices is important. A key policy question, which we address in this report, is whether household carbon prices could be increased without significant distributional consequences. If so, there would be equity and efficiency gains to be realised.

At the same time as carbon pricing policies have varied across households and firms, other policies designed to improve energy efficiency and to reduce energy costs for poorer and vulnerable households have also been implemented. Again, a range of policies have been put in place in these areas and they have layered up over time in ways that make the overall impact opaque.

This report attempts to provide a broad overview of evidence relating to the distributional implications of energy use policies affecting households in Britain. Box 1.1 provides some more detail on what we mean by 'distributional effects'. Chapter 2 outlines the main data sources for analysis. Our analysis then proceeds in four main parts.

In Chapter 3, we look at the impact of increases in energy prices, drawing on current and historical household expenditure data back to the 1970s. We consider how energy spending, both in cash terms and relative to total budgets, varies over time and across the distribution, and how these changes relate to patterns in energy prices.

In Chapter 4, we look at policies designed to improve energy efficiency and thermal insulation. An array of policies have been implemented, most of which have targeted poorer households in particular. We look at how the efficiency of domestic properties varies across the distribution and how that has changed over time, how eligibility for some policies varies across the distribution and whether the policies appear to have increased ownership and take-up of various key insulation measures. We also assess other existing evidence on the distributional impact of these policies.

In Chapter 5, we consider the package of policies designed to support energy bills. We look at how eligibility for these policies varies across the distribution, and how much support different groups of households may be entitled to, relative to their energy spending and total budgets. A crucial part of this analysis is how eligibility and receipt of support vary not just across the income or spending distribution, but also by household composition.

Finally, in Chapter 6, we draw on specific recommendations made in our companion report (Advani et al., 2013) to reform household energy pricing. We use expenditure data and tax–benefit modelling to assess the distributional effect of a package of measures that would significantly increase the effective carbon prices faced by households (both by charging the full rate of VAT on domestic energy and by introducing a new tax on domestic gas consumption), with some of the revenue used to fund a compensation package structured around increases in means-tested benefits. We look at who gains and loses from such a package and consider wider issues in how such a package might be designed. Our key finding is that a compensation package could be designed that left relatively few poorer households worse off (and was strongly progressive on average), whilst leaving some additional money to support improvements in energy efficiency for those poorer households that remain worse off (presumably because they face relatively high energy costs). The key trade-off would be around negative effects on work incentives coming both from higher energy prices reducing real incomes and from a substantial increase in the generosity of means-tested benefits.

Box 1.1. Defining 'distributional effects'

The distributional effects of a policy reform are a summary of how the policy would affect different groups of households or individuals. The usual comparison is between richer and poorer households, although it is also possible to look at other characteristics of people who live in households (age group, employment status, family composition and so on). Most often, interest lies in whether a particular reform would be 'progressive' or 'regressive'. A regressive reform is usually interpreted as one that would have a relatively larger proportional negative (or smaller positive) effect on poorer households than on richer households.

There are three important points to note from this:

1. Reforms that make everyone better off can still be regressive if the gains are proportionately smaller for poorer households than richer households.

2. The key interest is in the relative effect rather than the absolute effect: a reform that is worth more in cash terms to richer households can still be progressive if the relative effect is larger for poorer households.

3. The definition of 'richer' and 'poorer' is crucial in trying to understand the distributional impact of a reform.

The final point deserves particular attention. From an economic perspective, what we are really interested in is ranking households from richest to poorest on the basis of their standard of living, or 'utility'. Overall social welfare is usually assumed to depend on the total utility of everyone in society and how it is distributed – for a given total utility, a more even distribution is generally thought to be preferable to a less even distribution.

Of course, we cannot observe living standards directly, so we have to rely on proxy measures. When looking at the effect of a policy reform on households using survey data, the most common proxy is household income, measuring the distributional impact by examining how the reform affects high-income and low-income households as a share of their total (pre-reform) income. An alternative is to use household expenditure, measuring the impact of the reform on high-spending and low-spending households as a share of their total (pre-reform) expenditure.

Both measures are useful, for different reasons. Income is typically easier to capture in survey data than expenditure and so is more commonly reported. However, a snapshot measure of spending may be thought to be a better measure of household living standards than a snapshot of income, for a number of reasons (Brewer and O'Dea, 2012). Most importantly, incomes may be volatile, both over short periods (e.g. among the self-employed or casual workers) and over the life cycle (e.g. students or retired people). As a result, low incomes today might not indicate low living standards, particularly when people are able to borrow against their future income to finance current spending or to draw on previous savings.

Much of our analysis therefore uses expenditure as a measure of living standards, but we present results on an income basis either where spending data are not available or where there are important distinctions between the measures to draw out. We look at the cash-terms impact of reforms (the gain or loss from a particular policy package) across the expenditure or income distribution, and the impact as a proportion of total expenditure or total income.

Whether we use income or expenditure, we want to account for the fact that households have different needs because of their composition. For example, a household spending £10,000 per year that contained two adults would be better off than a household with the same spending where there were also dependent children. We therefore adjust ('equivalise') income and expenditure to account for household composition. We use the modified OECD scale. Where possible, we also exclude housing costs (rent, mortgage interest and local taxes) from measures of both expenditure and income. At least over the short run, most people's housing expenditure is non-discretionary such that higher costs (from a rent increase, say) do not translate into higher living standards. Housing costs may also fail to reflect the consumption benefits that many people enjoy from living in a home they own outright: many older people, for example, will have no rent or mortgage costs but will still benefit from living in their home despite having lower observed spending than those still paying these costs.[a]

[a] For a discussion of equivalisation and the treatment of housing costs in thinking about living standards, see appendix A of Cribb et al. (2013).

2. Data Sources

2.1 Living Costs and Food Survey

Expenditure data come from the ONS Living Costs and Food Survey (LCF) between 1974 and 2011. The LCF is an annual cross-sectional survey of some 6,000 households. Adult respondents aged 16 or over are asked to record all of their expenditures over a two-week period in a diary (children aged 7 to 15 keep a simplified diary).[1] Adults are also interviewed in detail about their income and other socio-economic characteristics. Spending on regular outlays (such as rent) and on infrequently purchased big-ticket items (such as durables and holidays) is asked about as part of the interview process. All expenditure and income data are expressed as household-level weekly averages.

We construct two measures of overall living standards, one based on total expenditure and one based on net income, both at the household level. Both measures are expressed after housing costs have been excluded, where housing costs include mortgage interest, rent and local taxes.

No information on energy consumption is recorded in the survey, only energy expenditure. How fuel expenditure data are recorded depends on the type of fuel and how it is paid for. Households using prepayment meters for gas and electricity are asked to record any top-up payments they make during the two-week diary period. Households that pay by direct debit or pay bills in arrears are asked how much their last bill or payment was and the period that it covered (monthly, annual, quarterly, etc.). Expenditure on non-metered fuels such as coal and oil is collected partly through the interview and partly through the diary. Households using oil or bottled gas for central heating are asked how much they spent on these fuels in the last three months. Spending on other fuels such as wood, coal and paraffin is recorded in the two-week diary if purchases are made during this period.

All fuel expenditures are converted to weekly averages. For example, a household paying a £200 quarterly gas bill would be recorded as spending £15.38 (200 ÷ 13) per week on gas. We break down each household's energy expenditure into electricity, gas and non-metered fuels.

[1] Between 1974 and 1993, the data were collected on a calendar-year basis. This changed to a fiscal-year basis in 1993, and then reverted to calendar year from 2006. We report all results on a calendar-year basis. Between 1974 and 2000–01, the data were known as the Family Expenditure Survey (FES). From 2001–02, the FES merged with the old National Food Survey to form the Expenditure and Food Survey (EFS). From 2006, the EFS became part of the wider Integrated Household Survey and was renamed the Living Costs and Food Survey. Our analysis is based on expenditure, income and demographic data that have been cleaned and coded to be as consistent as possible over time. Note that because children's expenditure was not asked until 1993, for consistency we include only expenditures made by adult (16+) household members.

The way that energy spending is recorded in the LCF leads to two problems that are particularly important when we are concerned with how expenditures vary across individual households, rather than looking at average expenditures by all households across a survey year.

- **Seasonality**: Since people who pay bills or by direct debit are asked about their previous payment, those observed in the autumn will typically report lower, summer energy bills whilst those interviewed in spring will typically report higher, winter energy bills.

- **Infrequency of purchase**: Prepay energy customers record any spending they make over a two-week period. If households top up only infrequently (once a month, say), then some households will not record any energy spending during the two weeks and will instead use up previously-purchased energy. Others will record large amounts of spending, which will cover not just the diary period but later consumption as well. A similar problem can arise for non-metered fuels recorded in the two-week diary.

Our analysis in Chapters 3 and 5 looks mainly at broad averages of spending, and so we make no attempt to account for these issues there since averaging should ameliorate both problems. In Chapter 6, we are explicitly interested in how energy expenditure varies across individual households. That chapter and the appendix describe the procedures used to adjust the observed data to account for both issues as best we can.

Our analysis using this data set excludes households in Northern Ireland. The energy use profile of households in Northern Ireland is very different from that in the rest of the UK, with relatively few households using gas. We also exclude a small number of households each year that report a negative figure for any component of their energy spending, which can happen when households receive a fuel bill rebate (rebates are counted as negative expenditure). Typically this affects only a few households each year, around 0.6% of the British sample on average (with a maximum of 1.2% in a single year, 1992).

All analysis of the data makes use of household-level weights that account for survey non-response, ensuring that the weighted sample matches up to the profile of all British households each year.[2]

2.2 English Housing Survey

The Living Costs and Food Survey contains only limited information on the characteristics of the property in which people live, and no information at all on its energy efficiency. We therefore also draw on the English Housing Survey

[2] These weights are supplied with the data from 2001–02 onwards. Before that, we derive our own weights from Census population data.

(EHS) between fiscal years 2002–03 and 2010–11 to analyse distributional issues around energy efficiency.[3]

The EHS is an annual cross-sectional survey in England, covering around 16,000 households. Households participate in an interview to record details of their socio-economic characteristics. Around half of the households then have a full survey of the dwelling carried out by a professional surveyor. The survey records physical features of the property, including the presence of various insulation measures, and a measure of the overall efficiency of the dwelling.[4]

Since we draw on the surveyor information in our analysis, we have a sample size of around 8,000 households per year. Where we discuss variation in the ownership of different domestic energy efficiency measures (such as loft insulation) across the distribution, we exclude households that could not physically have the measure in place (e.g. properties with no loft), meaning the sample sizes will be smaller. All descriptive statistics in Chapter 4 are weighted to account for survey non-response.

The EHS data underlie official measures of fuel poverty. Given information on the dwelling and occupants, estimates of the costs required to heat each home and of household income are derived for each household in the sample.[5] We use the 'full income' measure for each household calculated for fuel poverty statistics as a measure against which to judge the distributional impact of policies.[6] We have no information in the EHS on household expenditure, so we use income to proxy well-being instead. Details on the measure of income can be found in DECC (2013a). Broadly, includes net income from all sources for all adult members of the household. The measure is after council tax but does not exclude other housing costs (rent, mortgage interest) since these data are not collected in the survey.

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[3] In 2008, the EHS replaced and subsumed two previous surveys – the English House Conditions Survey (EHCS) and the Survey of English Housing (SEH). We use EHS throughout for ease of notation.

[4] This is based on the Standard Assessment Procedure (SAP) rating of the property. The SAP rating is expressed as an index between 1 and 100, with higher numbers reflecting more efficient properties. It is based on modelled estimates of the cost of heating the home under a standard heating regime, given its energy efficiency properties and other physical characteristics. The SAP methodology was updated in 2005 and 2009; ratings based on the 2005 methodology are available for households observed between 2002–03 and around half the 2009–10 sample, whilst ratings based on the 2009 methodology are available for half the 2009–10 sample and the 2010–11 sample. In practice, the two differ only slightly (see https://www.gov.uk/standard-assessment-procedure), and so we just compare directly across years. More details on the SAP methodology are available from Building Research Establishment (2011).

[5] Note that the survey does not collect information on *actual* energy use by each household.

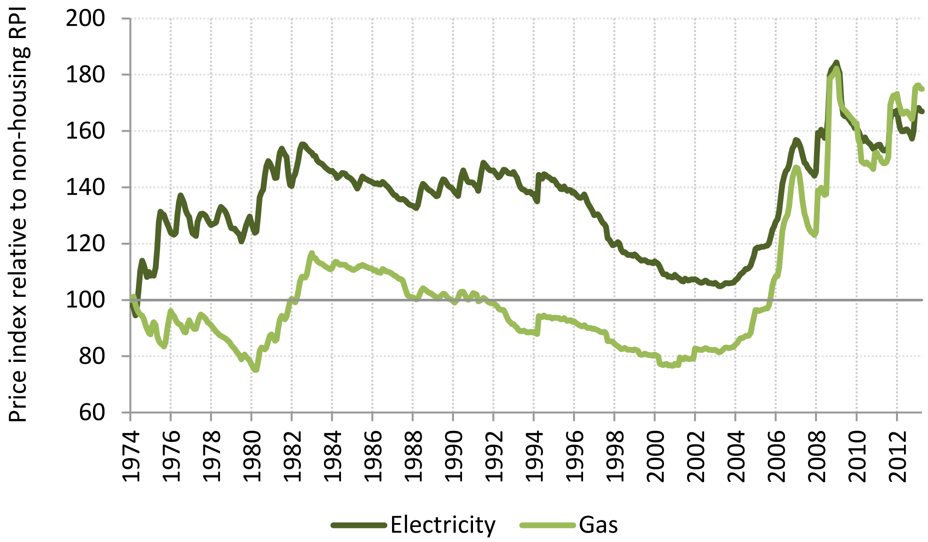
[6] The 'full income' measure includes income from all adult members of the household. It then subtracts net council tax payments, and adds housing benefit, income support for mortgage interest and mortgage payment protection income. This is the measure used to define fuel poverty targets.

2.3 Energy prices

We draw on energy price data from two main sources. The first is the Office for National Statistics (ONS) retail price index (RPI), monthly statistics on price index levels and inflation rates for a large number of individual goods and services. We explore specific price indices for electricity, gas and other fuels, as well as a measure of overall prices given by the all-items index (from which we exclude housing costs in common with our measure of total expenditure).[7] These data are used mainly to illustrate how trends in energy expenditure over time have been strongly driven by trends in energy prices. The all-items index is used to convert expenditure and income to a common time period when comparing trends over time or when we want to define household income or expenditure groups from a sample that uses several years of data pooled together.

Figure 2.1 shows long-term trends in energy (gas and electricity) prices as measured by the RPI, relative to movements in average prices. Increases in these indices show periods when energy was becoming relatively more expensive; reductions show periods when energy was becoming relatively cheaper.

Figure 2.1. Relative energy prices, January 1974 to May 2013 (January 1974 = 100)



Note: Relative to a non-housing RPI measure.
Source: Authors' calculations from ONS RPI data.

There is an early divergence in real gas and electricity prices in the mid-1970s: electricity prices rose by some 50% between 1974 and 1981, whereas gas prices fell by around 20 to 25% over the same period before rising quite sharply. From

[7] A methodology for how electricity and gas prices are collected for the RPI can be found in Office for National Statistics (2012). Briefly, popular tariffs from the major suppliers are sampled each month, converted into bills based on standard consumption measures and then weighted by customer numbers to give a measure of average costs.

there, the two move roughly in parallel, trending slowly downwards over much of the next two decades. By 2004, real electricity prices were almost back to their levels of 30 years earlier. Both series then increase sharply and exhibit a marked increase in volatility, with gas prices rising more sharply such that, by the end of the period, the two series move almost in lockstep.

The price of other fuels (which include coal and oil) is not shown on Figure 2.1, to aid clarity: other energy prices have been more volatile and risen more sharply over the period. By May 2013, other fuel prices had risen by around 175% relative to prices in general, compared with the 75% or so increase for electricity and gas. This increase happened from around 2000 onwards, somewhat earlier than the increases in relative electricity and gas prices, which started in around 2004.

The second source of energy price data is statistics from the Department of Energy and Climate Change (DECC).[8] In particular, we use estimates of the average electricity and gas tariff charges (including a fixed and variable component) by region and method of payment. The fixed component includes any standing charges. For tariffs that have an initial high price for the first units of energy consumed (up to the so-called 'split level') and then a lower price for subsequent consumption, the fixed component also includes the difference between the unit prices multiplied by the split level. Including this as a fixed cost assumes that the marginal price for additional energy use is given by the second, lower price and that all households consume more than the split level.[9] Our main use for these price data is to convert estimates of household-level gas expenditure into estimates of household-level gas consumption when we analyse a package of policy reforms in Chapter 6 that includes a new tax on household gas consumption.

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[8] See https://www.gov.uk/government/statistical-data-sets/annual-domestic-energy-price-statistics, tables QEP2.2.4 and QEP2.3.4 for 2010 and 2011 figures. Data for 2008 and 2009 were kindly supplied by DECC.

[9] DECC estimates that the split level for electricity is typically around 900kWh compared with an average consumption level overall of 3,300kWh, suggesting that most households would indeed by expected to consume more than the split level (see http://www.decc.gov.uk/assets/decc/statistics/source/prices/365-domestic-prices-statistics-methodology.pdf).

3. Distributional Effects of Energy Price Increases

This chapter looks at the importance of energy in household budgets and considers the distributional implications of increases in energy prices. Section 3.1 examines current levels of expenditure on energy compared with other items in household budgets, how these vary across the expenditure distribution and in historical context. It also tries to decompose trends in energy spending into changes in price and changes in the quantity of energy purchased. Section 3.2 then looks at changes in energy as a share of total spending over time and across the distribution, before considering what these mean for the distributional consequences of a rise in energy prices. Section 3.3 explores changes, both over time and across the distribution, in two factors that could influence some of the wider trends – how households pay for energy and how they heat their homes. Section 3.4 presents a summary and draws some conclusions.

All of the analysis in this chapter draws on the Living Costs and Food Survey (LCF) and takes household expenditure as the measure of well-being against which distributional implications are considered.

3.1 Levels of spending on domestic energy

Energy is a significant part of household budgets. Table 3.1 shows average household expenditures per week in 2011 broken down into a number of broad categories (April 2013 prices).[10] Households spent in total £396 per week on average, of which just over £24 was on energy. Of the 12 expenditure categories listed, energy on average is the sixth largest.

Table 3.1 also shows average spending patterns at different parts of the total expenditure distribution. As households get richer, they typically spend more on all commodity groups. Those in the richest 10% spend on average £32 per week on fuel, compared with £15 for those in the poorest 10%. However, spending on energy rises much less than spending on other commodities as we move up the distribution. For households in the poorest 10%, energy is the second-most important of the 12 categories (after food at home). For those in the richest 10%, it is the *least* important spending category. For another comparison, households in the poorest 10% spend on average £10 per week on leisure (goods and services), or two-thirds of the amount spent on fuel. Households in the richest 10% spend £319 per week on leisure, almost 10 times as much as their energy spending.

[10] Expenditure figures are equivalised to take account of household composition, and expressed for a childless couple.

Table 3.1. Average weekly expenditures on different commodity groups (£), 2011 (April 2013 prices)

£ per week	All households	By non-housing expenditure decile		
		Poorest 10%	Fifth decile	Richest 10%
Leisure services	67	7	32	261
Private transport	66	7	49	183
Food at home	55	29	56	73
Household services	36	10	27	110
Household goods	36	6	26	110
Domestic energy	24	15	23	32
of which:				
Electricity	*11*	*8*	*11*	*14*
Gas	*11*	*7*	*10*	*14*
Other fuel	*2*	*0*	*1*	*4*
Food outside	23	5	19	51
Clothing	20	4	14	53
Alcohol and tobacco	20	6	18	34
Personal spending	19	3	14	56
Leisure goods	18	3	13	58
Public transport	12	2	9	43
Total spending	396	97	299	1,065

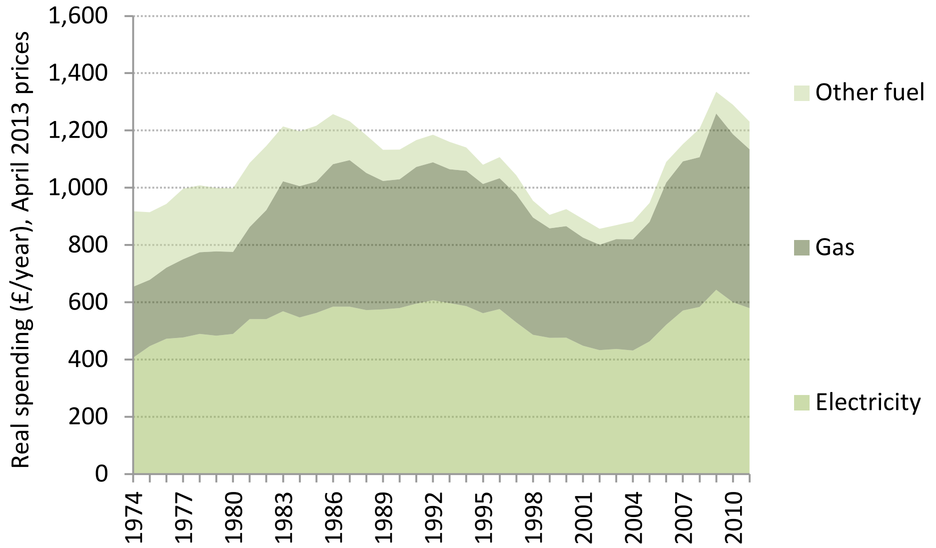
Note: Figures are equivalised using the after-housing-costs (AHC) modified OECD scale and expressed for a childless couple. Figures are weighted to account for survey non-response. Expenditures are rounded to the nearest pound. Table excludes households reporting negative fuel expenditure and households in Northern Ireland. Figures are expressed in April 2013 values using non-housing RPI.
Source: Authors' calculations from LCF data.

Figure 3.1 shows long-run trends in real annual average household energy expenditures since 1974.[11] Three broad periods can be discerned in the data. Average real energy expenditure rose by 37% between 1974 and 1986 (from £918 per year to £1,257). Real spending then began a downward trend, falling as low as £856 per week in 2002 (down 32% from the 1986 peak), before rising very rapidly, reaching a real-terms (April 2013 prices) high of £1,335 in 2009, 56% higher than the 2002 figure. Between 2009 and 2011, real energy spending fell by around 8%, though as is clear from Figure 2.1, energy prices did not continue to fall after 2011, suggesting that this trend may not persist into future years.

Figure 3.2 shows the proportion of energy expenditure accounted for by electricity, gas and other fuels.

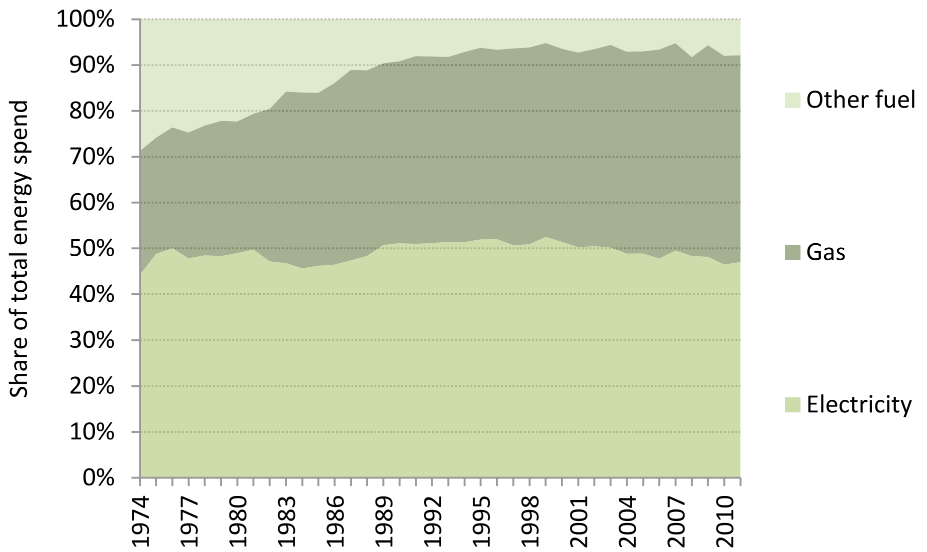
[11] Figures are expressed in April 2013 values using non-housing RPI.

Figure 3.1. Real annual average energy expenditures, 1974 to 2011 (April 2013 prices)



Note: Prices converted to April 2013 values using non-housing RPI. Figures are weighted to account for survey non-response. Excludes households reporting negative fuel expenditure and households in Northern Ireland.
Source: Authors' calculations from LCF data.

Figure 3.2. Breakdown of real energy spending into electricity, gas and other fuels, 1974 to 2011



Note: Figures are weighted to account for survey non-response. Excludes households reporting negative fuel expenditure and households in Northern Ireland.
Source: Authors' calculations from LCF data.

What is striking is that electricity has accounted for roughly half of the household energy spend over the whole period, despite the shifts in relative prices for different energy types highlighted in Figure 2.1. The growth in gas as a part of energy expenditure has come largely at the expense of coal, oil and other fuels, which in the past might have been used particularly for heating. In 1974, gas accounted for 27% of energy costs and other fuel for 29%. By 2011, gas accounted for 45% whereas other fuel accounted for just 8%.

Trends in the amount spent on energy can be driven by two factors – the price of energy and the quantity of energy consumed. Figure 2.1 showed that the relative price of gas and electricity has been fairly volatile, and there is a clear relationship between relative price trends in that figure and the total spending on energy shown in Figure 3.1. However, changes in the quantity of energy consumed may still be an important factor.

Although there are data on aggregate energy consumption over time, there is no consistent source of household-level data on quantities of energy consumed, which would allow us to decompose trends in spending between prices and quantities across the distribution. We therefore use data on average nominal energy spending – not adjusted for overall price inflation, though we continue to adjust for household composition by using equivalised expenditures – by year together with average energy prices taken from the retail price index to estimate a 'quantity' of energy consumed. This follows the approach taken by Crossley, Low and O'Dea (2013).

Because the price is an index, we express nominal expenditures and estimated quantities in index terms as well, and compare how spending, price and quantity indices evolve over time.[12] We do not have specific information on whether prices vary (both in level and in changes over time) at different points in the distribution, so we have to assume that the RPI measure applies equally to all households; it is probably not unreasonable to assume that (at least on average) trends in energy prices have been quite similar for richer and poorer households.

Figure 3.3 shows the expenditure, price and quantity indices since 1974 across the whole population. The right-hand panel isolates the quantity index to make the results somewhat clearer. What is particularly striking is that, at least until the year 2000 or so, trends in spending tracked changes in prices almost one-for-one, implying that consumption remained essentially unchanged. There was then some decoupling of this relationship. Between 2000 and 2011, energy prices rose by around 134% whereas energy spending rose by 82%, implying a fall in the quantity of energy consumed of around 22% on average.[13] This fall is also reflected in aggregate energy consumption data. The National Accounts suggest

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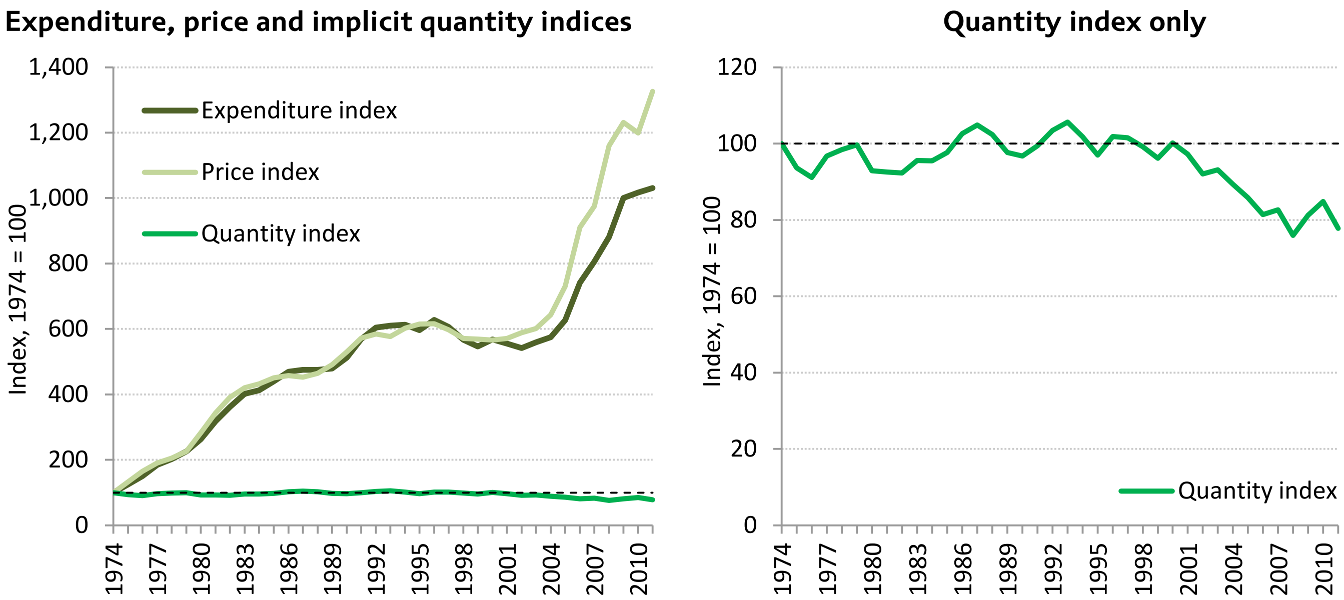
[12] As expenditure is Price × Quantity, we estimate the quantity index as Expenditure index ÷ Price index.

[13] This does not appear to have been driven by changes in the extent to which energy spending is recorded in the household data. Brewer and O'Dea (2012) show that relative to estimates of spending in the UK National Accounts, energy spending recorded in the survey did fall from around 100% in 2003 to 80% in 2005, and this appeared to be a step change. However, we suggest the fall in energy consumption began somewhat earlier than this, in 2000, and continued long after 2005. Brewer and O'Dea also find some more long-term decline in the coverage of energy spending in the survey data: in the early 1990s, for example, the survey appeared to *over*-record energy spending relative to National Accounts estimates by around 10%. We do not see any clear evidence that consumption of energy was falling in this period.

that per-household energy consumption fell by 19% between 2000 and 2011. This is also consistent with the fall in domestic consumption shown by DECC (2013b).[14]

Figure 3.3. Indices of nominal energy expenditure, price and quantity, 1974 to 2011



Note: Figures are weighted to account for survey non-response. Excludes households reporting negative fuel expenditure and households in Northern Ireland. Quantity index is the expenditure index divided by the price index. Expenditure index is in nominal terms.
Source: Authors' calculations from LCF data and ONS RPI price data.

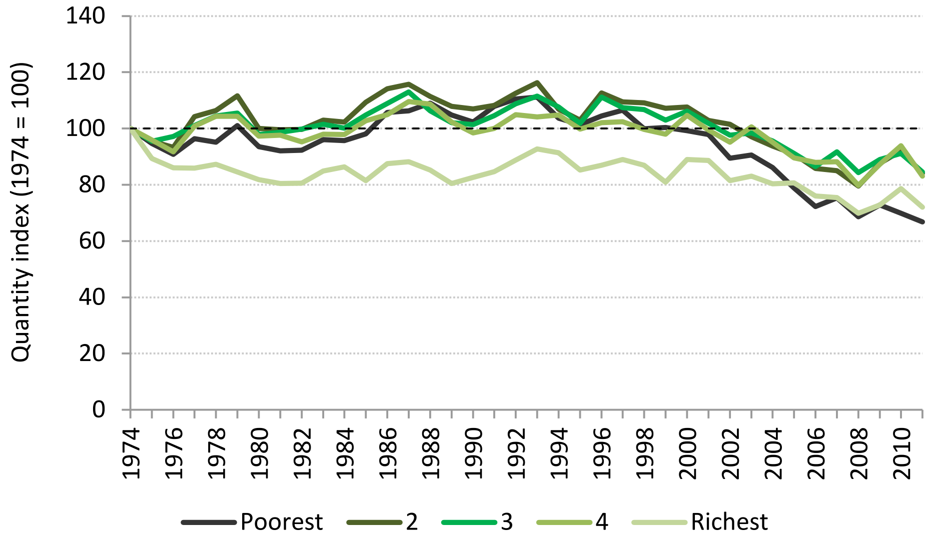
To assess whether these trends in the quantity of energy purchased have differed across the distribution, Figure 3.4 shows the quantity index by total expenditure quintile and year. We choose quintiles rather than deciles to make the charts easier to interpret and to allow a reasonable within-year sample size in each quintile.

Two particularly striking differential trends emerge:

- Richer households (the top expenditure quintile) appeared to cut back their energy consumption in the mid-1970s and then hold it constant for most of the rest of the period up to the mid-2000s or so, when it began to fall slightly. In other quintiles, energy consumption rose a little through the 1980s, levelled off and then fell from around 2000 onwards.

[14] Domestic energy consumption as recorded within the LCF fell at a faster pace between 2003 and 2008 than the aggregate data sources suggest (a fall of 18% compared with the 4% reflected in the National Accounts). This may be consistent with the under-reporting of spending described in footnote 13. However, by 2011, the overall reduction in energy consumption (relative to 2000) is very similar across sources: 22% in the LCF data, 19% in the National Accounts and 22% in Department of Energy and Climate Change (2013b).

Figure 3.4. Energy quantity index, by total non-housing expenditure quintile, 1974 to 2011



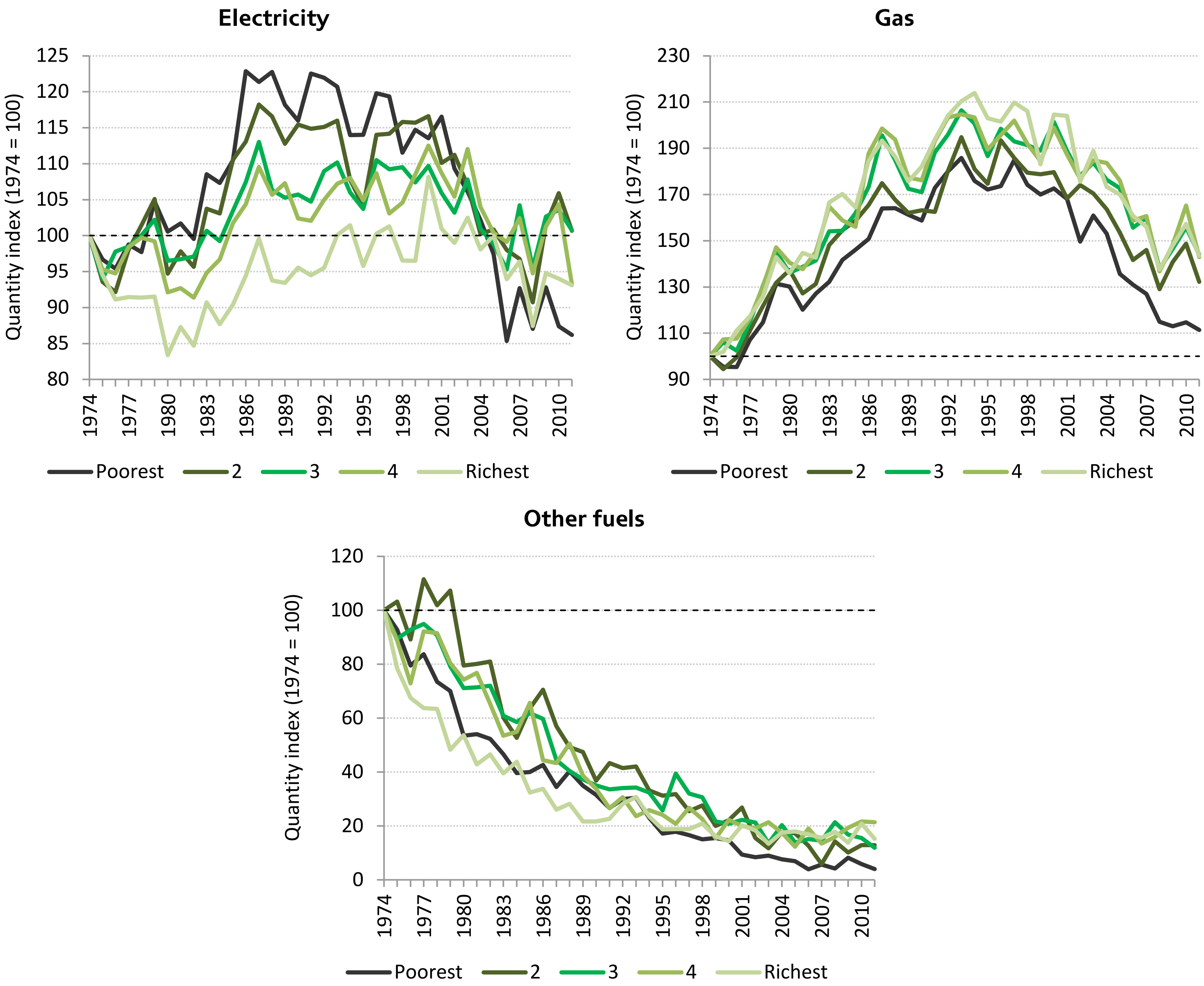
Note: Figures are weighted to account for survey non-response. Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Excludes households reporting negative fuel expenditure and households in Northern Ireland.
Source: Authors' calculations from LCF data and ONS RPI price data.

- The decline in consumption from the early 2000s appears to have been most concentrated among poorer households (the bottom quintile). Between 2000 and 2011, the consumption index fell by 33% in the poorest quintile, and by between 19% and 22% in other quintiles.

It is not immediately clear what might have driven these trends, particularly the latter one towards what appear to be larger reductions in total energy consumption among poorer households. One possibility could be price differentials that we simply do not observe: it may be that poorer households have seen smaller increases in energy prices on average than richer households, perhaps resulting from policies that have tried to mitigate the impact of wholesale price increases for poorer groups. These would have held down energy spending for poorer households which, coupled with the price increase we assume to be common across everyone, is interpreted as a reduction in consumption. This may play some role, though policies that explicitly reduced prices for poorer households – such as social tariffs – were not introduced until 2008. Other policies that tried to improve the energy efficiency of dwellings for poorer groups have been in place for longer (see Chapter 4) and may have genuinely resulted in more rapid falls in consumption among these groups.

Another possibility is switching across fuel types: poorer households may have substituted towards metered fuel (particularly gas) for heating, for example, allowing them to consume less energy to achieve a given level of warmth. We look explicitly at heating methods in Section 3.3. Here, we break down the quantity index shown above for total energy into electricity, gas and other fuel components to look at the extent to which the larger relative reduction in consumption for poorer households is common across fuel types. We follow the same method as above, dividing a nominal expenditure index (specific to each quintile) for each fuel by an RPI index (common to all quintiles) for each fuel to estimate a quantity index. The results are shown in Figure 3.5.

Figure 3.5. Energy quantity index, by total non-housing expenditure quintile and fuel type, 1974 to 2011



Note: Figures are weighted to account for survey non-response. Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Excludes households reporting negative fuel expenditure and households in Northern Ireland.
Source: Authors' calculations from LCF data and RPI price data.

There are very different trends in the quantity indices across fuels. Consumption of non-metered fuels (coal, oil and so on) has declined almost continually for all quintiles over the whole period. Electricity consumption rose in the 1980s, particularly among poorer households, and gas consumption rose rapidly in the

1970s to 1990s, peaking in the mid-1990s before beginning a relatively consistent decline since then. Comparing across quintiles of total spending within fuel type, we find that the poorest households have seen the most rapid decline in consumption of all fuel types since 2000, suggesting that the trends in Figure 3.4 are not driven by a single fuel type. The differential trend in consumption across quintiles between 2000 and 2011 is, though, larger for electricity than for gas. The poorest quintile saw an estimated reduction in electricity consumption of 24% between 2000 and 2011, compared with between 8% and 17% in other quintiles. For gas, the poorest quintile saw a reduction in consumption of 35%, compared with 26–30% in other quintiles.

3.2 The share of domestic energy costs in total expenditure

The analysis so far has focused on the level of energy spending (or estimates of quantity) over time. Table 3.2 shows the average *share* of spending devoted to different items in 2011.[15] This helps make clear how the relative importance of energy costs changes as we move up the expenditure distribution. Across all households, energy represents on average 8.1% of budgets (4.0% electricity, 3.7% gas and 0.5% other fuels). For the poorest tenth, energy makes up 15.8% of budgets; and for the richest tenth, it represents just 3.3% of expenditure on average.

Figure 3.6 shows the energy budget share by fuel type in 2011 for each expenditure decile. The average budget share declines monotonically across the expenditure distribution. The gradient is slightly stronger for electricity (8.5% in the bottom decile, 1.4% in the top) than for gas (7.2% and 1.4%). Other fuels are a small part of spending for all deciles, and exhibit no clear relationship with total spending.

There is considerable variation in the importance of energy spending in total budgets for households within each decile.[16] This is illustrated in Figure 3.7: the boxplot shows the 10th percentile (bottom whisker), lower quartile (bottom of the box), median (central line), upper quartile (top of the box) and 90th percentile (top whisker) of total energy budget shares by decile; the black dot replicates the total mean values shown in Figure 3.6. The variability is particularly obvious for poorer households: in the bottom tenth, one in ten households spend more than 36% of their budget on energy while more than one in ten actually report zero

[15] Note that this is not the same as dividing average energy spending in Table 3.1 by average total spending. That calculation gives an average energy expenditure share of 6% (£23.67 ÷ £396.01). This is an estimate of aggregate energy expenditure as a proportion of aggregate total spending. Table 3.2 instead shows the average of each household's individual energy share. Either figure represents a measure of the 'average' importance of energy in expenditures, but the approach taken in Table 3.2 is perhaps more sensible when we want to think about comparing expenditure patterns across individual households.

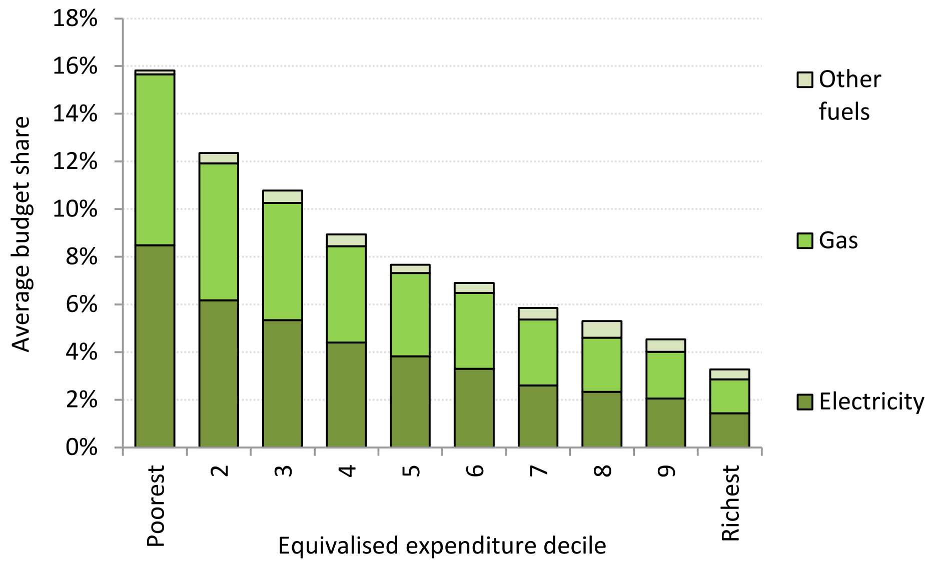
[16] Mindful of the measurement issues described in Chapter 2.

Table 3.2. Average budget shares of different commodity groups, 2011

£ per week	All households	By non-housing expenditure decile		
		Poorest 10%	Fifth decile	Richest 10%
Food at home	18.3	30.3	18.7	7.5
Private transport	15.3	7.0	16.5	17.7
Leisure services	13.3	7.2	10.8	24.1
Household services	8.9	10.3	9.1	9.2
Household goods	8.4	6.4	8.5	10.8
Domestic energy	8.1	15.8	7.7	3.3
of which:				
Electricity	*4.0*	*8.5*	*3.8*	*1.4*
Gas	*3.7*	*7.2*	*3.5*	*1.4*
Other fuel	*0.5*	*0.2*	*0.3*	*0.4*
Food outside	6.0	4.8	6.3	5.1
Alcohol and tobacco	5.5	5.9	6.2	3.4
Clothing	4.8	3.6	4.5	5.2
Personal spending	4.6	3.4	4.6	5.2
Leisure goods	4.2	3.0	4.3	5.0
Public transport	2.7	2.2	2.9	3.6

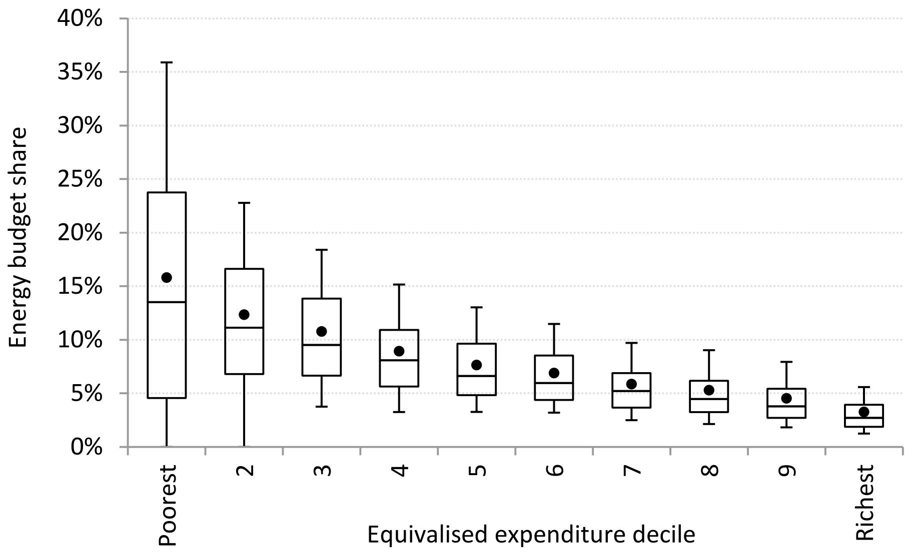
Note: Figures are weighted to account for survey non-response. Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Excludes households reporting negative fuel expenditure and households in Northern Ireland.
Source: Authors' calculations from LCF data.

Figure 3.6. Distribution of energy budget shares, by non-housing expenditure decile and fuel type, 2011



Note: Figures are weighted to account for survey non-response. Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Excludes households reporting negative fuel expenditure and households in Northern Ireland.
Source: Authors' calculations from LCF data.

Figure 3.7. Within-decile variation in energy budget shares, 2011



Note: Figures are weighted to account for survey non-response. Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Excludes households reporting negative fuel expenditure and households in Northern Ireland. Top whisker is 90th percentile, top of box is upper quartile, dot is the mean, middle line is the median, bottom of box is lower quartile and bottom whisker is 10th percentile.

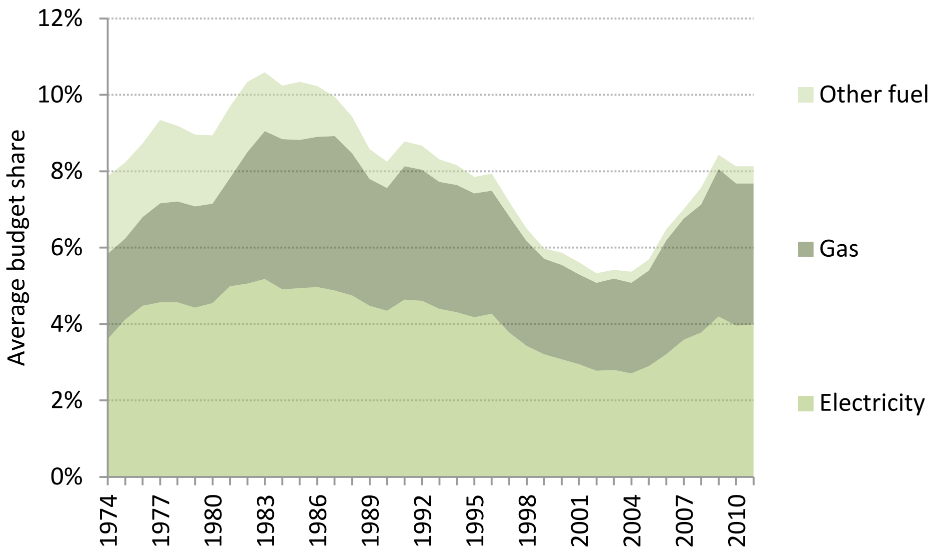
Source: Authors' calculations from LCF data.

energy spending. In the top decile, by contrast, nine out of ten households have energy budget shares in the narrow range of 1.2% to 5.6%.

Figure 3.8 shows the average energy budget share across all households for each year since 1974. Although the trends are similar to those in Figure 3.1, it is notable that the energy budget share was lower in 2009 than in the mid-1980s, despite the record energy expenditures. The average budget share for energy rose from 7.9% in 1974 to a peak of 10.6% in 1983 (three years before the peak in energy expenditure). There was then a steep decline: by 2002, energy made up just 5.3% of the average household budget, around half its peak value. The energy budget share has risen sharply in recent years, peaking at 8.4% in 2009. That was the highest share since 1992.

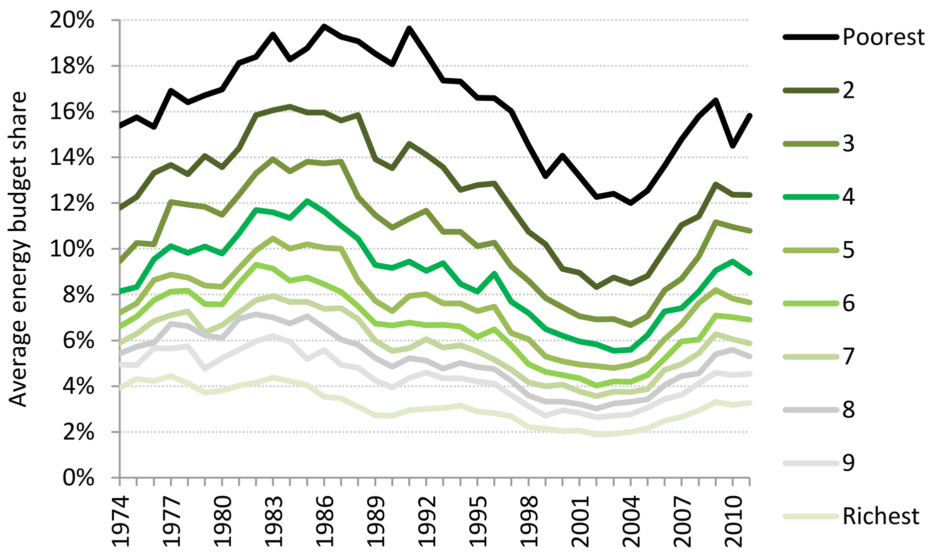
The finding that the average energy budget share has changed little between 1974 and 2011 is a surprising one. During this period, real average incomes have increased drastically. Energy is a necessity, as shown by the decreasing budget share across the expenditure distribution in Figure 3.6. In comparison, the budget share for food at home (another necessity) has decreased significantly during this period, falling from an average budget share of 29% in 1974 to 18% in 2011. Also notable is that the sharp decline in real energy spending between 2009 and 2011 shown in Figure 3.1 does not lead to any particular decline in the energy budget share. This is because total spending was also falling: real equivalised total non-housing expenditure fell by 4.4% between 2009 and 2011. Indeed, by 2011, total expenditure after housing costs was at its lowest real-terms level since 1997.

Figure 3.8. Average energy budget share, 1974 to 2011



Note: Figures are weighted to account for survey non-response. Excludes households reporting negative fuel expenditure and households in Northern Ireland.
Source: Authors' calculations from LCF data.

Figure 3.9. Energy budget shares by non-housing expenditure decile, 1974 to 2011



Note: Figures are weighted to account for survey non-response. Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Excludes households reporting negative fuel expenditure and households in Northern Ireland.
Source: Authors' calculations from LCF data.

Figure 3.9 shows the trend in budget share by expenditure decile. There are some interesting differences across decile groups. Energy budget shares were flat at the top of the spending distribution throughout the 1970s and early 1980s, but tended to rise for households at the middle and bottom. Budget shares towards the top of the spending distribution fell in the mid-1980s, whereas they did not begin to decline at the bottom of the spending distribution until the late

1980s/early 1990s. By contrast, recent increases in budget shares tended to happen at all points of the distribution at around the same time. In 2009, the average budget share was at its highest level since 1996 for the poorest decile, since 1988 for the fifth decile and since 1987 for the richest decile.

Figure 3.6 showed that poorer households spent a much larger budget share on energy than richer households in 2011. Figure 3.9 shows that this is true not only for the most recent period, but in all years between 1974 and 2011. This suggests that increases in energy prices have a greater adverse impact on poorer households than on richer ones (despite a larger effect in cash terms on the expenditure of richer households, which consume a greater quantity of energy).

Energy prices rose by around 134% between 2000 and 2011. During this period, budget shares for the poorest households have increased particularly quickly. In 2000, households in the bottom expenditure decile spent 14% of their total expenditure on energy. Households in the richest decile spent 2% of their budget on energy in the same year. By 2011, these numbers had increased to 16% and 3% respectively. Given that the trend of rising energy prices appears set to continue, policy in this area must pay careful consideration to the distributional effects of increasing energy prices.

3.3 Influences on energy spending: methods of payment and heating

Method of payment

The way in which energy is paid for may be one factor explaining differences in expenditure across households. Broadly, households can pay a bill in arrears, pay by direct debit or some other regular budgeting mechanism, or use a prepay meter. Those using direct debit will have smoother, more regular energy payments than those paying in arrears or prepaying. There are also differences in price according to payment method.

Table 3.3 summarises DECC figures the national average fixed and variable energy costs in 2011 by payment method. Average prepay and bill-in-arrears tariffs are very similar, whereas direct debit tariffs are notably cheaper both in terms of a lower fixed cost (standing charge) and in terms of a lower cost per unit of energy.

How have payment methods varied over time and how do they vary across the distribution? The LCF has asked about payment method for gas and electricity since 1977. However, in 2009, a significant change to the coding frame for the question was implemented. Before 2009, households reported paying by a prepayment mechanism (slot meter or card), paying an 'account' (e.g. bills in arrears), paying via a 'budgeting scheme' (e.g. regular consistent payments such as direct debit) or some other method (e.g. paid outside the household). From 2009 onwards, the interviewers were asked to probe specifically for the method

Table 3.3. Average fixed and variable costs for gas and electricity, by payment method, 2011

Gas (GB average)

	Prices		Relative to prepay	
	Fixed (£/year)	**Variable (p/kWh)**	**Fixed**	**Variable**
Prepay	112.09	3.51	1.00	1.00
Bill	115.05	3.52	1.03	1.00
Direct debit	100.29	3.33	0.89	0.95

Standard electricity (UK average)

	Prices		Relative to prepay	
	Fixed (£/year)	**Variable (p/kWh)**	**Fixed**	**Variable**
Prepay	60.97	12.66	1.00	1.00
Bill	66.36	12.29	1.09	0.97
Direct debit	49.25	11.67	0.81	0.92

Note: Electricity figures are for standard electricity; figures for Economy 7 electricity are also available from DECC. Figures are in 2011 prices.
Source: Department of Energy and Climate Change, energy price statistics (http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/prices/prices.aspx).

of payment – direct debit, standing order, bill in arrears, prepayment or other method.[17]

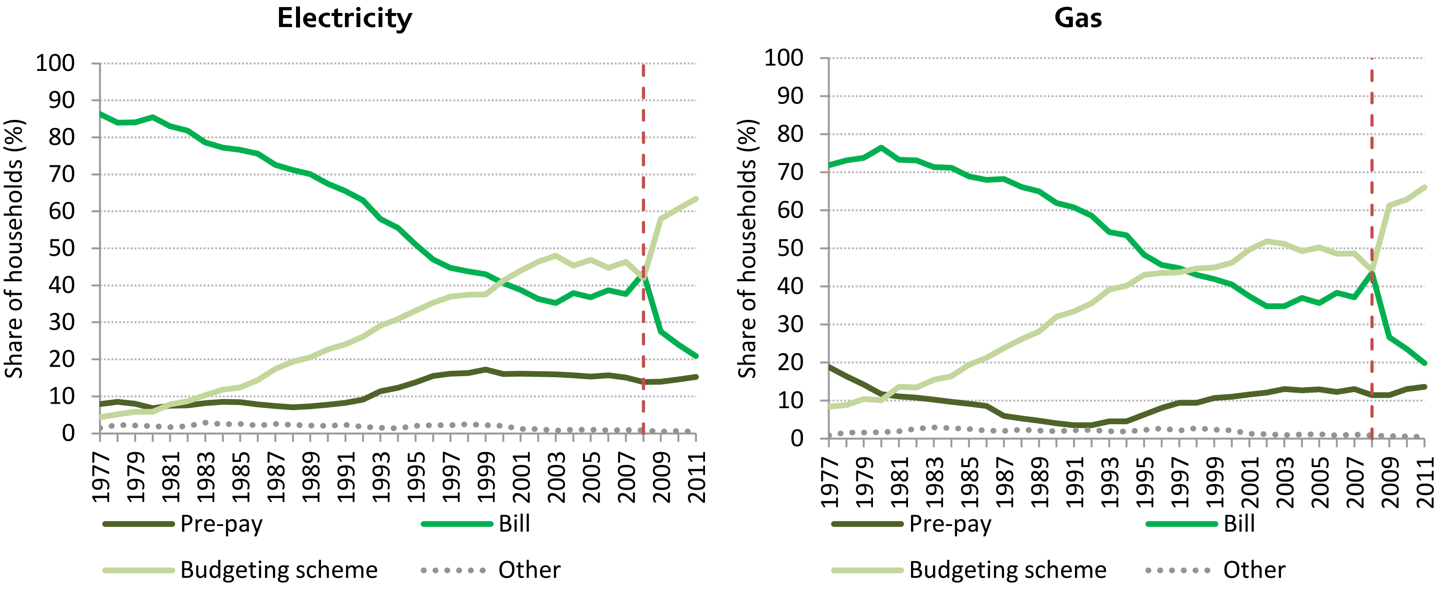
There does not appear to be any easy way to reconcile these coding frames, which leads to a large inconsistency in 2009 in reported payment method, as shown in Figure 3.10. For example, the proportion reporting using a budgeting mechanism for electricity (i.e. direct debit) increases from 42.0% in 2008 to 58.0% in 2009, while the proportion paying bills in arrears falls from 43.3% to 27.5%.

DECC figures for 2011 show that across Great Britain, 54% of households pay for standard electricity via direct debit, 31% pay bills in arrears and 15% use prepayment.[18] Our figures (for all electricity, not differentiating between standard credit and Economy 7 customers) are 63%, 21% and 15% respectively. Thus the LCF data appear to overestimate the proportion of direct debit customers relative to those paying in arrears.

[17] For 2009 onwards, the coding frame for method of payment is brought into line with that in the English Housing Survey. Following Department of Energy and Climate Change (2013a, section 7.3), in those years we categorise standing order payments and frequent cash payments as 'bill' and energy costs paid in whole or in part by the Department for Work and Pensions (DWP) or included in rent as 'direct debit'. Where households report that bills are paid 'outside the household' or in some 'other' way, we continue to code them as 'other'.

[18] See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/49366/qep242.xls.

Figure 3.10. Household method of payment for metered fuel, 1977 to 2011 (conditional on using fuel type)



Note: Figures are weighted to account for survey non-response. Excludes households reporting negative fuel expenditure and households in Northern Ireland. Red line indicates break in series.
Source: Authors' calculations from LCF data.

Nevertheless, if we focus on the period before 2009, when the payment method questions were asked on a consistent basis, there are some interesting long-term trends. For both gas and electricity, there was a rapid increase in the proportion of direct debit or other budgeting scheme customers over the 1980s and 1990s, largely at the expense of those paying bills in arrears. Between 1977 and 2003, the proportion paying for electricity (gas) in arrears fell from 86% (72%) to 35% (35%). Over the same period, the proportion of customers using direct debit or a similar smoothing scheme rose from 4% (8%) to 48% (51%). However, the switch to direct debit appeared to level off in the 2000s. For electricity, it is notable that there was no particular switch away from prepay; indeed, the proportion of prepay customers rose in the 1990s from around 10% to around 15%. For gas, prepay rates fell substantially in the 1970s and 1980s: prepay customers made up 19% of gas users in 1977 compared with just 4% in 1992. However, prepay started to increase again later, and by the end of the period around 13% of customers used prepay, roughly the same proportion as in the early 1980s.[19]

Figure 3.11 shows how payment method varies across the expenditure distribution, using pooled data from the 2009 to 2011 surveys (which follow the change in survey methodology). Again, we show figures only for households that

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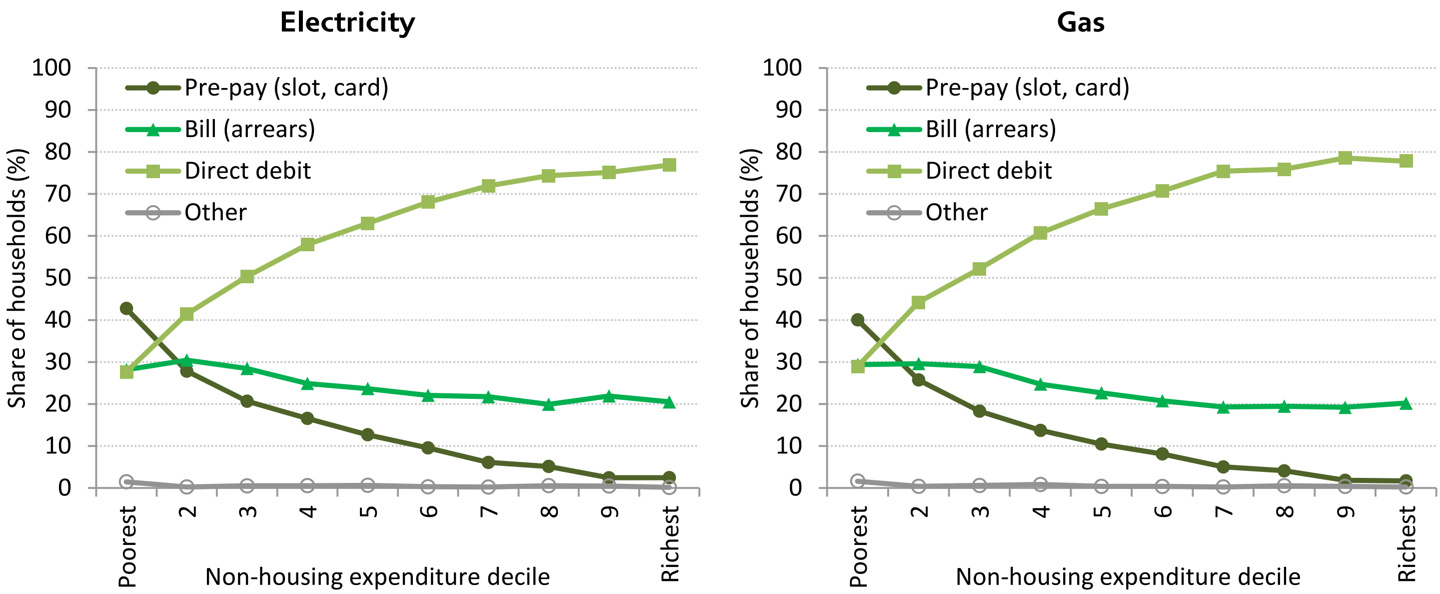
[19] Note that this does not appear to be related to people being connected to the gas network for the first time with prepay meters: the proportion of households without a gas connection fell from 33% in 1977 to around 20% in the mid-1990s, but has fallen much more slowly since then (the period during which prepay rates have risen), to around 15% by the end of the period.

use each fuel type.[20] As households get better off, there is a clear tendency to move towards direct debits, largely at the expense of prepayment. In the poorest decile, for example, 43% of households use prepayment for electricity whilst 28% use direct debit. In the richest decile, only 2% of households use prepayment whilst 77% use direct debit. The proportion using bills declines as we move up the distribution, but to a smaller degree: 28% in the poorest decile use bills compared with 21% in the richest decile. Very similar trends and levels are seen in gas method of payment: households are typically slightly more likely to use direct debit for gas and slightly less likely to prepay, with a similar proportion within decile using bills. Thus it is richer households that are more likely to benefit from the cheaper fixed and variable charges available from using direct debit payments, though for both gas and electricity more than half of households use direct debit from the third decile onwards.

Figure 3.11. Method of payment by equivalised non-housing expenditure decile, 2009 to 2011



Note: Figures are conditional on having electricity or gas in the household. Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Excludes households with negative fuel expenditure and households in Northern Ireland. Figures are weighted to account for survey non-response.
Source: Authors' calculations from LCF data.

Method of heating

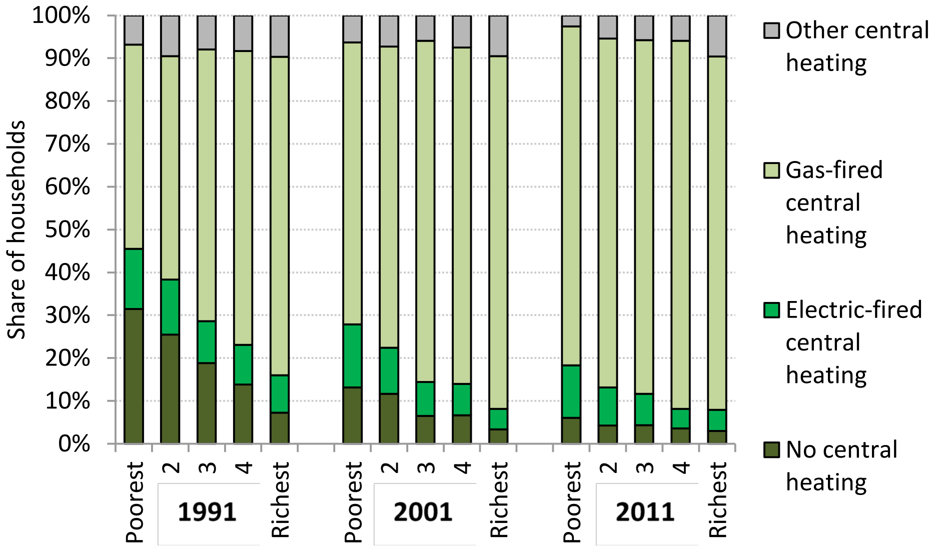
For an individual household, a key determinant of energy spending is likely to be the cost of heating the home. DECC (2013a) estimates based on modelled energy

[20] Virtually all households have an electricity connection. There is no clear relationship between expenditure decile and having a gas connection. Those in the poorest decile are most likely not to have gas: 19% are not connected. However, it is generally in the middle of the distribution that rates of non-connection are lowest (around 12–14% in deciles 3, 4, 7, 8 and 9); in the richest decile, 15% have no connection.

needs for households in England are that 68% of energy bills are devoted to space and water heating, compared with 28% for lighting and powering appliances and 5% for cooking. Heating costs will depend on a number of factors, including the characteristics of the property and the people living there. Two other important determinants will be the type of fuel used for space heating (e.g. gas, electricity or solid fuel) and the thermal insulation standard of the dwelling. We end this section with an analysis over time of changes in heating regimes across the distribution, before turning in Chapter 4 to look at distributional issues around insulation and energy efficiency and policies designed to encourage improvements in efficiency.

The LCF asks whether or not households have central heating and, if so, the fuel used for heating. Figure 3.12 shows the main results across expenditure quintiles, comparing trends between 1991, 2001 and 2011. There is a remarkable degree of convergence in heating arrangements across the distribution over this period. In 1991, almost a third of households in the bottom spending quintile did not have central heating (and so presumably relied on electric heaters, coal fires or oil heaters in individual rooms), compared with 7% of those in the top quintile. Just under half of the poorest quintile had gas-fired central heating, compared with almost three-quarters of the top quintile. By 2011, these differences had largely been eliminated. Just 6% of the bottom quintile did not have central heating compared with 3% of the top quintile. Over 79% of the bottom quintile had gas-fired central heating compared to 83% of the top quintile. Poorer households were still slightly more likely to have electric central heating in 2011 (12% in the bottom quintile versus 5% in the top).

Figure 3.12. Main heating regime, 1991, 2001 and 2011, by non-housing expenditure quintile



Note: Figures are weighted to account for survey non-response. Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Excludes households with negative fuel expenditure and households in Northern Ireland.
Source: Authors' calculations from LCF data.

3.4 Summary and conclusions

Energy is a significant part of household budgets. In 2011, households spent around £1,230 per year (April 2013 prices) on electricity, gas and other fuels. Although richer households spend more than poorer households on energy, it is a much bigger part of the overall budget of poorer households. Among the poorest tenth of households (as measured by total equivalised non-housing spending), energy was the second-biggest expense (after food) among 12 broad groups of goods and services. Among the richest tenth of households, energy was the smallest expense.

After allowing for general inflation, energy costs hit new highs in 2009, surpassing the previous peaks from 1986. This has mostly been driven by higher prices: indeed, there is suggestive evidence from survey and aggregate data that, having been roughly flat for most of the period between the 1970s and 2000, the average *quantity* of energy purchased by households has fallen sharply in recent years, particularly for poorer households. Further, although the amount spent on energy has risen to new highs, the share of total spending devoted to energy is lower now than it was in the mid-1980s, and roughly back to where it was in the mid-1970s. Recent increases in the share of spending devoted to energy have been seen across the distribution.

A 5% rise in energy prices now would increase living costs for those in the poorest spending decile by 0.8% on average, but less than 0.2% in the richest decile. Energy is an economic necessity, so this result is not surprising, though we do see some shifts in the relative size of budget shares spent on energy across the distribution over time.

How households pay for energy will also influence their spending: direct debit customers typically face lower prices than those using prepayment meters or paying bills in arrears. Over time, there has been a shift away from bills and towards direct debit, though the proportion of households using prepayment for gas and electricity is higher now than it was in the early 1990s. Poorer households are much more likely to prepay and less likely to use direct debit than richer households.

4. Distributional Issues around Energy Efficiency Policies

As discussed in the companion paper to this report (Advani et al., 2013), improving the energy efficiency performance of residential property is a key objective of a number of policies implemented in recent years. Concerns about the impact of higher energy prices on poorer households together with specific goals to reduce greenhouse gas emissions clearly rationalise a focus on energy efficiency improvements.

Section 4.2 considers the distributional implications of the various efficiency-related policies that have been introduced, drawing on a summary of existing evidence from other studies. We begin, though, with an analysis in Section 4.1 of how the energy efficiency of domestic properties varies across the distribution, looking at some common insulation measures and overall efficiency ratings. Since the LCF data used in the previous chapter contain little information on dwelling characteristics, we turn to the English Housing Survey (EHS). Since the EHS contains no information on total household spending, we use equivalised net household income (after direct taxes and council tax) to look at distributional patterns across households instead.

4.1 Energy efficiency characteristics across the income distribution

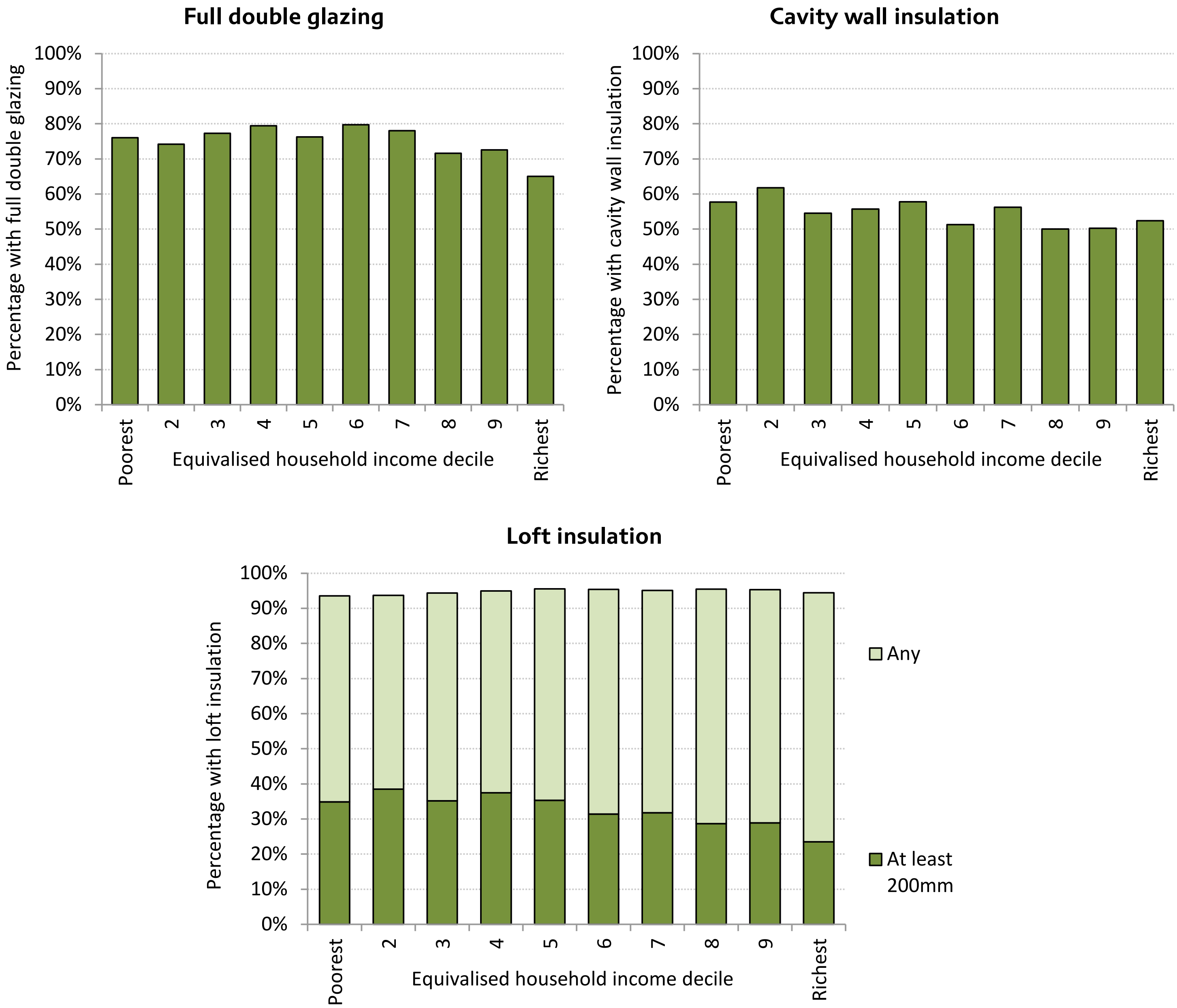
Improved thermal efficiency in domestic properties can come from installing a number of insulation measures. Insulating lofts to a reasonable degree of thickness and insulating cavity walls are among the cheapest and most obvious measures. Installing double-glazed windows is another possibility open to most households.

Figure 4.1 shows the proportion of households with these measures by income decile in 2010–11, the most recent year of data. Note that for loft and cavity wall insulation, we exclude households who could not possibly have the measure (e.g. those with no loft or non-cavity walls).

The pattern of ownership is similar across measures: those in poorer income deciles are, if anything, slightly more likely to own insulation measures than those in richer deciles. The proportion of households with full double glazing is 65% in the richest income decile compared with 76% in the poorest decile and around 80% for those in the fourth and sixth deciles. Over half (52%) of households in the richest decile have cavity wall insulation, compared with 58% in the poorest decile. And whilst rates of loft insulation are high and bear little relationship to income (exceeding 93% in every income decile), if we look just at households with thick insulation of at least 200mm, ownership rates are again higher for poor households (35% in the poorest decile compared with 24% in the richest).

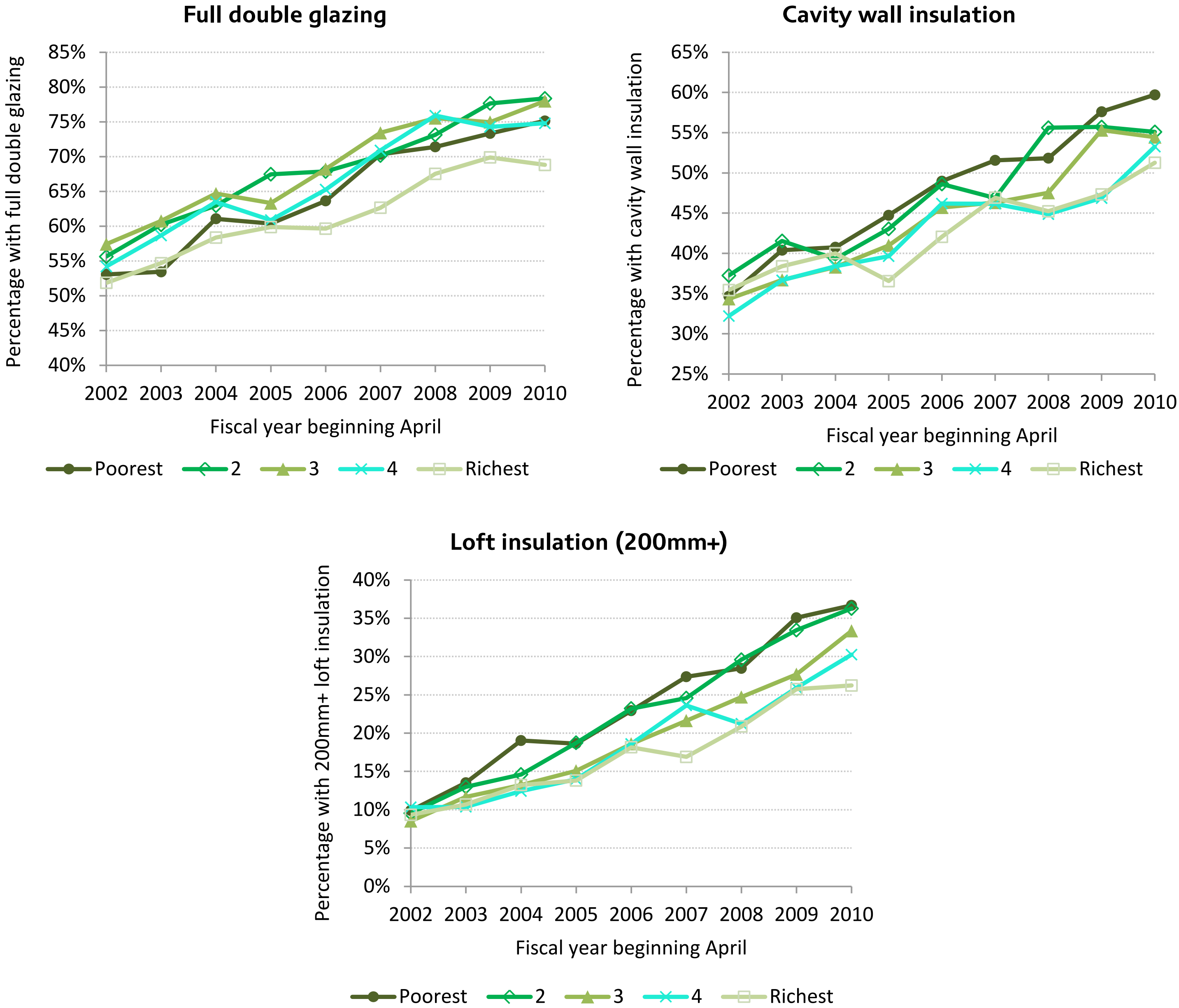
Figure 4.2 shows how ownership rates of different measures have evolved over the last decade or so. Because we have relatively small sample sizes within a single year and income decile, we aggregate households into five income quintiles (poorest 20% to richest 20%).

Figure 4.1. Ownership rates of insulation measures by income decile, 2010–11



Note: Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Figures are weighted for survey non-response.
Source: Authors' calculations from EHS data.

Figure 4.2. Trends in ownership rates by income quintile, 2002–03 to 2010–11



Note: Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Figures are weighted for survey non-response.
Source: Authors' calculations from EHS data.

There is some evidence that ownership rates of these measures have risen more quickly among poorer households. In 2002–03, both the poorest and richest 20% of households were less likely than other income groups to have full double glazing; over time, poorer households appear to have caught up whilst richer households have continued to lag behind. For cavity wall insulation, growth in ownership appears to have been slightly faster among the poorest 20% of households than among the others. A similar picture holds for loft insulation of 200mm or more: in 2002–03, all income groups had very similar ownership rates of around 10%, but the poorest 40% or so of households have seen faster take-up of this measure than middle and high income groups.

One factor that might have influenced these trends is the improvements in insulation standards among social housing in recent years. Leicester and Stoye (2013) show that rates of ownership of these measures amongst social tenants increased at least as quickly as, and usually more quickly than, rates among other tenure types between 2002–03 and 2010–11. For example, 14% of social tenants owned thick loft insulation in 2002–03. This had increased to 45% by 2010–11. A similar growth is also observed for cavity wall insulation and double glazing. This could reflect the impact of policies that sought to directly regulate the efficiency standards of the social housing stock, such as the Decent Homes Programme which by 2010 required social houses to have relatively efficient heating and some minimum insulation measures. The programme was delivered through a combination of central, local and private finance funding, and there is evidence (e.g. National Audit Office, 2010) that it made considerable progress towards its overall objective.

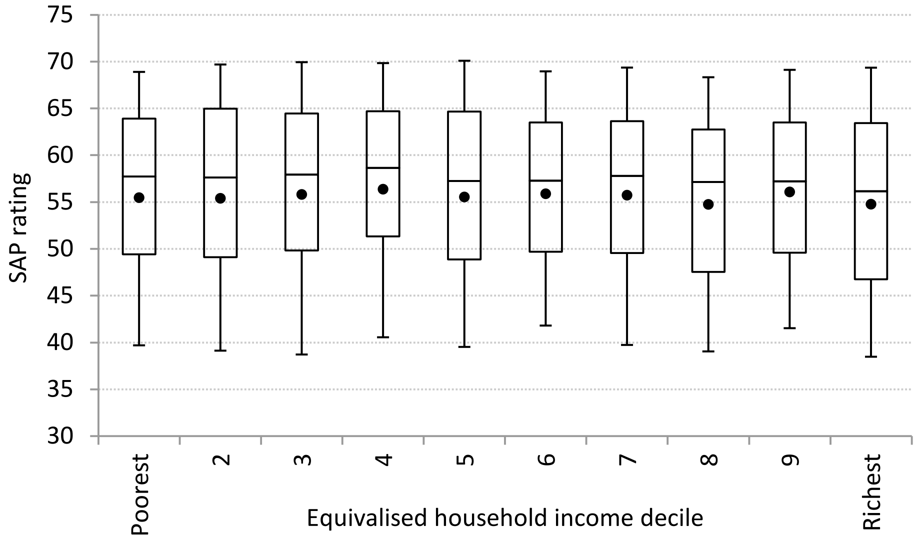
To give some longer-term historical perspective, it is interesting to see how these ownership rates by income compare to similar analysis done of the 1986 English House Conditions Survey by Brechling and Smith (1992). They found that rates of full double glazing in 1986 were less than 20% for the poorest income decile compared with around 50% for the richest income decile. Rates of loft insulation (they did not condition on a particular thickness) rose from just over 70% to around 85% between the bottom and top income deciles, and rates of cavity wall insulation from less than 10% to just under 20%. Thus not only has there been a substantial increase in ownership rates of different efficiency measures over the last 20 years or so, but also the increase has been concentrated on poorer households.[21]

Rather than looking at individual insulation measures, we can use the overall SAP efficiency rating (see footnote 4 and recall that higher values mean more efficient properties) estimated for each household in the EHS data to see whether richer households tend to live in more efficient properties. Figure 4.3 shows the mean and distribution of SAP ratings within each household income decile in 2010–11. The whiskers give the 90th and 10th percentiles, the top and bottom of the boxes the upper and lower quartiles, the central line the median and the dot the mean. There is clearly very little discernible relationship between dwelling energy efficiency and household income. The mean SAP score ranges between 54.7 in the eighth decile to 56.4 in the fourth decile, a difference of just 3%. There is also no evidence that the dispersion of SAP ratings within decile changes with income in any consistent way – for example, the 90/10 ratio of SAP scores is 1.74 in the

[21] Note that in a regression model, Brechling and Smith (1992) found evidence that higher income had a positive impact on whether these measures were present, but the effect was relatively modest once other dwelling and resident characteristics were controlled for. Leicester and Stoye (2013) carried out similar modelling using more recent data and found no positive relationship at all between higher income and ownership of insulation measures, all else held constant.

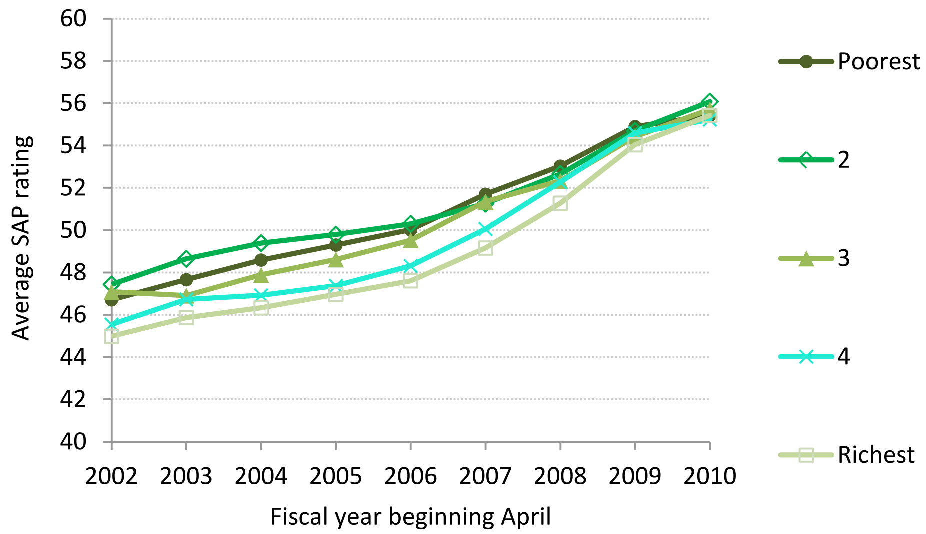
poorest decile, 1.65 in the sixth decile and 1.80 in the top decile. There is considerable heterogeneity in the SAP rating of households across England, but this is not correlated with household income.

Figure 4.3. Mean and distribution of SAP scores within income decile, 2010–11



Note: Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Figures are weighted for survey non-response.
Source: Authors' calculations from EHS data.

Figure 4.4. Mean SAP score by income quintile, 2002–03 to 2010–11



Note: Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Figures are weighted for survey non-response.
Source: Authors' calculations from EHS data.

Figure 4.4 shows how the mean SAP rating has changed over time within income quintile. Interestingly (given the trends in individual insulation measures in Figure 4.2), there is evidence that richer households have seen the largest gains in overall dwelling efficiency over the last decade or so. In 2002–03, households in the richest quintile had an average SAP score of 45.0 compared with 46.7 in the poorest quintile (a difference of around 3.7%). This gap widened to 4.9% in 2007–08 but has since been eliminated. This suggests that while poorer households have benefited from faster installation of cavity wall and thick loft insulation, and have caught up with richer households in terms of double glazing, there has been a relative improvement in other efficiency characteristics among richer households. These could include boiler efficiency, microgeneration, methods of lighting and so on, which also affect SAP ratings.

4.2 The distributional effects of policies to encourage energy efficiency

Summary of policies

Energy suppliers have, since 1994, faced formal obligations to improve the energy efficiency of the housing stock in various ways.[22] Since 1998, these have included specific obligations for a minimum amount of expenditure per customer and targets for total reduction in energy consumption from delivered measures. Through various mechanisms, government has also provided direct support for energy efficiency targeted variously at poor and vulnerable households and people living in relatively inefficient properties.

Of particular interest is how eligibility for these schemes varies across the income distribution and according to the energy efficiency of properties. As we saw above, there is little evidence that richer households tend to live in relatively more efficient properties on average (which in itself could be partly driven by previous energy efficiency obligations). Continued targeting of support for energy efficiency on the basis of income alone may not therefore target support on people in the most inefficient properties. On the other hand, targeting support on the basis of the efficiency rating of the property may see relatively well-off households, which presumably could afford to install measures if they wished to do so, benefiting.

The following measures have recently been in place:

- **Warm Front** was funded through general taxation and provided direct grants to low-income and vulnerable households to install energy efficiency measures. It ran from 2000 to January 2013 before being superseded by the Green Deal. Over this period, 2.3 million households received assistance from the scheme (DECC, 2013c). Eligibility was restricted to owner-occupiers and private renters. Initially, the eligibility criteria were restricted to households

[22] Supplier Obligations have been in place since 1994, when the Energy Efficiency Standards of Performance (EESoP) I was introduced. This was followed by EESoP II (1998 to 2000), EESoP III (2000 to 2002), the Energy Efficiency Commitment (EEC) I (2002 to 2005) and EEC II (2005 to 2008). Measures since then are detailed in the text.

that were both poor (in receipt of one of a number of means-tested benefits) and considered vulnerable (contained dependent children, someone over 60 or a disabled person). From 2011, an additional efficiency criterion was introduced so that homes with a SAP score in excess of 55 were ineligible. Toward the end of the scheme, both income and efficiency criteria were slightly relaxed.

- The **Carbon Emissions Reduction Target** (CERT) ran from April 2008 to December 2012 and was delivered through energy companies, which could recoup the costs through bills. The aim was to deliver savings equivalent to 293 million tonnes of CO_2 through a variety of actions including delivery of efficiency measures (such as loft and cavity wall insulation and energy-efficient lighting), providing energy efficiency advice, and microgeneration. Initially, a *priority group* was established with an obligation that 40% of the emissions reduction must be achieved in this group. Eligibility for the priority group was based on age (the householder being over 70) or income (the householder being in receipt of any of the major means-tested or disability benefits, or in some cases tax credits). In 2010, a *super priority group* was established with a specific target for emissions reductions in that group. This was a subset of the priority group focused on low-income pensioners and low-income people with young children or disabilities.

- The **Community Energy Saving Programme** (CESP) was established in 2009 and ran until the end of 2012. It was a relatively small-scale scheme which tasked energy suppliers (and, unlike CERT, electricity generators) to provide measures that would save in total 19.25 million tonnes of CO_2. Households were eligible if they lived in the poorest 10% of lower-level super output areas (LSOAs) in England or the poorest 15% in Scotland and Wales as defined by the income index in the 2007 Indices of Multiple Deprivation (IMD).[23] The intention was for suppliers to take a 'whole house' approach, installing a number of measures including insulation, heating system upgrades, energy efficiency advice and microgeneration technologies at once. Suppliers were also encouraged to look at districts rather than individual households. Incentive measures were built into the scheme to deliver multiple measures at once to a single house or a district. Restrictions were also imposed on how much of the CESP target could be delivered simply through installation of loft and cavity wall insulation (4% each) or providing advice (1%).

[23] An LSOA is a small-scale geographic region containing around 400 to 1,200 households. There are more than 32,000 LSOAs in England. For more information, see http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/census/super-output-areas--soas-/index.html. For more information on the IMD, see http://neighbourhood.statistics.gov.uk/dissemination/Info.do?page=analysisandguidance/analysisarticles/indices-of-deprivation.htm. A list of qualifying LSOAs for CESP can be found at http://www.official-documents.gov.uk/document/other/9780108508417/9780108508417.pdf.

- The **Energy Companies Obligation** (ECO) superseded CERT and CESP from January 2013, and is set to run until March 2015. It contains three components with specific targets for each:
  - *Home heating cost reduction obligation*: Suppliers must spend a minimum amount to improve energy efficiency for a 'warmth affordability group', defined as low-income households (in receipt of child tax credit, working tax credit, ESA/income-based JSA or income support) who also have dependent children, disabled household members or older household members. Only those in private accommodation (owned or rented) are eligible. Total bill savings of £4.2 billion are required over the obligation period. DECC (2012a) estimates that these savings can be produced through the installation of 45,000 cavity wall insulations, 90,000 loft insulations and 260,000 heating systems.
  - *Carbon saving community obligation*: Suppliers must carry out actions to improve energy efficiency that save a minimum amount of CO_2 in areas of low income (defined as the most deprived 15% of small areas in England with equivalent definitions in Scotland and Wales) and adjoining areas. There is a further obligation to provide at least 15% of savings under this part of ECO to people in the warmth affordability group in those areas. Savings of 6.8MtCO_2 are expected. This is approximately equivalent to the installation of 39,100 solid wall, 142,200 cavity wall, 29,000 loft and 39,300 combined loft and cavity wall insulations between January 2013 and March 2015 (DECC, 2012a).
  - *Carbon saving obligation*: Suppliers must carry out actions to save a minimum amount of CO_2 through measures that would not qualify for the Green Deal, such as solid wall insulation, cavity wall insulation in hard-to-treat homes and connection to district heating systems. This part of ECO has no specific income or area-based criteria. Savings of 21MtCO_2 are required between January 2013 and March 2015. To achieve these savings, DECC (2012a) estimates that the installation of 107,500 solid wall, 256,300 cavity wall and 116,800 combined cavity wall and loft insulations is required.

  The combined ECO emissions savings target of 27.8MtCO_2 is noticeably smaller than the 312.25 MtCO_2 of savings required between 2008 and 2012 by the previous supplier obligations.

- The **Green Deal** launched in January 2013 and provides loans to fund energy efficiency measures. Following an assessment of the property by a qualified adviser, households are granted loans to pay for the up-front installation costs of measures that are deemed to be cost-effective. Repayments (with interest) are made through future energy bills, with the obligation attached to the property rather than to the owner or the tenant. Loans are only granted for measures that meet the 'golden rule': the amount repaid through the bill in the first year must be no more than the expected bill savings achieved by the installed measures.

- **Small-scale feed-in tariffs** (FITs) provide long-term financial incentives for businesses and households to generate energy from renewable sources on a small scale (up to 5MW). Launched in April 2010, microgenerators receive a 'generation' payment for each kWh of energy produced. Tariffs vary by technology and by the size and date of the installation. A further 'export' payment is received on a fixed per-kWh basis for exporting this energy to the national grid. Payments are guaranteed for 20 years and are uprated in line with RPI inflation. Energy suppliers with a minimum of 50,000 domestic customers are obliged to take part in the scheme. Total payments of £135 million were made to 247,951 eligible installations in 2011–12 (Ofgem, 2012a).

Evidence on the distributional effects

For some initial evidence on how eligibility for two of these schemes – Warm Front and the CERT priority group – varied across the distribution, we use data from the 2009–10 English Housing Survey, supplemented with identifiers derived by DECC for whether each household is eligible. Table 4.1 shows the relationship between eligibility and household income decile. Unsurprisingly, households in poorer deciles are much more likely to be eligible: more than 80% of households in the bottom two deciles were eligible for the CERT priority group compared with 10% of households in the top decile. The relatively high eligibility rates towards the top of the distribution largely reflect an age criterion (being aged 70+) that was not accompanied by any additional income restriction. Not all of those in the poorest decile were eligible; this partly reflects the facts that some low-income households may not be eligible for means-tested benefits and that some low-income households do not claim benefits to which they are entitled.

Eligibility rates for Warm Front were lower (recall that low income alone was not sufficient to qualify; households also had to be older, disabled or have dependent

Table 4.1. Eligibility for CERT priority group and Warm Front (England), by income decile, 2009–10

Income decile	CERT priority	Warm Front
Poorest	84.6%	33.7%
2	80.3%	34.1%
3	74.2%	34.1%
4	55.0%	23.9%
5	43.6%	16.3%
6	39.7%	12.2%
7	27.7%	7.6%
8	20.2%	5.6%
9	11.4%	3.4%
Richest	9.7%	1.5%

Note: Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Figures are weighted for survey non-response.
Source: Authors' calculations from EHS data.

children, and social renters were ineligible): around a third of those in the bottom three deciles were eligible compared with just 2% in the richest income decile. Note that all households eligible for Warm Front are also eligible for the CERT priority group.

Table 4.2 shows take-up rates for three efficiency measures (having a condensing boiler, having 200mm or more of loft insulation and having cavity wall insulation), broken down into whether households do not have the measure, installed the measure in the last 12 months or already had the measure. The table compares these rates by eligibility for Warm Front (WF) and the CERT priority group in 2009–10.

Table 4.2. Ownership and take-up rates of efficiency measures, by scheme eligibility, England 2009–10

Measure	Eligibility	Does not have	Had in last year	Had already
Condensing boiler	Neither	78.1%	5.3%	16.6%
	CERT	77.5%	6.3%	16.2%
	CERT + WF	75.9%	6.1%	18.1%
200mm+ loft insulation	Neither	76.7%	4.4%	18.9%
	CERT	60.7%	6.6%	32.7%
	CERT + WF	64.3%	7.8%	28.0%
Cavity wall insulation	Neither	53.5%	4.5%	42.0%
	CERT	37.9%	4.0%	58.0%
	CERT + WF	38.1%	7.5%	54.5%

Note: Figures are weighted for survey non-response.
Source: Authors' calculations from EHS data.

Unfortunately, though the survey data record whether or not households took up various measures in the previous year and were eligible for various support schemes, it is not possible to isolate whether the measure was funded wholly or partly through a scheme such as CERT or Warm Front, or paid for by the household itself. Thus the figures are only suggestive of the impact of eligibility on ownership and take-up of new measures (and, of course, eligibility is not fixed – households may have paid for a measure before they became eligible). Nevertheless, they do suggest some impact. Those ineligible for both policies are much less likely to have either of the insulation measures. For loft insulation, there is evidence that ineligible households are also less likely to have received the measure in the past year than other households. For cavity wall insulation, although overall ownership rates are higher amongst ineligible households than for loft insulation, around the same proportion took up the measure in the last year as among those eligible just for the CERT priority group. Households eligible for Warm Front as well as CERT appear to have been more likely to have loft and wall insulation installed in the year prior to the survey, though they were slightly less likely to have owned them in the first place than those who were just CERT-eligible. There is less evidence that eligibility was associated with a much higher ownership rate or new take-up of condensing boilers.

Although eligibility for the policies is clearly strongly related to income, and there is some impact in terms of take-up, to understand the distributional impacts it is perhaps of greater interest to know whether those who took up measures were richer or poorer among eligible households. Given that CERT, CESP and ECO were funded through levies on energy bills, those who did not receive measures through the schemes would have faced higher bills. Thus the ultimate distributional impact of CERT, say, could have been regressive if those who took up measures were the richer eligible households. Warm Front, by contrast, was tax-funded. Given the progressivity of overall taxation and the much stronger relationship between eligibility for Warm Front and income, it seems unlikely that the net distributional effect of Warm Front was regressive, but again there may have been some difference between take-up and eligibility.

Given the relatively low overall take-up rates, there is not enough data to get a clear sense of how they varied across the distribution, but it would seem an important topic for future work (particularly if more precise attribution of take-up to particular efficiency schemes could be made). The DECC National Energy Efficiency Data-Framework (NEED) keeps a record of certified efficiency installations (including the scheme used to fund them) tied to addresses along with related information on energy consumption recorded by meters and imputed household characteristics based on local area. This would be a useful source for such analysis.

Other limited attempts have been made to understand the types of households that benefited from these domestic energy efficiency policies. The National Audit Office assessed to what extent the Warm Front scheme successfully targeted those in fuel poverty in 2001 and 2008. In 2001–02, a third of households living in fuel poverty were not eligible for assistance, while two-thirds of those eligible were not fuel-poor (National Audit Office, 2003). In 2008, the scheme remained poorly targeted, with 57% of 'vulnerable' households in fuel poverty still ineligible (National Audit Office, 2009).

Evidence on the effects of previous supplier obligations is also limited. DECC (2011) evaluated the delivery methods and the uptake of CERT prior to the introduction of the super priority group (SPG) target. Beneficiaries of the policy were more likely to be owner-occupiers, to be living in semi-detached properties and to be living outside of metropolitan areas. A quarter of CERT measures were delivered through Registered Social Landlords. CESP was targeted specifically at areas of low income. Ofgem (2013) suggests that the majority of measures were delivered through partnerships with social housing providers. Measures were also installed in private homes within social housing developments.

Preston et al. (2013a) suggest that CERT was regressive while it was 'live' (i.e. prior to its replacement by ECO in 2013). This is because they assume that energy companies recover the costs of the policy on a 'per-customer' basis, rather than on the basis of energy consumption.[24] This means that low-income households spend a larger proportion of their income on their energy bill as a result of the policy. However, by 2020, the policy is progressive. This is because the cost of the policy will then be zero while the benefits of the measures installed under the policy will still be accruing to households that received the measures. These households tend to be in the lower income deciles, due to the targeting of CERT towards the priority and super priority groups. On average, households experience annual savings on their energy bill of £20.

Box 4.1. Average impact of energy use and climate change policies on household prices and bills

DECC (2013d) provides estimates for the average effect of all energy use and climate change policies on household energy prices and bills. These include not only the energy efficiency policies outlined above, but also policies that price emissions and support renewable technologies. The DECC estimates suggest that the climate change policies increased domestic gas prices by 5% and electricity prices by 17%. This figure will rise to 33% for electricity in 2020.

However, these estimates apply to prices rather than bills. Bill impact estimates take into account the reduction in energy consumption that could occur as a result of energy efficiency policies. DECC estimates significant savings from policies such as product policies and the smart meter rollout, alongside savings from previous supplier obligations (CERT and CESP). As a result, its estimates suggest that overall policy will reduce the average dual-fuel energy bill by 1% in 2013 and 6% in 2020 relative to a scenario where no policy is in place.

It is difficult to see what the precise impacts are for the individual energy efficiency policies. For example, CERT and CESP are costless in these estimates (as the policies are no longer 'active') but continue to provide benefits through previously-installed measures. This does not reflect the overall impacts of these policies as it is unclear how the policy costs were recouped.

Some of these policies also imply costs that are not felt through bills. For example, products policies impose regulations on minimum efficiency standards for energy-using products such as refrigerators and boilers. This may increase the cost of purchasing these products. Such costs are not reflected in the bill effects provided by DECC, which only include energy bills, even though overall costs for households have increased.

It should also be noted that these estimates are of average impacts. These impacts are likely to differ across the distribution due to a number of factors, including to what extent households benefit from the energy efficiency schemes and the amount of energy consumed.

[24] Note that DECC (2013d) makes the opposite assumption – that supplier obligations are recouped through energy prices rather than lump-sum additions to energy bills. Advani et al. (2013) follow the DECC assumption but note the uncertainty over precisely how these policies are recouped, and thus the uncertainty over their distributional implications.

Preston et al. (2013a) also provide estimates for the impact of small-scale FITs. The policy is estimated to result in average bill savings of £34. However, significant differences exist in the expected impact on households that install FITs and those that do not, with large savings (£359) estimated for the 12% of households that have FIT installations. These households fall disproportionately into the upper income deciles, with 36% of households in the top decile benefiting from the policy. In comparison, only 1% of households in the lowest income decile have an installation. The remaining 88% of households are estimated to experience average bill increases of £10. Due to the composition of these households across the distribution, the policy is highly regressive despite the average bill savings.

Evidence on the overall effect of energy use and climate change policies is also available. DECC produces annual estimates of the average impact of all energy use and climate change policies (including policies to support renewable technologies and those that price carbon) on household prices and bills. These results are briefly discussed in Box 4.1.

5. Distributional Impact of Policies Supporting Energy Bills

As well as policies that support improvements in energy efficiency and insulation (Chapter 4), another broad group of policies that relate to household energy use are ones that provide direct support for energy costs. In this chapter, we consider distributional issues related to these policies. We look at three key nationwide policies – the cold weather payment, the warm home discount and the winter fuel payment. We consider them in isolation in Sections 5.1 and 5.2 and then as a whole in Section 5.3, looking at the overall impact of the package of bill support policies. Section 5.4 presents a summary and draws some conclusions.

Of the three policies, only the warm home discount is paid as a direct bill rebate. The others are labelled cash payments, which in principle can be seen as straightforward cash benefits rather than 'bill support' policies. However, as noted by Beatty et al. (2011), the labelling of the winter fuel payment encourages it to be spent much more heavily on energy than would be expected from a straightforward cash transfer. They estimate around 40% of the payment goes on energy compared with 3% of an unlabelled transfer. Although no similar figures exist for the cold weather payment, it is unlikely that the labelling effect is any smaller: indeed, given that it is paid precisely when the weather is very cold and is also labelled, we might expect it to be even more heavily devoted to energy.

In this chapter, we consider the three policies as a whole, under the assumption that in terms of their behavioural impact and their intention, they are designed to effectively reduce energy bills. However, the objectives of the winter fuel payment are unclear. If the main objective is to provide support for winter fuel bills (as the name suggests), then the discussion below suggests sensible policy improvements. If payments are instead seen as transfers to older households, different arguments apply.

5.1 Cold weather payment and the warm home discount

There are two main policies that support energy bills for lower-income households more generally.

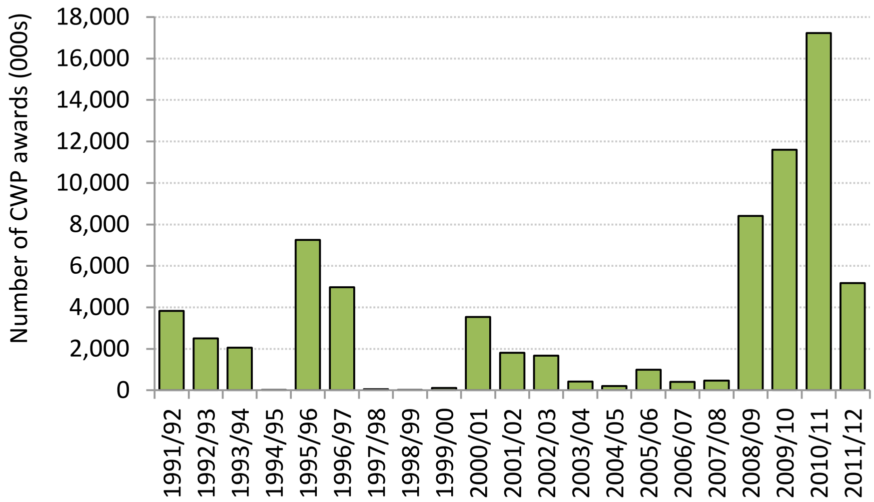
Cold weather payment (CWP) is administered through the Social Fund by the Department for Work and Pensions (DWP). Each UK postcode is linked to one of 92 national weather stations. A payment is automatically made to eligible recipients following a period of seven consecutive days (between 1 November and 31 March) when the daily mean temperature at the relevant station is recorded or forecast to be 0°C or below. The CWP was introduced in 1986 at a rate of £5 for each week,[25] which increased to £6 in January 1991 and to £7 in November 1994. In the winter of 1995–96, payments were set at £8.50 for each week of cold weather. Payments remained unchanged until 2008–09, when they were increased to £25 per week, originally as a temporary policy which was then made permanent as part of the 2010 Spending Review.[26]

Eligibility for the CWP is determined by receipt of a number of means-tested benefits:

- recipients of pension credit are automatically eligible;
- recipients of income-based jobseeker's allowance or income support are eligible if they also receive a disability or pensioner premium, or have a young (under 5 years old) or disabled child;
- recipients of income-related employment and support allowance (ESA) who have had a work capability assessment and go on to receive the support- or work-related component of ESA are eligible. ESA recipients who have not had the assessment are eligible if they also receive a disability or pensioner premium, or have a young or disabled child.

The number of payments each year is obviously very sensitive to weather conditions. Figure 5.1 shows the number of awards made each fiscal year between 1991–92 and 2011–12. In 2010–11, a record 17.2 million payments were made at a cost of £430.8 million. In 2011–12, a milder winter (daily mean

Figure 5.1. Number of CWP awards made, 1991–92 to 2011–12



Source: Figures up to 2008–09 from http://www.parliament.uk/briefing-papers/SN00696; more recent figures from various DWP annual Social Fund reports.

[25] The original temperature was –1.5°C, but it was raised to 0°C in 1987.

[26] See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/203826/Spending_review_2010.pdf.

winter temperatures rose from 2.4°C in 2010–11 to 4.5°C in 2011–12[27]) saw the number of payments fall to 5.2 million at a cost of £129.2 million (DWP, 2012a).

The **warm home discount** (WHD) scheme gives electricity bill rebates (worth £135 in 2013–14) to low-income and vulnerable households.[28] WHD rebates were first made in 2011–12 and are currently set to run until 2014–15. Energy companies with at least 250,000 domestic customers are obligated to take part. The cost of the scheme to energy companies is recouped through higher energy bills for non-recipients. There are two groups eligible for the rebate:

- A ***core group*** of low-income pensioners. There are two determinants of eligibility for the core group:
  - customers aged under 75 who receive just the guarantee credit element of the pension credit, but not the savings credit element (for a single pensioner in 2013–14, this amounts to a weekly income of less than £145.40);
  - customers aged 75 and over who receive the guarantee credit element of the pension credit are eligible irrespective of whether they also receive the savings credit element.[29]

- A ***broader group*** of other customers are also eligible for a rebate. The criteria are at the discretion of individual energy companies (subject to Ofgem approval); in practice, eligibility is largely determined by receipt of an income-related benefit (income support, income-related employment and support allowance or income-based jobseeker's allowance) together with having young children, older people or disabled people in the household; or by receipt of pension credit for those not already part of the core group.[30] These are essentially the eligibility criteria for CWP.

A key difference between the core and broader groups, aside from eligibility criteria, is that those in the core group should automatically receive the rebate: DWP benefit payment records are matched to energy company customer records. Households in the broader group have to apply for the rebate themselves. In its first-year report on the scheme, Ofgem (2012b) found that around 600,000 of an

[27] Temperatures between December and February. 2010–11 from http://www.metoffice.gov.uk/climate/uk/2011/winter.html; 2011–12 from http://www.metoffice.gov.uk/climate/uk/2012/winter.html.

[28] There are other aspects to the WHD scheme, including spending by energy companies on social tariffs and some activities carried out by energy companies to help people reduce bills. For details, see Hough and Bolton (2012).

[29] Note that the age threshold at which receipt of the savings credit element is ignored is set to fall to 65 in 2014–15. The weekly incomes determining eligibility for the different components of pension credit are different for couples and for people with particular housing costs or caring circumstances; for information, see Browne and Hood (2012).

[30] The eligibility criteria for the broader group for British Gas, for example, in 2012–13 can be found at http://www.britishgas.co.uk/products-and-services/gas-and-electricity/the-warm-home-discount.html.

estimated 800,000 core group households received an automatic rebate, with a further 100,000 subsequently receiving a rebate through a mop-up process. More than 234,000 broader group rebates were paid, though only 42% of the broader group applicants whose application was audited by energy companies could produce evidence of their eligibility.

Assessing the distributional implications of CWP and WHD is much more difficult doing so for WFP (see Section 5.2 below). The eligibility criteria are more complex and, for the WHD, are in part determined by energy companies, which can set their own individual rules. Further, at least for the WHD broader group, eligibility need not determine receipt since payments have to be applied for (and, as discussed, less than half of applicants could provide evidence to support their claim when audited, which suggests that eligibility and receipt among the broader group need not align properly).

We use the most recent fiscal year of household expenditure data (2010–11) to approximate each household's *eligibility* for CWP and WHD (in 2013–14) as best we can given the detailed information on household composition and benefit receipt.[31] We do not know which energy company households use to supply their homes, which means we do not know what eligibility criteria are being used for the WHD broader group, so we assume that energy companies adopt the CWP eligibility criteria. Households may be eligible for CWP but not WHD – we assume that the bill is paid by the head of the household, and so require the head (or their spouse) to be eligible for CWP in order for the household to also be eligible for the WHD rebate.

Table 5.1 shows household-level eligibility rates by household expenditure decile. Note that households may receive multiple CWP if there is more than one benefit unit in a particular household eligible to receive the payment, but here we look only at whether there is anyone eligible in the household. Eligibility for the WFP is also shown for comparison.

Eligibility for the WHD and CWP is much more concentrated in lower expenditure deciles than eligibility for the WFP, unsurprisingly given the universal (conditional on age) nature of the WFP and the targeting of the other policies on those receiving means-tested benefits. Just over a third of households in the poorest decile are eligible for WHD and CWP compared with 1% in the richest decile.[32]

[31] We do not have detailed information on the presence of disabled children, but we proxy receipt of disability premiums with means-tested benefits using receipt of attendance allowance, severe disablement allowance, incapacity benefit or severe disablement allowance. We also know whether households receive pension credit but not the split between the guarantee and savings credit elements. Because all non-core pension credit recipients are likely to be eligible as part of the broader group, we simply use receipt of pension credit to determine eligibility but do not try to separate the core and the broader groups in the data.

[32] Overall, around 1.5% of households are estimated to contain someone eligible for CWP who is not the head of household or their spouse (who are assumed to determine eligibility for WHD). Of

Table 5.1. Household eligibility rates for policies supporting energy bills, by non-housing expenditure decile, 2010–11

Decile	WHD eligible	CWP eligible	WFP eligible
Poorest	34.3%	36.2%	39.6%
2nd	24.9%	28.2%	45.2%
3rd	17.4%	19.7%	45.1%
4th	11.7%	14.4%	40.8%
5th	9.6%	10.4%	36.8%
6th	7.3%	8.8%	39.4%
7th	3.7%	5.2%	32.0%
8th	2.7%	3.9%	34.4%
9th	2.1%	2.8%	32.6%
Richest	0.9%	0.9%	32.7%
All households	*11.5%*	*13.1%*	*37.8%*

Note: Based on 2013–14 eligibility criteria, assuming WHD eligibility is restricted to cases where the head of household or their spouse is eligible for CWP. Data are weighted for survey non-response. Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Excludes Northern Ireland.
Source: Authors' calculations from LCF.

Recall, though, that just under 1 million WHD rebates were paid in the first full year of the scheme (2011–12). Estimates from the Office for National Statistics (2013) suggest there were around 26.4 million households in the UK in 2011–12, implying that only around 3.5% of households received a rebate against the 11.5% or so we estimate may have been eligible. If all eligible households received a payment, around 3 million rebates would have been paid, at a cost of over £400 million.

5.2 Winter fuel payment

The winter fuel payment (WFP) is a tax-free lump-sum payment made to households containing people who have reached the female state pension age.[33] The payment is normally made in winter (November/December) and is automatic. Where there is more than one eligible individual in a household, payments are split.[34] In 2012–13, payments were made to 12.7 million individuals at a cost of £2.13 billion (DWP, 2012b).

course, in practice, it would make sense for households with pooled responsibility for energy bills to have the CWP-eligible person named on the bill.

[33] Technically, eligibility for payment in the following winter is based on someone in the household meeting the qualifying age for pension credit (historically 60, and itself linked to the female state pension age) in the 'qualifying week', which starts on the third Monday in September. For winter 2013–14, claimants must have been born on or before 5 January 1952.

[34] For more details, see https://www.gov.uk/winter-fuel-payment/what-youll-get.

The WFP was introduced in 1997–98. The total payment has varied over time according to the age of the eldest eligible individual, benefit receipt and a number of 'one-off' additions, which have often persisted over several years. Perhaps most oddly, in 2004–05, an additional payment was made to some older households, which was described as supporting council tax bills but was paid

Table 5.2. Rates of and expenditure on WFP, by fiscal year (nominal terms)

Year	Rate (age 60–79)	Rate (age 80+)	Total cost (£ billion)	Notes
1997–98	£20/£50	£20/£50	0.19	£50 if anyone eligible in receipt of income support
1998–99	£20/£50	£20/£50	0.19	£50 if anyone eligible in receipt of income support
1999–00	£100	£100	0.76	
2000–01	£200	£200	1.75	
2001–02	£200	£200	1.68	
2002–03	£200	£200	1.71	
2003–04	£200	£300	1.92	
2004–05	£200+	£300+	2.47	If anyone aged 70+ then additional £100 for 'council tax'; effectively means rate for 80+ was £400.
2005–06	£200+	£300+	3.11	If anyone aged 65+ and not getting guarantee element of pension credit (so pays council tax), then extra £200. If anyone aged 70+ and in receipt of guarantee element of pension credit (so does not pay council tax), then extra £50.
2006–07	£200	£300	2.02	
2007–08	£200	£300	2.07	
2008–09	£250	£400	2.70	Extra payments from 2008–09 described as 'one-off'.
2009–10	£250	£400	2.73	'One-off' payment maintained.
2010–11	£250	£400	2.76	'One-off' payment maintained.
2011–12	£200	£300	2.15	
2012–13	£200	£300	2.13	
2013–14	£200	£300	2.15	

Note: Expenditures in 2004–05 and 2005–06 treat one-off additional benefits for older pensioners that were paid alongside the WFP as WFP expenditure. Expenditure figures are out-turns to 2011–12 and forecasts for 2012–13 and 2013–14.
Source: Rates to 2012–13 from Kennedy (2012). Rates for 2013–14 from https://www.gov.uk/winter-fuel-payment/what-youll-get. Expenditures from DWP (2012b).

with the WFP. In 2005–06, similar additional supplements were paid either described as 'council tax refunds' or 'support for the cost of living', but again paid with the WFP.

Table 5.2 summarises the value of and expenditure on WFP over time.[35] From low introductory rates with a means-tested element, the benefit became universal for older households from 1999–2000 and more generous. With the ending of the 'one-off' additions from 2011–12 onwards, the cash value of WFP is now the same as it was in 2003–04 (though, given an increase in the number of older households, expenditure is higher).

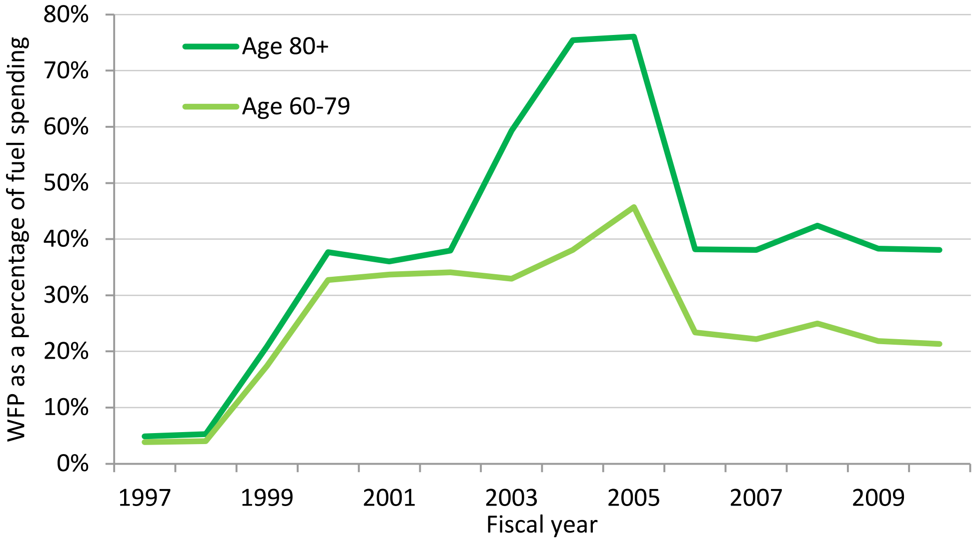
Of course, energy bills as well as prices, household income and expenditure have changed significantly over this period. In thinking about the 'value' of WFP to recipients, these may be sensible benchmarks. The WFP was much more generous in the mid-2000s. In 2005–06, for example, households containing someone aged 60 to 79 received on average £325 in WFP (this includes the 'council tax' or 'cost of living' additional payments made with WFP that year) and those with someone aged 80+ received an average of £469. These amounts equated to around 1.8% and 3.8% of average incomes for these age groups, and 2.1% and 5.3% of average non-housing spending, as recorded in the LCF data.

Even more striking is the size of average WFP receipt relative to fuel expenditure. Figure 5.2 shows, by fiscal year, WFP as a percentage of fuel spending for average recipient households by age group. In 1997–98, the WFP was worth around 4% of fuel spending for those aged 60–79 and 5% for those aged 80+. In 2005–06, these figures were 46% and 76% respectively: that is, for those aged 80+, the WFP was equivalent to *more than three-quarters* of average fuel spending. As the one-off bonuses were removed and fuel bills rose markedly in more recent years, this proportion fell back. By 2010–11, the WFP was equivalent to around 21% of fuel spending for those aged 60–79 and 38% for those aged 80+. Our calculations suggest these figures have likely fallen to 13% and 22% respectively by 2013–14. These would be the smallest proportions since 1998–99 for those aged 60–79 and since 1999–2000 for those aged 80+. Thus, through a combination of the ending of one-off supplements to WFP and energy price inflation in recent years, the 'value' of the WFP relative to fuel spending has fallen markedly in the last few years.

The pattern of WFP receipt across the expenditure distribution has changed over time, with a larger proportion of payments received by higher-spending households in recent years. When WFP was introduced in 1997–98, 33% of total payments were received by households in the bottom expenditure quintile and 10% by those in the top quintile. By 2011–12, these figures had become 20% and 17% respectively. This change is even more remarkable if we look only at payments to the older (80+) group alone. In 1997–98, 49% of these payments

[35] Note that we treat 'council tax' or 'cost of living' one-off additions in 2004–05 and 2005–06 as WFP expenditures.

Figure 5.2. Winter fuel payment as a percentage of fuel spending, by fiscal year and age group, 1997–98 to 2010–11



Note: Excludes Northern Ireland and households with any negative component of fuel spending. Data are weighted for survey non-response.
Source: Authors' calculations from LCF data.

were received by households in the bottom quintile but this figure dropped to 30% in 2011–12.

Despite these trends, the WFP is broadly progressive when measured against household spending. Taking the most recent (2010–11) figures, WFP was worth around 4% of expenditure in the poorest decile and 0.2% of expenditure in the richest decile. The pattern is remarkably similar to that seen back in 2000–01, when a universal £200 payment was first introduced for all older households.[36] Although data are not available for the current year, the value of WFP relative to expenditure will have fallen owing to the lower rates of WFP and increases in expenditure, though it is unlikely that the pattern across expenditure deciles will have changed markedly.

5.3 Combined distributional impacts based on policy eligibility, 2013–14

We look now at the overall value of bill support policies for which households are eligible and how this varies across the expenditure distribution and household type. Because we cannot model receipt of the WHD rebate, we look at eligibility. However, only one-third of rebates (relative to the proportion of households we estimate to be eligible) were actually paid in the first full year of the WHD, and some of those who received a rebate may not have been eligible. The figures in

[36] When measured against income, WFP also looks progressive but to a lesser extent: the average value of WFP as a proportion of total income is roughly similar in the poorest three income deciles in these years and then falls higher up the income distribution. Figures are available on request.

this section should therefore be seen as the support for energy bills that would occur under full intended take-up of measures were the WHD budget to allow for this. We discuss the issue of take-up further in Section 6.2.

We want to look at the distributional effects in the current year (2013–14) based on current rates of each policy. Since we do not have any more recent data on which to estimate eligibility, we use the 2010–11 data as above to estimate where in the distribution of expenditures and household types eligibility lies. We increase total household expenditures in line with RPI inflation between the month in which we observe households and April 2013 to estimate how much households would spend if observed now. We increase household energy expenditures (separately for gas, electricity and other fuels) in line with RPI inflation in those individual commodities to estimate households' energy spending today.

Table 5.3 shows the average value of bill support policies for which households are estimated to be eligible by expenditure decile. Average energy spending by decile is shown for comparison. We assume each eligible benefit unit receives one CWP worth £25 (though households may receive multiple payments if there is more than one eligible benefit unit). Households can only receive a single WHD rebate of £135, and they receive WFP of either £200 or £300 depending on the age of the eldest resident.

Table 5.3. Average value of bill support eligibility and energy spending, by non-housing expenditure decile, 2013–14 values

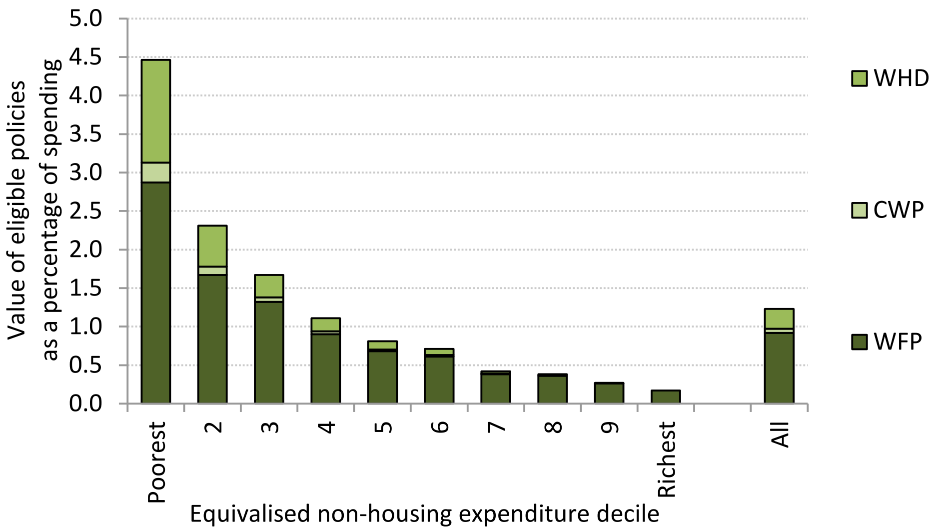
Decile	Fuel spend (£/year)	WFP (£/year)	CWP (£/year)	WHD (£/year)	Total (£/year)	Total as a % of fuel spend
Poorest	783.04	95.65	9.42	46.41	151.48	19.3%
2nd	1,059.49	102.65	7.46	33.79	143.90	13.6%
3rd	1,343.02	103.49	5.07	23.52	132.07	9.8%
4th	1,334.93	90.00	3.83	15.84	109.67	8.2%
5th	1,379.28	82.20	2.55	12.57	97.32	7.1%
6th	1,440.56	86.85	2.31	9.88	99.03	6.9%
7th	1,499.53	69.53	1.32	5.07	75.91	5.1%
8th	1,590.73	74.61	0.90	3.17	78.68	4.9%
9th	1,738.04	68.87	0.70	2.80	72.37	4.2%
Richest	1,888.03	69.58	0.22	1.21	71.02	3.8%
All households	*1,405.96*	*84.32*	*3.37*	*15.41*	*103.10*	*7.3%*

Note: Based on 2013–14 eligibility criteria, assuming WHD eligibility is restricted to cases where the head of household or their spouse is eligible for the CWP. Assumes eligible benefit units receive one CWP. Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Data are weighted for survey non-response. Excludes Northern Ireland.
Source: Authors' calculations from 2010 and 2011 Living Costs and Food Survey.

Across all households, eligible bill support policies are worth just over £103 per year on average, 7% of the average energy spend of £1,406. Households in the poorest decile are eligible for bill support policies worth £151 per year, just under 20% of their estimated 2013–14 energy spend of £783. Households in the richest decile are eligible for policies worth £71 per year, about 4% of their energy spending of £1,888. The WFP accounts for around 63% of the total average value of eligible support in the bottom decile, compared with 98% in the richest decile. The value of policies relative to average fuel spending falls consistently as we move up the expenditure distribution.

Figure 5.3 shows the average value of bill support policies for which households are eligible as a proportion of total expenditure for each expenditure decile. The policies are all progressive, and represent around 4.5% of spending in total for the bottom decile against 0.2% for the top decile (and 1.2% across all households). Beyond the sixth expenditure decile, the WHD and CWP have virtually no impact relative to expenditure on average.

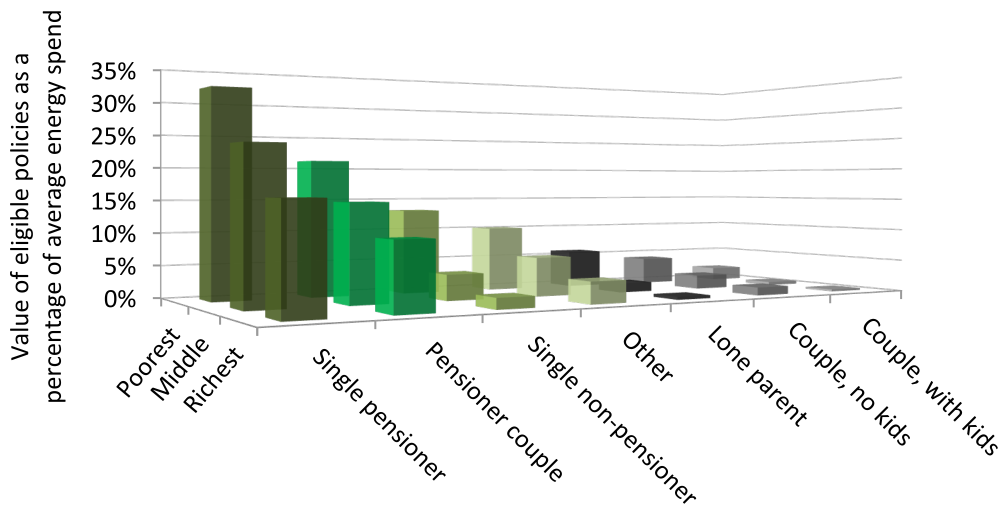
Figure 5.3. Distributional effect of bill support policies (eligibility basis), by non-housing expenditure decile, 2013–14



Note: Based on 2013–14 eligibility criteria, assuming WHD eligibility is restricted to cases where the head of household or their spouse is eligible for the CWP. Assumes eligible benefit units receive one CWP. Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Data are weighted for survey non-response. Excludes Northern Ireland and households with total non-housing expenditure below £1,000 per year.
Source: Authors' calculations from 2010 and 2011 Living Costs and Food Survey.

Figure 5.4 looks at the relationship between family type, living standards as measured by total expenditure, and the value of eligibility for bill support policies. It divides households into seven family groups and three groups ('tertiles') based on total expenditure, and shows the value of eligible support relative to energy spending.

Figure 5.4. Average value of bill support policies (eligibility basis) relative to energy spending, by household type and total non-housing expenditure tertile, 2013–14 values



Note: Based on 2013–14 eligibility criteria, assuming WHD eligibility is restricted to cases where the head of household or their spouse is eligible for the CWP. Assumes eligible benefit units receive one CWP. Tertiles are equivalised using the after-housing-costs (AHC) modified OECD scale. Data are weighted for survey non-response. Excludes Northern Ireland and households with total non-housing expenditure below £1,000 per year.
Source: Authors' calculations from 2010–11 Living Costs and Food Survey.

The biggest beneficiaries from these bill support policies are single pensioner households in the poorest third of the expenditure distribution. Their eligible support (almost all of which will be paid automatically assuming they are likely to be in the core group of the WHD) is worth around 7% of expenditure and 32% of average energy costs. Support for pensioner couples in the poorest third by spending (again, likely to receive automatic payments under the WHD) is worth 21% of energy spending on average.

Looking at other poor groups, these policies are worth relatively small amounts as a share of fuel spending, and since they will not be part of the WHD core group, many will not actually receive a bill discount for which they are eligible because they have not applied of it. For example, lone parents in the bottom third of the spending distribution are eligible for support worth 5.8% of energy bills on average. However, around 80% of the support for which lone parents in the poorest third are eligible comes through the WHD rebate (ignoring any other policies delivered through the WHD for which they may be eligible, such as social tariffs), for which they would have to apply.

5.4 Summary and conclusions

At present, there are three main policies that provide support for energy bills, either in the form of labelled cash benefits paid to older households (the winter fuel payment) or to poor households in periods of cold weather (the cold weather payment), or as a direct bill rebate paid for by energy companies and recouped through all domestic energy bills (the warm home discount).

The generosity of the WFP has changed markedly over time. It was worth three-quarters of the average fuel bill for those aged 80+ in the mid-2000s, compared with less than 5% when it was introduced in 1997–98. As bills have risen and the cash value of the payment has fallen in recent years, it now looks to be worth 22% or so of fuel bills for those over 80 and 13% for those aged 60–79, the lowest figures since 1998–99 to 1999–2000. Nevertheless, the WFP is still quite progressive, worth around 4% of spending on average for the poorest expenditure decile and 0.2% for the richest decile.

Other policies are more strongly progressive, targeted directly on poorer people rather than being universally paid to those households meeting an age threshold. However, the WHD (which, except in a very severe winter, would be worth more than the CWP) is only paid automatically to low-income pensioners, a group that already benefits from the automatic WFP as well as CWP when temperatures are low. Single pensioners in the bottom third of the spending distribution are therefore eligible for automatic support worth in excess of 7% of their spending (more than double the value of support for any other group relative to expenditure) and around one-third of their fuel spending on average. Other poor groups, such as poorer single parents, face much less generous packages of support. The WHD rebate is not automatic for non-pensioner poor groups, and evidence from the first year of the scheme suggests that a relatively small proportion of this group actually receive support to which they are in principle entitled.

There may well be a very strong argument to wrap up support for energy bills in ways that are targeted on poorer households more generally and are greater when the weather is colder. The structure of the winter fuel payment – an unconditional transfer to individuals over the female state pension age – suggests that it is part of the broader welfare system, aimed at supporting older households generally. On the other hand, its name suggests it might be intended to provide support for heating costs. We treat it as a form of support for fuel bills, and hence suggest in Chapter 6 reforms that would improve its effectiveness in providing such support.

6. Reforms to Household Carbon Prices and Compensation Measures

We observed in Chapter 3 that energy is a necessity, with poorer households spending a much higher budget share on energy than richer households. Policies that increase energy prices therefore place a greater burden upon poorer households. This, combined with concerns over carbon emissions, has led to a complicated multitude of policies, with multiple (and sometimes conflicting) objectives, resulting in rather opaque distributional consequences.

One aim of these policies is to reduce carbon emissions. However, as long as emissions reductions are an objective, energy prices are likely to increase. Indeed, DECC (2013d) forecasts that energy and climate change policies will increase household electricity and gas prices on average by 33% and 5% respectively in 2020. This gives rise to further distributional concerns.

But policies are currently inconsistent and the carbon price faced by households when using electricity and, especially, gas is considerably below those prices faced by firms and below target carbon prices. Indeed, domestic gas use is currently subject to no carbon tax at all.

There is also the separate issue of VAT. Domestic energy use is subject to a reduced rate (5%) of VAT. This effectively subsidises domestic energy use, and in fact creates a negative carbon price for domestic gas. This can be understood in the context of distributional concerns – concerns which explain the damaging political consequences suffered by Norman Lamont and the Conservative Party when he attempted to impose VAT at the full rate on domestic energy back in 1993. But this effective subsidy obviously conflicts with an objective to reduce carbon emissions.

Nevertheless, it has proved possible to introduce a range of policies that have increased electricity prices quite substantially. This cost, though, is rather hidden by comparison with an explicit VAT or carbon tax. And, in contrast to the 1993 proposals to impose the full rate of VAT, no package of compensating increases in benefits or reductions in taxes has been put in place to mitigate the distributional effect of these additional costs.

In that context, this chapter examines the extent to which it might be possible both to reduce the variation in carbon prices (by taxing household energy use in a more efficient way) and to ameliorate the distributional consequences that arise as a result of such a reform. We model two reforms inspired by the recommendations in Advani et al. (2013) and analyse a package of measures that is designed to mitigate the adverse distributional impacts.

We begin, in Section 6.1, with a brief overview of previous studies that have tackled similar issues. We then outline the data and methods for the analysis and set out the proposed reforms in more detail in Section 6.2. We summarise the key results in Section 6.3 and then discuss some of the issues with the modelling approach and issues relevant for policymakers in Section 6.4.

6.1 Previous studies

A number of studies have examined similar issues. Johnson, McKay and Smith (1990) examine the distributional impact of imposing a VAT rate of 15% (then the standard rate) on domestic energy, which was at that time zero-rated for VAT. They use household expenditure data from 1986 to model the impact with and without compensation packages. The imposition of VAT itself is regressive but, on average, households can be adequately compensated through lump-sum cash transfers. However, due to substantial within-decile variation in energy demand, such a compensation package is likely to result in many losers in the poorest expenditure deciles. A compensation package using the tax and benefit system (focused on increases in income support, housing benefit, family credit and the basic state pension) is shown to target vulnerable households that spend a greater proportion of their income on energy (the poor, those with young children and the elderly). Crawford, Smith and Webb (1993) take a similar approach to model the impact of the introduction of VAT at a rate of 17.5% (the standard rate rose in 1991) on domestic energy.[37] They note that the automatic indexation of social security benefits will provide substantial compensation for poorer households. However, this uprating would be implemented with a lag due to increases in prices only being reflected in the value of benefits in the following year. It also fails to compensate poorer households, which target a higher proportion of their expenditure on energy than the average household. Discretionary measures could focus on providing larger 'premiums' for means-tested benefits, and could aid the elderly in particular through generous pensioner premiums.

Mirrlees et al. (2011) examine a general broadening of the VAT base, which includes full-rate VAT on domestic energy (as well as food, children's clothing and so on). They show that negative distributional consequences could be offset on average without worsening work incentives through a combination of benefit increases and cuts in other tax rates that cost the same as the estimated revenues from higher VAT rates. A cheaper package, which more than compensates poorer households through increases in means-tested benefits (and presumably leaves fewer poorer 'losers'), is also possible, though could significantly weaken work incentives among that group.

Dresner and Ekins (2006) use expenditure and housing survey data to examine whether compensation packages based on the tax and benefit system could be

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[37] The March 1993 Budget announced that domestic energy would be subject to a VAT rate of 8% from April 1994, with plans to increase to the full rate in April 1995. The subsequent increase was never actually implemented and the rate was reduced to 5% in 1997 by the incoming Labour government.

used to offset the effects of a household carbon tax on the poorest households. They consider 13 reforms containing a combination of changes to means-tested and pensioner benefits. Each reform is progressive on average, with the poorest income decile achieving annual net gains between £1.77 and £118.14. However, it remains that a substantial proportion of households within this decile lose as a result of the package (19–48%) due to large variation in the energy efficiency of the UK housing stock. Targeted carbon-tax exemptions are found to be almost infeasible to implement. Instead, the authors argue for council tax and stamp duty surcharges, together with direct support targeted on poorer households, to incentivise the installation of efficiency measures in the domestic housing stock.

Preston et al. (2013b), however, argue that not only can the impact on poorer households of higher taxes on energy be (over-)compensated on average through existing taxes and benefits, but also it can be done in a way that leaves relatively few losers in lower income deciles. They model the effects of reform packages in 2017–18 based on estimates of the distribution of energy consumption and household incomes in that year. The closest package to the one we consider introduces a carbon tax on domestic gas and non-metered fuel at a rate equivalent to the Carbon Price Floor, along with an increase in the rate of VAT on domestic energy to 20%. The reform is estimated to raise £6.8 billion per year, which is fully recycled to households through compensating tax and benefit reforms (including an increase in the personal allowance for income tax and in the generosity of universal credit). This package leaves 72% of low-income households (those in the bottom three deciles) better off, though amongst low-income losers the average net cost is around £170 per year.

Some studies of similar issues have been conducted in the US. Metcalf (1999) evaluates a number of potential environmental tax reform packages using US income and expenditure data, including a combination of a carbon tax, vehicle fuel taxes, air pollution taxes and a virgin materials tax. He examines the effects across the annual and lifetime income distribution and shows that the distributional effects of this reform can be (in general) offset through a reduction in other taxes, such as payroll taxes and personal income tax. This is easier to achieve when progressivity is judged across the lifetime income distribution. The progressivity of the reform depends on the exact compensation package, with the reforms that most improve economic efficiency often being the most regressive. Rausch, Metcalf and Reilly (2011) examine the impact of imposing a price of \$20/tCO_2e (through either a cap-and-trade system or a tax) and distributing the revenues in three different ways: lower marginal tax rates on income; a lump-sum per-capita cash transfer; and a cash transfer proportional to the capital income of the household. Their results suggest that the redistribution approach chosen determines both the efficiency and the equity of the policy. They also find substantial variation in the net impact of the reform within income groups.

This chapter adds to the existing literature in a number of ways. First, we take account of under-reporting in energy consumption (due to purchase infrequencies for prepay customers) and seasonal variation. This yields more accurate measures of energy expenditure by removing artificial variation in household expenditure patterns.

Second, we model a distinct reform from that previously estimated in the literature. We aim to equalise gas and electricity carbon prices through the introduction of the full rate of VAT and a new gas tax. This approach differs from that of Preston et al. (2013b), who introduce a gas tax that increases the carbon price of domestic gas but does not result in equalised prices.

Third, our compensation package includes the 'automatic' uprating effect that would follow an increase in the price level due to the rise in VAT on domestic energy and the new tax on gas. This allows us to see to what extent the automatic increases in tax thresholds and in the rates of means-tested benefits and tax credits (both at present and in the future) provide compensation for households affected by the reform.

Finally, we analyse whether it is possible to address the worst distributional issues without fully exhausting all revenues raised from the reform. If this can be achieved, other funds could be used for other priorities. For example, additional revenues could be used to cut marginal tax rates elsewhere in order to avoid strong work disincentives that could arise from the reform.

6.2 Methodology

Data

We use pooled data from the 2009 and 2010 Living Costs and Food Surveys.[38] As described in Chapter 2, we exclude Northern Ireland and any households that report a negative component to their energy expenditures. The total sample size is 10,276 households.

Because we are particularly concerned with how the impact of the reforms varies across individual households, we have to be mindful of the issues of seasonality and infrequency of purchase described in Chapter 2, which stem from the methods used to record energy spending in the LCF data. Both issues are likely to lead to some artificial variation in household-level energy spending as observed in the data, compared with the variation we would see were we able to observe each household's expenditure over the entire period.

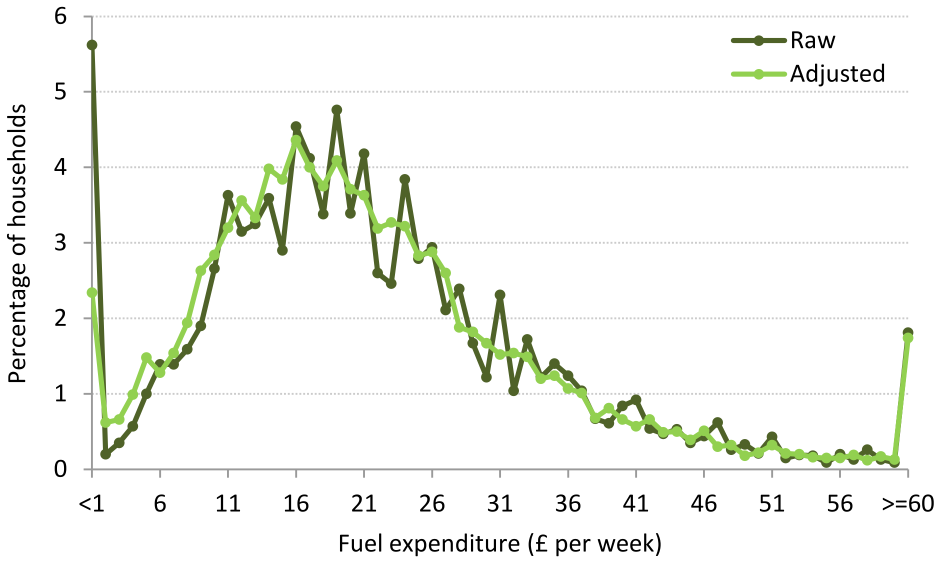
We use statistical methods to adjust the observed expenditure data to try to account for these issues as best we can. Our methods adjust electricity and gas expenditure (and make a corresponding adjustment to total expenditure) using different approaches according to the method of payment. The aim is that the adjusted expenditure should be a good estimate of an individual household's average spending on electricity and gas over the whole period, rather than being

[38] Although data from the 2011 LCF are available (and used in the analyses in Chapters 3 and 5), the 2011 survey is not yet incorporated into the IFS tax–benefit modelling software.

driven by seasonality and infrequency problems. We do not adjust non-metered fuel expenditures.

Appendix A details the procedures and the effect on the data. The adjustment process does little to the mean weekly spend on household fuel (£21.28 in the raw data, £21.26 in the adjusted data) or the median spend (£18.96 and £18.90 respectively), but slightly reduces the standard deviation (from £14.31 to £13.83). Figure 6.1 summarises the raw and adjusted distribution of household-level energy expenditures. The adjusted series is considerably smoother than the raw series and contains far fewer households reporting essentially zero energy expenditure: 5.6% of households in the raw data report less than £1 per week energy spending, compared with 2.3% in the adjusted data.

Figure 6.1. Distribution of household-level energy expenditures, raw and adjusted, 2009 to 2010



Note: Excludes Northern Ireland and households with any negative component of fuel spending. Figures are weighted for survey non-response.
Source: Authors' calculations from 2009 and 2010 Living Costs and Food Survey.

Modelling the price-based energy reforms

As discussed in detail by our companion paper Advani et al. (2013), current policy has resulted in inefficient taxation of energy use. This is evidenced by the large variation in implicit carbon prices that different end-users face when using different fuels. Households currently face implicit carbon prices that are much lower than those faced by businesses. This is largely due to a reduced rate of VAT (5%) on domestic energy use, which acts as an implicit subsidy of 14.3% on domestic energy use. Electricity is also priced at a higher rate than gas, with the implicit VAT subsidy resulting in a negative carbon price for gas. We assess the combined effect of two reforms that would reduce this variation by reducing the difference in the carbon prices faced by households across electricity and gas use. These reforms are:

- an increase in the rate of VAT on domestic fuel (electricity, gas and other fuel) from 5% to 20%;
- a new tax on domestic gas of 0.8p per kWh. Since VAT is applied to the tax-inclusive price, we assume the total cost to households is 0.96p per kWh.

We take as given the implicit carbon price on domestic electricity use that is estimated to result from the existing mix of policies once the VAT subsidy is removed, although we do not use this as a particular guide to what would be an *appropriate* carbon price in practice. However, it is notable that the resultant £58.65/tCO_2e is very similar to the central carbon price of £59/tCO_2e for emissions that are not covered by the EU Emissions Trading Scheme (this includes domestic gas, which is not covered by the EU ETS) estimated by the government to be consistent with meeting domestic emissions reduction targets.[39]

In addition, it is very important to note that there are policies already in the pipeline for implementation, notably changes to the electricity market which will further support deployment of renewable technologies. These will in any case push up the cost of electricity for households to a level not dissimilar to the level that we model here. But, as of now, no cash compensation package is proposed.

The gas tax rate was chosen to mimic the estimate in Advani et al. (2013) for 2013–14 of the difference between the implicit carbon tax on household electricity use and household gas use once the implicit subsidy to households from the reduced VAT rate is ended. Table 6.1 summarises pre- and post-reform energy prices both on a per-kWh and on a carbon-price basis.

Table 6.1. Impact of illustrated reforms on domestic energy prices, 2013–14

	2013–14 unit price (p/kWh, estimate)	Effect of 20% VAT rate (p/kWh)	Effect of gas tax (p/kWh) including VAT	Post-reform unit price (p/kWh)	Change in unit price (%)	Pre-reform carbon price (£/tCO_2e)	Post-reform carbon price (£/tCO_2e)
Electricity	15.60	2.23	0.00	17.83	14.3%	5.92	58.65
Gas	4.83	0.69	0.96	6.47	34.0%	–18.92	56.05

Notes and sources: Pre-reform unit prices are 2012 figures from DECC (2012b for electricity, 2012c for gas) uprated to 2013 values using the year-on-year electricity and gas RPI inflation rates at April 2013. Pre-reform carbon prices are taken from Advani et al. (2013); the post-reform prices are the estimates from Advani et al. (2013) excluding the carbon subsidy from reduced-rate VAT and adding an additional £43.48/tCO_2e to gas from the 0.8p/kWh tax rate based on Defra and DECC (2012) estimates that a MWh of gas generates 0.184tCO_2e. Figures are rounded to two decimal places (one decimal place for the percentage price change).

[39] See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/248604/2013_Appraisal_Guidance_-_Toolkit_Tables_-_FINAL.xlsx, table 3.

To put the price rises resulting from the tax reforms into context, based on RPI inflation measures, electricity prices rose by 15.2% between August 2011 and May 2013 and gas prices rose by 33.3% between November 2010 and May 2013. In other words, rises of this magnitude have been seen in energy prices in recent years (without a compensation package such as the one modelled here).

We assume that the reforms do not lead to any behavioural response by households in terms of energy consumption. We return to discuss this issue in more detail in Section 6.4.[40]

We aim to model the reforms as if they were introduced in 2013–14. We estimate the cost of each reform (in cash terms, and as a proportion of total expenditure or income) for each household in the pooled data set. We adjust total expenditure to April 2013 values using a non-housing RPI calculated from ONS data. Household incomes are taken from the tax and benefit model (described in more detail in the next subsection). Components of income are uprated to current values using appropriate indices (e.g. an average earnings index for earned income).[41]

To model the VAT reform, we uprate household electricity, gas and other fuel expenditures to April 2013 prices using the relevant sub-indices from the RPI.[42] This allows us to estimate the impact of the VAT reform based on 2013–14 energy prices. Nominal energy prices have risen since 2009, which means the value of the VAT subsidy (which is proportional to price) has also risen and we want to capture this effect.

The VAT reform is modelled simply as a price increase for each fuel of 14.29% (1.2 ÷ 1.05). Under the maintained assumption of no behavioural response, the cost of the policy for each household is therefore 14.29% of its inflation-adjusted fuel expenditure.

To model the impact of the gas tax, we need to estimate the number of kWh of gas consumed by each household. We use DECC (2012d) estimates of the average tariffs (fixed and marginal cost) by year, region and payment method and apply these prices to the adjusted gas expenditure figures to back out an estimate of

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[40] Note this is consistent with the assumption made by Preston et al. (2013b) in their recent analysis.

[41] Income and expenditure are measured after housing costs (rent, mortgage interest payments and local taxes). Deciles of income and spending for the distributional analysis are constructed on the basis of real equivalised expenditure, using the after-housing-costs modified OECD equivalence scale.

[42] For electricity and gas, we take the RPI sub-indices directly from ONS data. For other fuel, we calculate an index based on the weighted sub-indices for coal and oil/other fuel. Recall that for electricity and gas, the data have been adjusted to take account of seasonal and other variation as described in Appendix A, and so represent an expected expenditure treating the pooled 2009 and 2010 data sample as taken from a single point in time. We therefore uprate adjusted electricity and gas expenditures by the average monthly uprating factor (the relevant RPI index in each month divided by the RPI index in April 2013) between January 2009 and December 2010. This means electricity spending is uprated by around 19% and gas spending by 28% on average over the period. For other fuels, where no adjustment has been made to the raw data, we use the relevant uprating factor from the month of observation.

household consumption. Where this gives a very low (or even negative) estimate of consumption, we instead use DECC (2012c) estimates of the average per-kWh price by year, region and payment method.[43]

The new gas tax only applies to domestic gas – we do not attempt to model a similar new tax on non-metered fuels to mimic the implicit tax on electricity on a carbon basis.[44] This is because we have no information on the price of non-metered fuels from which we can estimate household-level consumption of these fuels in a similar way. Whilst on average non-metered fuel is a small part of total fuel expenditure, for a small minority of households it is significant, and any policy reform would need to consider the impact on such households carefully.[45] A gas tax that was not accompanied by a similar measure for oil and coal, for example, may give unwelcome incentives for households to switch to these more polluting fuels for heating their home.

Having estimated the cost of each reform, we use weights supplied with the data to approximate the aggregate cost to all households (averaged over each year) and so the total revenue from the reform package. As we discuss in more detail in Section 6.4, the precise revenue that would ultimately be raised by such a reform is in any case somewhat uncertain. As a result, we are cautious in spending the full revenue estimate on a compensation package.

Modelling a compensation package

We use the IFS tax and benefit model (TAXBEN) to devise a compensation package for the price-based energy reforms.[46] We are able to estimate, using TAXBEN, the gains to each household from increases in various means-tested benefits and compare these with the estimated losses from the energy tax reforms. This gives a net impact for each household, allowing us to look at the

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[43] We use a cut-off point of 2,680kWh. We prefer the fixed and variable components where possible since, as an average of observed tariffs, they are likely to better reflect the average prices faced by households in a given year, region and payment method group than an average per-unit price which is estimated based on an assumed level of consumption.

[44] From Advani et al. (2013), the relevant carbon tax would be £56/tCO_2e on coal and LPG once the reduced rate of VAT on domestic energy was abolished. Given estimates from Department for Environment, Food and Rural Affairs & Department of Energy and Climate Change (2012), this equates to a tax of around 13.7p/kg on coal (2.449tCO_2e/tonne) and 16.4p/kg on LPG (2.929tCO_2e/tonne).

[45] Among all households reporting positive fuel spending (9,788), the average share of non-metered fuel was 3.5%. Only 660 households (6.4% of the 10,276 without any negative component of fuel spending) report any spending on non-metered fuel. Amongst those, the average share was 54.2%.

[46] Details of how TAXBEN operates can be found in Giles and McCrae (1995); although this is now an outdated summary, the broad methodology is very similar. Essentially, tax liabilities and benefit entitlements are calculated for the 2009 and 2010 LCF samples (with financial variables uprated to 2013–14 values) based on observed pre-tax income, expenditure behaviour and self-reported entitlement to disability benefits. Tax liabilities and benefit entitlements can also be calculated under hypothetical alternative tax and benefit systems and the gain or loss from the reforms can be estimated for each household in the data; the overall cost of the tax and benefit changes can be calculated using the weights provided with the survey data.

overall distributional impact of the energy tax and compensation package reforms taken together.

As with the analysis of the energy reforms, we assume no behaviour change (in terms of earnings or employment status, for example) by households following the compensation package. It should also be borne in mind that TAXBEN calculates each household's *eligibility* for means-tested benefits and assumes they are fully taken up. To the extent that some people do not take up the benefits to which they are entitled, more people may lose out from the overall package of reforms including compensation than is captured by the modelling. DWP (2012c) estimates that take-up for means-tested benefits by caseload (i.e. the proportion of eligible people who actually claim) in 2009–10 ranged from around 62–68% for pension credit to 77–89% for income support and income-related employment and support allowance. Take-up rates are higher, though, amongst those eligible for larger amounts (likely to be lower-income people), as take-up increases with total eligible expenditure on each benefit.

Details of the specific compensation packages considered are given in Section 6.3.

6.3 Compensating poorer households through the benefits system

We now discuss the combined effect of the reforms to energy prices and a package of compensatory measures that redistributes some of the revenue to poorer households through increases in various means-tested benefits.

It should be borne in mind that our intention is not to suggest a precise package of compensation measures that ought to be optimally implemented. Our aim is more to illustrate the scope to ameliorate the adverse distributional implications of a more rational approach to carbon pricing for households through changes to the benefits system. We discuss other issues that will be important for policymakers throughout the analysis, and of course different governments may have different priorities for the optimal use of the revenue from such energy reforms.

The impact of the combined reforms can be summarised in a number of ways. A natural approach is to ask whether households are compensated for the cost-of-living increase they face as a result of the energy reforms (Mirrlees et al., 2011, ch. 9). If prices rise by 1%, then real purchasing power is maintained if a household's income rises by 1%. We therefore compare the increase in the cost of living (measured as the impact of the energy reforms relative to total spending) against the proportional income gain from the tax and benefit reforms. We look at how this effect varies across the expenditure and income distributions: as we argued in Chapter 1, both can be used as measures of household well-being.

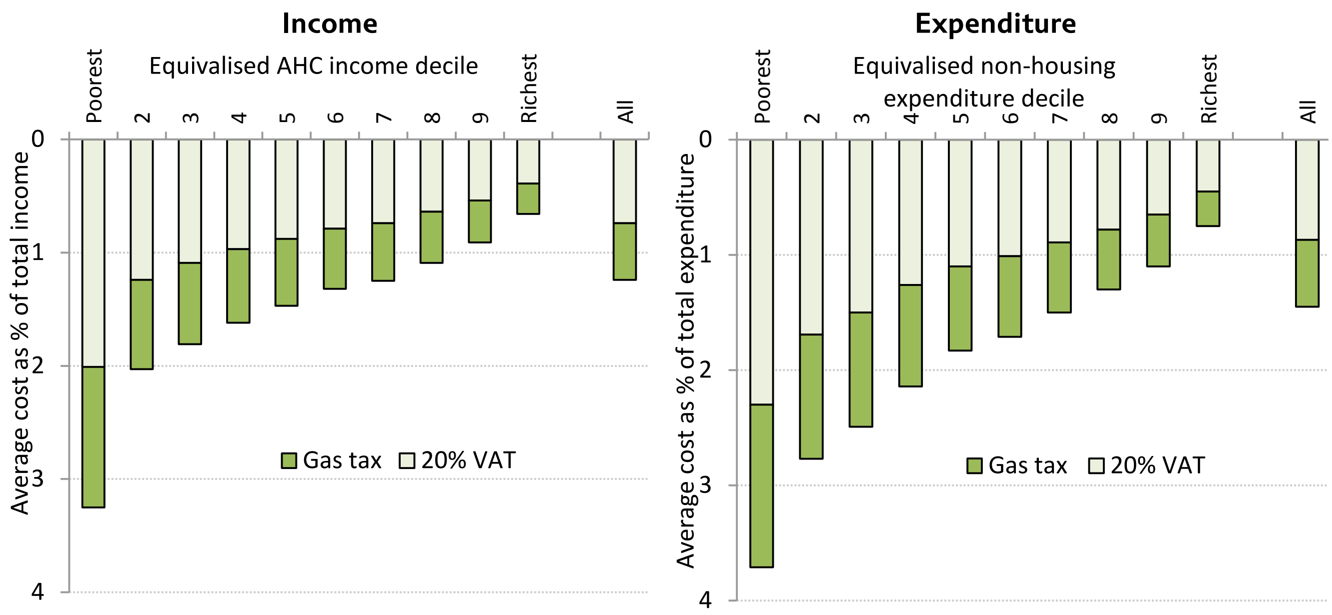
We also look at the effect of the reforms in cash terms: how much more or less net per week do households have following the increase in energy costs and the extra income from the compensatory reforms? This can be expressed as cash values or relative to overall well-being as measured by income or expenditure.

Finally, we look at the extent to which the impact varies even for households with relatively similar living standards by illustrating the 'winners' and 'losers' from the combined reforms within income or spending deciles. We categorise households that have a net gain of at least £1 per week as 'winners' and those that lose more than £1 per week as 'losers'; other households are deemed to be broadly unaffected. As we saw in Chapter 3, there is considerable variation in the importance of energy spending within deciles, suggesting that some households will be more strongly affected by the energy price reforms, and so much harder to compensate through tax and benefit changes, than will others.

Distributional effect of the reform without any compensation package

Figure 6.2 shows the average net impact (relative to total income or spending) of the energy price reform *before any compensation package is applied*. The left-hand panel shows the average net cost in cash terms as a proportion of income across the income distribution. The right-hand panel shows the same results as a proportion of spending across the spending distribution.

Figure 6.2. Average cost (relative to total income/spending) of reforms without any compensation package, by decile



Note: Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Figures are weighted for survey non-response. Excludes Northern Ireland.
Source: Authors' calculations from TAXBEN using 2009 and 2010 Living Costs and Food Survey.

The reforms are highly regressive when applied without compensation, in particular when households are ranked on an expenditure basis. Households in the poorest spending decile lose 3.7% of total expenditure due to the reform.

Households in the richest expenditure decile lose 0.8% of total expenditure. On average, households lose 1.9% of total expenditure as a result of the reform. A similar pattern is observed when households are ranked on an income basis. Losses are noticeably higher in the poorest income decile than elsewhere in the distribution, with the poorest households losing 3.2% of total income, compared with an average loss of 1.5% of income.

Automatic compensation through higher prices

We now begin to introduce ways in which households could be (at least partly) compensated for the effects of the energy price reform.

We first consider the automatic effect that would come through an increase in the price level following the rise in VAT on domestic energy and the new tax on gas. Many benefit rates are typically adjusted as prices increase. Higher prices feed into a one-off rise in inflation, which should see tax thresholds and rates of various means-tested benefits and tax credits increase more quickly than they otherwise would. Whilst the increase in inflation is temporary, the increase in the price level is permanent, meaning this is a permanent cost (rates and thresholds are higher in all future years as well).

Using the weights for household energy from the 2013 consumer price index (CPI), we estimate that the reforms could lead to a one-off increase in inflation of 1.2 percentage points. We therefore include in all our compensation packages a 1.2% rise in tax thresholds, tax credits, excise duty rates and means-tested benefit rates. This is estimated to cost £2.6 billion.[47] In effect, this is just what happens when prices rise for other reasons.

However, this automatic compensation does little to compensate households for the costs of the increased energy prices. An important reason for this is that the measures of inflation used to uprate benefits and tax thresholds are plutocratic averages – that is, they are estimates of economy-wide inflation, which is driven more by the spending patterns of the rich (high spenders) than by those of the poor. This means it is possible that a majority of households will experience an inflation rate greater than the economy-wide inflation measure (see Levell and Oldfield (2011) for a discussion). In our case, households that spend a greater-than-average proportion of their budgets on energy will experience an inflation rate greater than the 1.2% increase in benefits and tax thresholds, and so will not be fully compensated for the changes. This group will disproportionately include poorer households as these households tend to spend more on energy (see Chapter 3).

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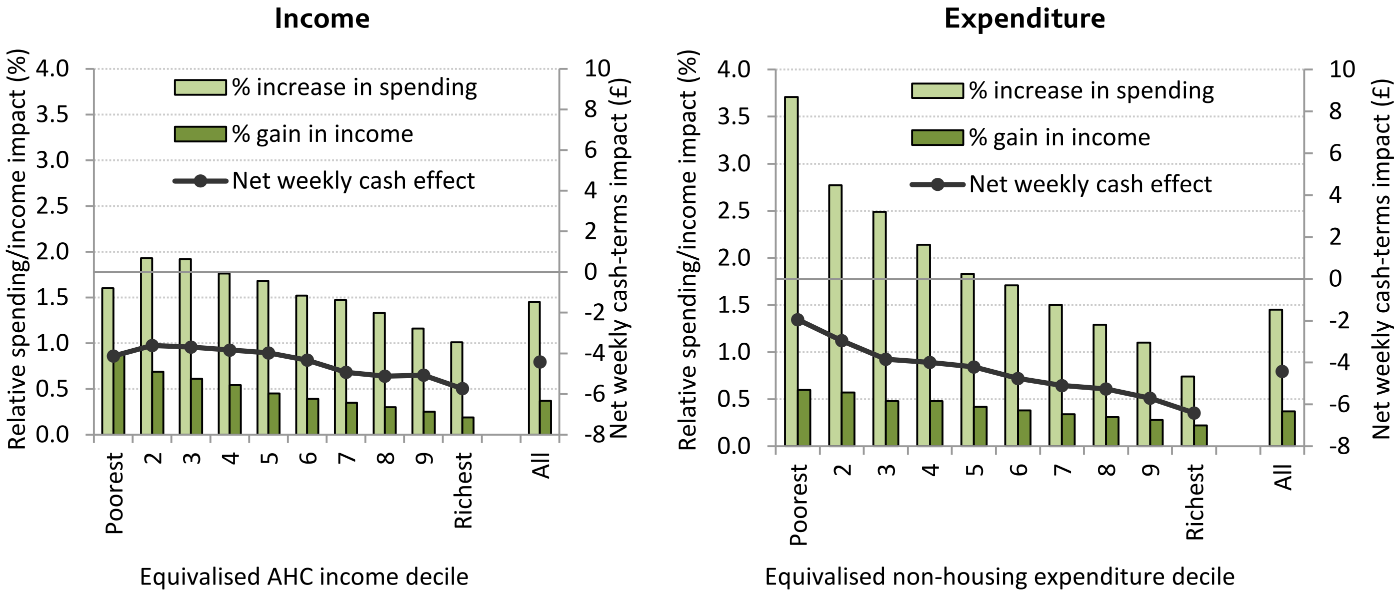
[47] Note this includes an increase in the basic state pension – which is subject to a 'triple lock' (rising by the fastest of prices, earnings and 2.5%) – since at the moment price inflation is greater than earnings growth. Of course, that may not always hold; if the inflation rate were 1.2 percentage points lower than earnings growth, then the reform would not lead to a default rise in pensions. This would save around £420 million of the projected cost.

Figure 6.3 shows the average (mean) effect within decile of the energy price reforms on the cost of living (shown as the pale bar and read against the left-hand axis), the average income gain *once the automatic compensation is included* (dark bar, left-hand axis), and the net cash gain or loss per week (black line, right-hand axis). The left panel shows the effect measured across income deciles, the right panel across expenditure deciles.

Figure 6.3. Average impact of energy reforms with automatic compensation, by decile



Note: Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Figures are weighted for survey non-response. Excludes Northern Ireland.
Source: Authors' calculations from TAXBEN using 2009 and 2010 Living Costs and Food Survey.

Households are on average £4.42 per week worse off once the automatic compensation is taken into account. The relative income gains from the automatic compensation are slightly larger for those at the bottom of the income or expenditure distributions, but still nowhere near sufficient to compensate for the cost-of-living increases faced by these groups, which are also much higher than average since they come through increases in the price of energy which is a more important part of the budget of poorer households (see Chapter 3).

Compensation for the cost-of-living increases of low-income households

We next consider additional support targeted at poorer (low-income) households. This support is, on average, just enough to compensate households in the bottom three income deciles for the cost-of-living increases they face from the energy reforms. In particular, we model targeted support on poorer pensioner and non-pensioner households as well as those out of work (see Table 6.2). Together with the automatic compensation already discussed (which cost

£2.6 billion), the combined cost of this compensation package is therefore £4.8 billion per year.

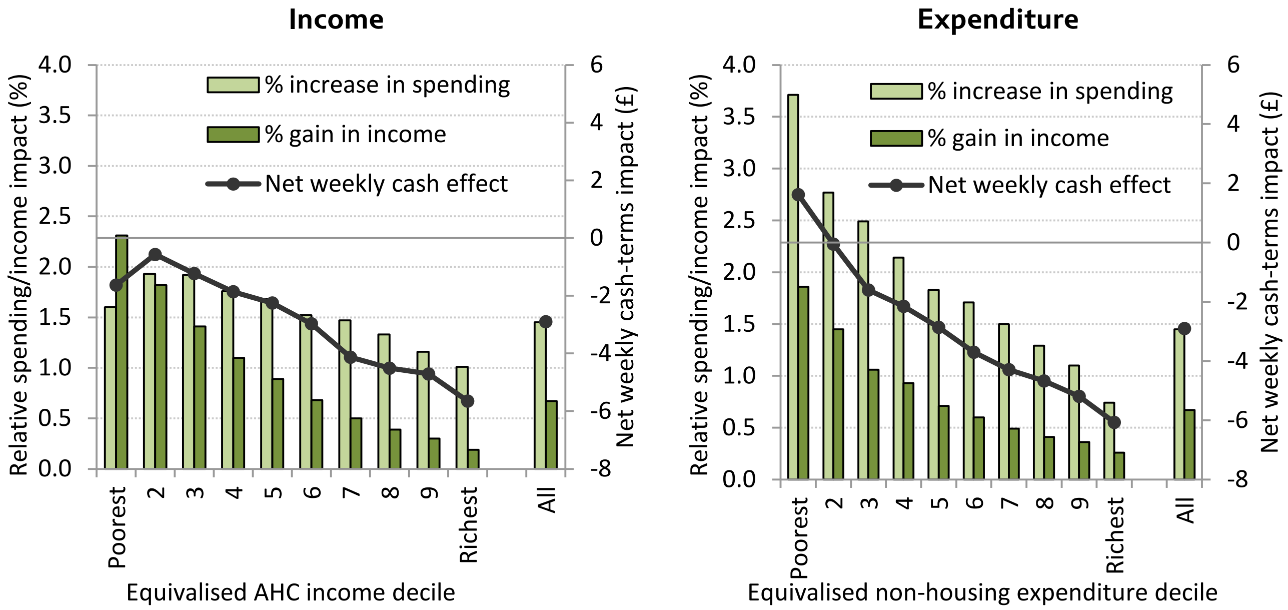
Figure 6.4 shows the average net effect of the compensation package. The left panel shows the effect measured across income deciles, the right panel across expenditure deciles.

Table 6.2. Cost-of-living compensation measures modelled

Measure	Annual cost
Increase pension credit by £7/week Increase income-based jobseeker's allowance and income support by £3.50/week Increase the benefits cap by £3.50/week	£2.2 billion

Note: Costs are averages of the annual costs for the 2009 and 2010 samples. All increases modelled are also reflected in increases in the relevant housing benefit parameters.

Figure 6.4. Average impact of targeted compensation package, by decile



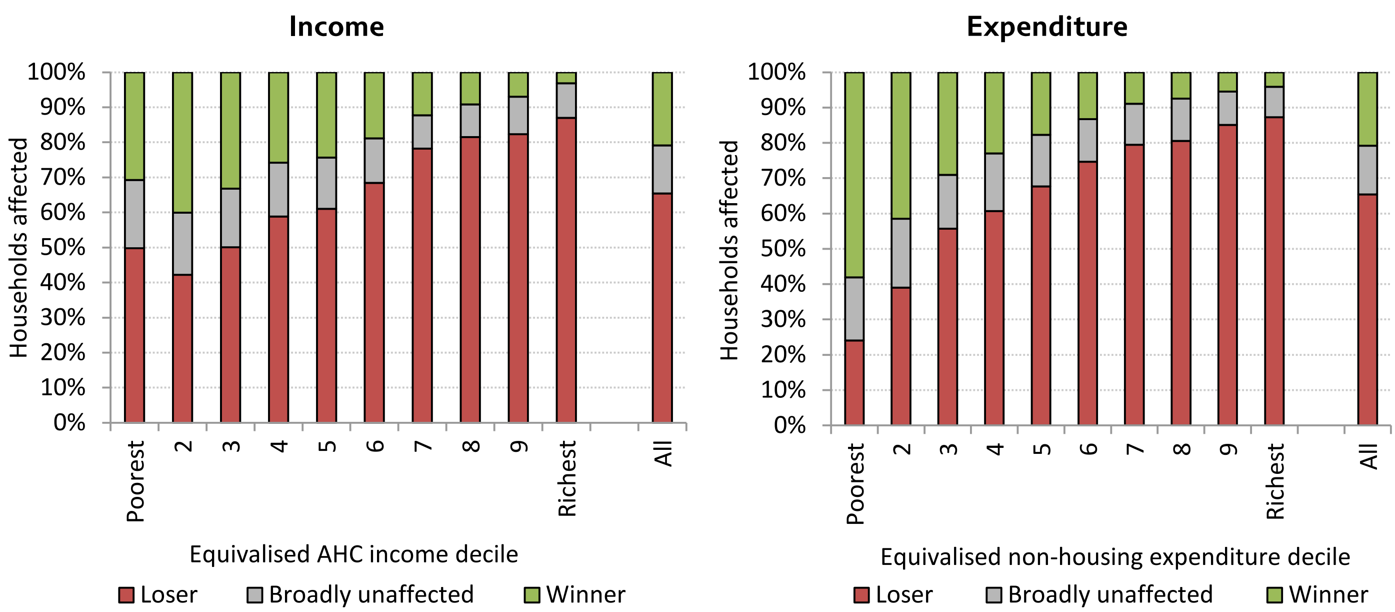
Note: Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Figures are weighted for survey non-response. Excludes Northern Ireland.
Source: Authors' calculations from TAXBEN using 2009 and 2010 Living Costs and Food Survey.

The left panel of Figure 6.4 shows that households in the bottom three income deciles are, on average, compensated for the energy price increases. The cost of living for this group rises by 1.8% on average whilst their incomes also rise by 1.8%. It is striking that the cost-of-living increase is actually *smaller* for the poorest income decile than for the second-poorest (1.6% versus 1.9%), suggesting that some very-low-income households have expenditure patterns (in terms of energy) more akin to households higher up the distribution. Indeed, the cost-of-living rise in the bottom income decile is lower on average than for any decile before the sixth. Nevertheless, although this decile has on average a slightly smaller cost-of-living increase from the energy reforms and a larger average income gain from the targeted benefit increases, on a cash basis households in the poorest income decile lose £1.63 per week on average. This group has much lower income than expenditure, such that the larger proportional income increase is still just not quite enough to offset the higher spending in cash terms. The second income decile experiences a smaller net cash loss of 57p a week from the combined reform.

When we rank households by spending (right-hand panel of Figure 6.4), the poorest spending decile sees a much larger rise in the cost of living than any other decile. No decile is fully compensated on average for the cost-of-living increase following the energy price rises. However, because households in the bottom expenditure decile typically have higher income than spending, the bigger relative income gains at the bottom of the spending distribution are more than enough to offset in cash terms the losses from the higher energy prices. Households in the poorest spending decile gain £1.62 per week net on average from the combined reform; those in the second decile lose 5p a week.

Whilst this package does a reasonable job on average of compensating poorer households, there remain a relatively large number of losers (particularly looking at poorer income groups). Figure 6.5 shows the proportion of winners and losers within each income and expenditure decile. Overall, just under two-thirds of households lose from the reform (lose at least £1 per week) and 21% of households gain (at least £1 per week). Around 14% are essentially unaffected by the combined package of energy price rises and compensatory benefit increases.

Figure 6.5. Proportion of 'winners' and 'losers' from targeted compensation package, by decile



Note: Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Figures are weighted for survey non-response. 'Winners' are those who gain at least £1 per week from the overall reform package. 'Losers' are those who lose at least £1 per week. Excludes Northern Ireland.
Source: Authors' calculations from TAXBEN using 2009 and 2010 Living Costs and Food Survey.

On an income basis, around half of households in the poorest decile lose, compared with around 31% that gain. In the second decile, 42% of households are net losers and 40% are net winners. That there are fewer losers and more winners in the second-poorest income decile than in the poorest again suggests that very low income does not necessarily reflect very low living standards. From the second decile, the proportion of winners falls steadily and the proportion of losers rises. In the third-poorest decile, half of households are net losers; in the top decile, 87% of households are net losers and only 3% are net gainers.

On an expenditure basis, there are fewer net losers in the bottom decile: 24% of households lose and 58% gain. The proportion of losers rises steadily with total spending: 39% of households in the second-poorest decile are net losers and more than half (56%) lose in the third decile.

Additional compensation for poorer households

The combined package considered so far still costs around £3.5 billion per year less than the total static revenue estimate from the reforms. If policymakers remained concerned about the relatively high number of net losers in poorer income and spending deciles, they could consider a more generous compensation package that aims to reduce the number of these losers. Table 6.3 shows additional benefit increases targeted at poorer working people without children, families with children and those with longer-term sickness and disabilities, added on top of the automatic compensation discussed earlier (which cost £2.6 billion). These extra increases cost a further £4.6 billion per year (compared with the automatic compensation package), bringing the combined compensation package to a total cost of around £7.2 billion per year.[48]

Table 6.3. Additional compensation measures modelled

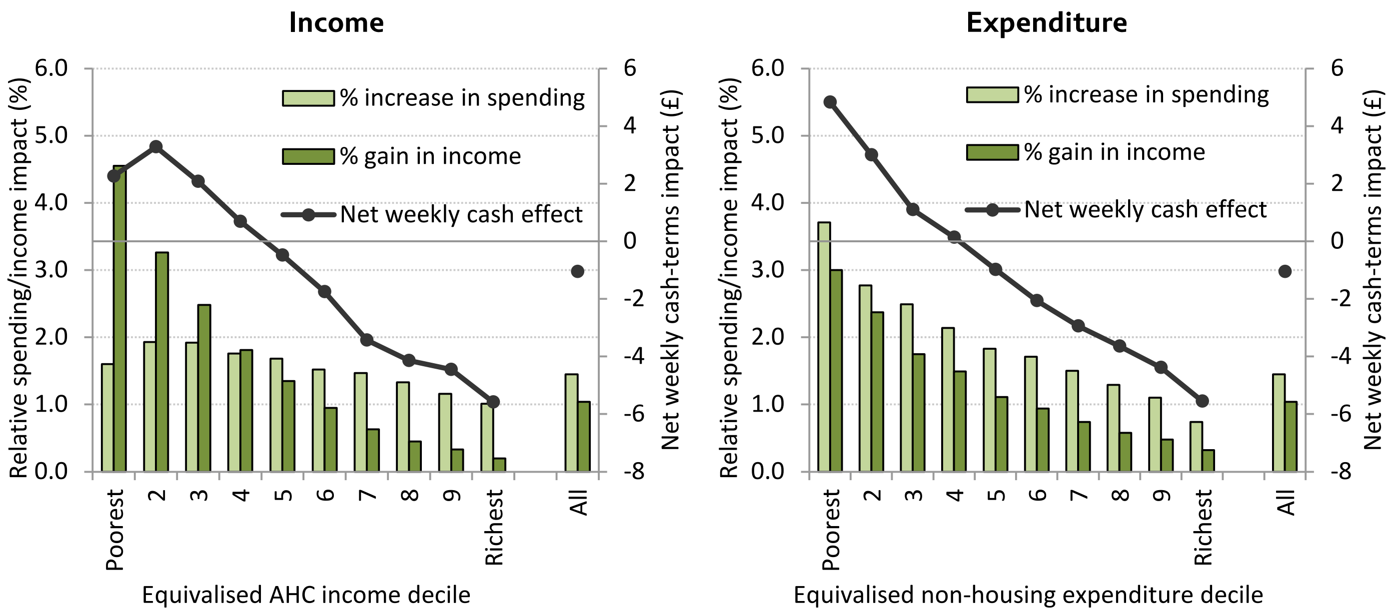
Measure	Annual cost
Increase pension credit by £8 a week Increase income-based jobseeker's allowance and income support by £4/week Increase the benefits cap by £4/week Increase family element of child tax credit by £8/week Increase working tax credit for single adults without children by £8/week Increase working tax credit for couples without children by £4/week Increase long-term incapacity benefit by £4/week	£4.6 billion

Note: Costs are averages of the annual costs for the 2009 and 2010 samples. All increases modelled are also reflected in increases in the relevant housing benefit parameters.

[48] Note that we consider broad increases in a range of means-tested benefits that exist in the 2013–14 system as a way to try to compensate poorer households more generally rather than increasing a single specific benefit. Over the next few years, the system will be simplified by the roll-out of universal credit, which will reduce the number of parameters of the system that need to be changed to try to compensate poorer households. We discuss this further in Section 6.4.

Figure 6.6 shows the average net effect of the combined package. Those in the poorest four income and expenditure deciles are on average net gainers. Again, it is striking that the second income decile performs slightly better than the very poorest decile; other than that, the cash-terms effects are quite similar across the income and expenditure distributions. Those in the second income decile, for example, gain £3.28 per week on average and those in the second spending decile £3.00. Those in the top income or spending decile lose just over £5.50 per week on average. Note that on an expenditure basis, the full compensation package now compensates households in the bottom half of the distribution almost entirely for the average cost-of-living increases they face. When we rank households by income, households in the bottom two deciles receive significantly more from the compensation package than they lose in the reforms. Those in the third to fifth deciles are roughly fully compensated, while those in the top half of the distribution are less than fully compensated.

Figure 6.6. Average impact of compensation package including additional measures, by decile



Note: Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Figures are weighted for survey non-response. Excludes Northern Ireland.
Source: Authors' calculations from TAXBEN using 2009 and 2010 Living Costs and Food Survey.

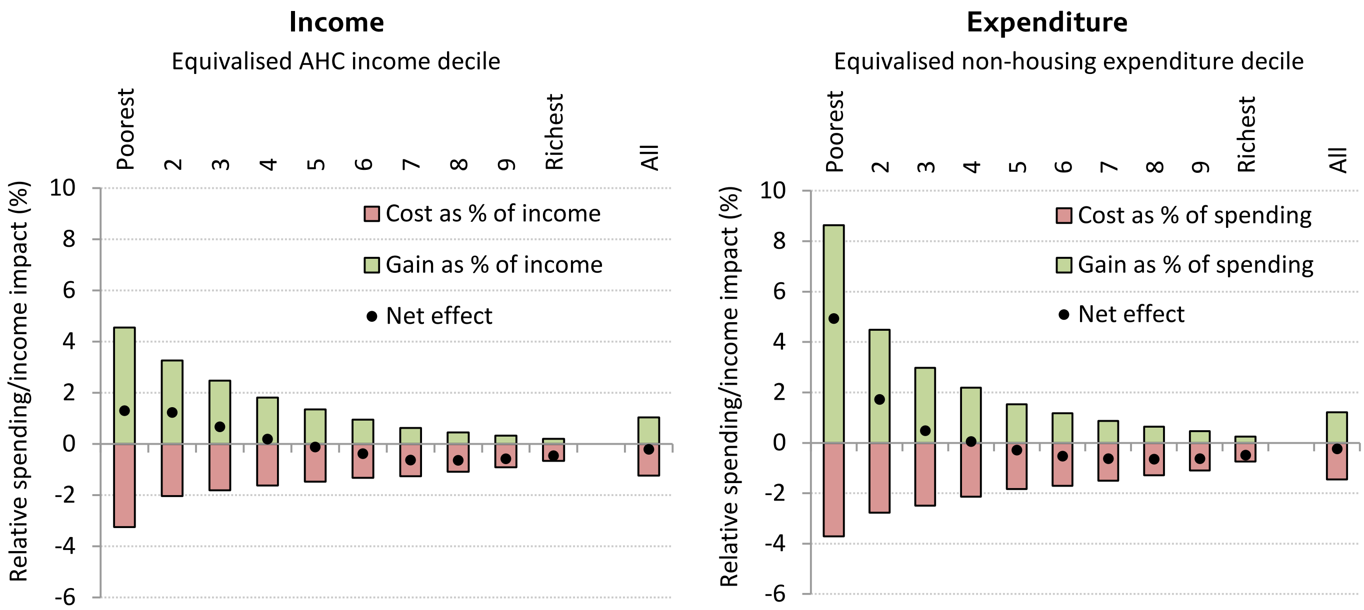
Figure 6.7 shows the average net impact (relative to total income or spending) of the combined package. The left-hand panel shows the average gain, loss and net effect in cash terms as a proportion of income across the income distribution. The right-hand panel shows the same results as a proportion of spending across the spending distribution.

The net effect of the full compensation package is progressive, in particular when households are ranked on an expenditure basis. The average gain is 8.6% of spending for the poorest expenditure decile, set against a cost of 3.7%, leaving a net gain worth 4.9% of total spending. Those in the second spending decile gain

1.7% of spending on average. In the top half of the distribution, the effect is relatively neutral, with average losses varying between 0.5% and 0.7% of spending for the sixth to tenth expenditure deciles.

On an income basis, although the combined reform is progressive, the average gains relative to income are smaller at the bottom of the distribution. Those in the poorest income decile have a net gain worth 1.3% of income on average (gaining 4.6% from the compensation package and losing 3.3% from the energy reforms). Those in the second decile gain 1.2% of income on average. Losses vary from 0.5% to 0.6% of income for those in the seventh to tenth income deciles.[49]

Figure 6.7. Average net impact (relative to total income/spending) of package including additional measures



Note: Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Figures are weighted for survey non-response. Excludes Northern Ireland.
Source: Authors' calculations from TAXBEN using 2009 and 2010 Living Costs and Food Survey.

To what extent does the additional compensation reduce the number of net losers in poorer income and spending groups? Figure 6.8 shows the within-decile impact, as before classifying winners and losers on the basis of whether net gains or losses exceed £1 per week.

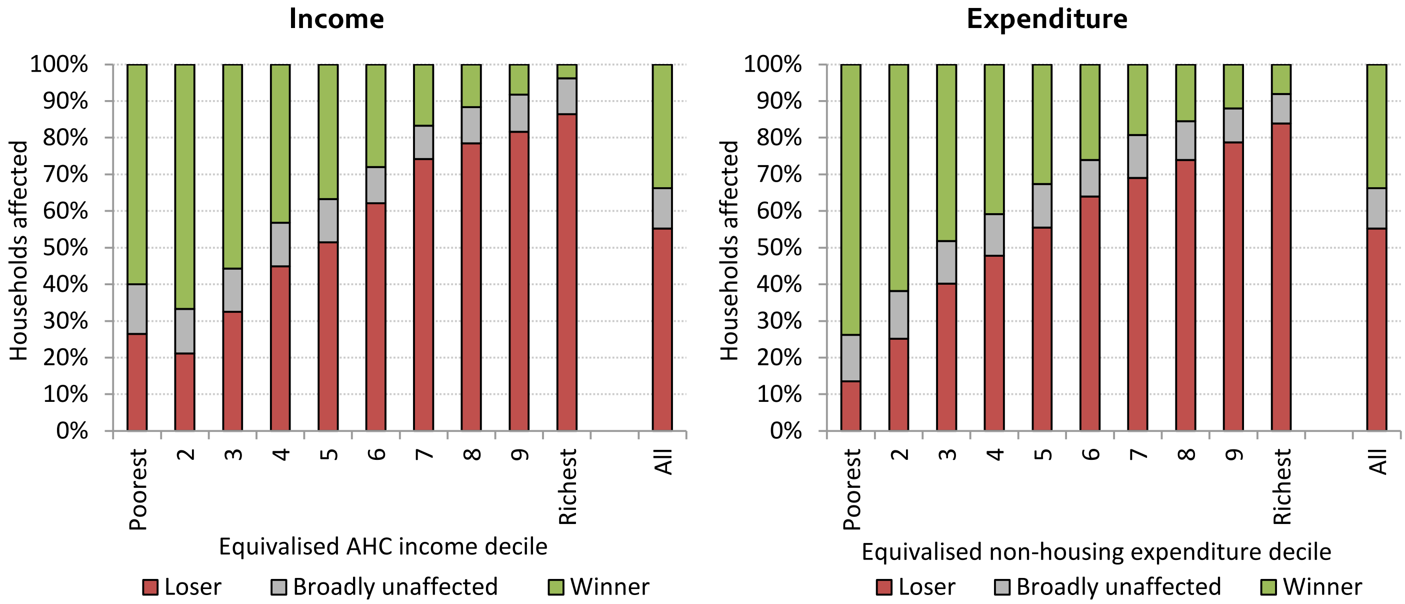
Compared with Figure 6.5, the proportion of losers in the poorest income decile falls by almost half, from 50% to 26%, whilst the proportion of winners rises from 31% to 60%. In the second income decile, 21% of households are now net

[49] Note that Figure 6.6 shows the average net cash-terms impact across all households to be negative – this of course must be the case since the value of the compensation package is less than the revenue estimate from the energy reforms. As a proportion of income or spending, though, Figure 6.7 suggests the average effect across all households is positive, suggesting that very large proportional gains for poorer households are more than offsetting the larger number of smaller losses.

losers compared with 42% without the additional compensation. Compared with the package without the additional measures, the proportion of net losers falls by at least 10 percentage points in each of the bottom five income deciles.

On a spending basis, there were relatively fewer losers in the bottom decile before the additional compensation, but the proportion of losers is still substantially reduced (from 24% to 14%). Around three-quarters of households in the bottom spending decile are net gainers (compared with 58% without the additional measures). In the second decile, 25% of households are net losers following the extra compensation, compared with 39% without it. The proportion of net losers falls by 10 percentage points or more in each of the second to seventh spending deciles.

Figure 6.8. Proportion of 'winners' and 'losers' from package including additional measures, by decile



Note: Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Figures are weighted for survey non-response. 'Winners' are those who gain at least £1 per week from the overall reform package. 'Losers' are those who lose at least £1 per week. Excludes Northern Ireland.
Source: Authors' calculations from TAXBEN using 2009 and 2010 Living Costs and Food Survey.

Even with the additional measures, while there are fewer poor losers in the very bottom spending decile than the bottom income decile, the fraction of losers is larger in the 'lower-middle' of the spending distribution than in that part of the income distribution. For example, the fractions of losers in the second to fourth spending deciles are 25%, 40% and 48%, compared with 21%, 33% and 45% on an income basis. In addition, there are more net winners in high-spending deciles than in high-income deciles: 12% of the ninth spending decile and 8% of the top one gain, compared with 8% and 4% respectively on an income basis.

One reason for this is that our compensation package operates mainly through means-tested benefits. There is a stronger gradient between income and eligibility for such benefits than between spending and eligibility. Table 6.4 shows, by income and spending decile, the proportion of households estimated to be eligible for one or more of the means-tested benefits that form the basis of the compensation package. The difference is particularly striking in the second decile, where 86% are eligible by income but only 73% by spending. There are also large differences at the top: 13% of the top spending decile are eligible for means-tested benefits compared with just 3% of households in the top income decile.[50]

Table 6.4. Proportion of households eligible for means-tested benefits, by income and non-housing spending decile

Decile	Income basis	Spending basis	Difference (ppts, spending – income)
Poorest	87.0%	84.3%	–2.7
2	85.5%	72.5%	–13.0
3	68.8%	59.8%	–9.1
4	54.7%	51.3%	–3.5
5	43.7%	42.2%	–1.6
6	32.5%	35.2%	+2.7
7	21.0%	30.2%	+9.2
8	15.5%	22.9%	+7.4
9	9.4%	19.1%	+9.8
Richest	3.4%	13.2%	+9.8

Note: Deciles are equivalised using the after-housing-costs (AHC) modified OECD scale. Figures are weighted for survey non-response. Eligibility is on the basis of benefit rates *after* the full compensation package.
Source: Authors' calculations from TAXBEN using 2009 and 2010 Living Costs and Food Survey.

An explanation for why there is a larger proportion of 'poor' losers in the lower-middle (though not the very bottom) of the expenditure distribution can be found by looking at the type of households affected. Across the entire sample, around 26% of households are pensioner households (15.2% single pensioners and 10.3% pensioner couples). Amongst all households that are net losers, 23% are pensioners, meaning that pensioners are slightly less likely to be losers than other household types.

However, amongst households in the bottom three spending deciles, 34% of the net losers are pensioner households. Thus pensioners are over-represented amongst the low-spending losers. These pensioners are not entitled to any means-tested benefits (including pension credit), suggesting they have relatively high incomes (or high savings). Amongst this group of older households that are

[50] As noted by Preston et al. (2013b), low-income households that are *not* eligible for any means-tested benefits are likely to be those with relatively large liquid assets, which prevent them being entitled to means-tested support, or perhaps student households (those in halls of residence are not surveyed in the LCF but those in private student accommodation are). Neither of these groups may be those we traditionally consider 'poor'.

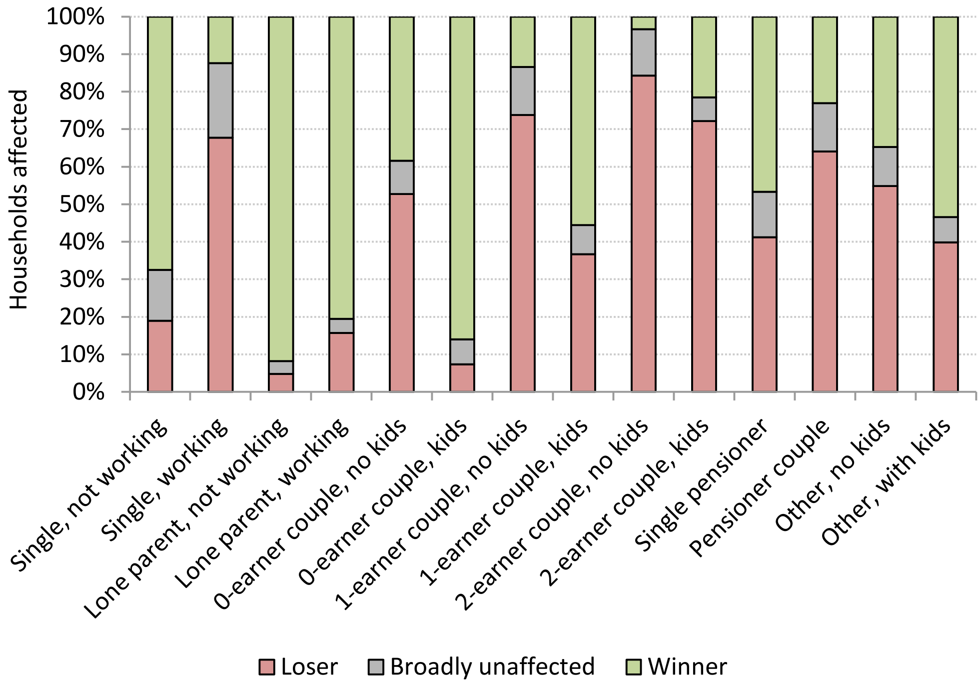
net losers with low spending, 31% are in the poorest three income deciles and 35% are in the top half of the income distribution.

It is not altogether clear why there are a large number of relatively low-spending but high-income pensioners. Finch and Kemp (2006) do not find any particularly compelling consistent evidence to explain why some pensioners spend low proportions of their income, although they suggest a lack of mobility and social engagement could be one explanatory factor. Another possibility is that some pensioners are pushed further up the income distribution because their incomes are modelled by TAXBEN on the basis of full take-up of benefits, but non-take-up is a particular problem for pension credit (see Section 6.2).

If the government were keen to compensate more of the low-spending losers, then it might require increases in the basic state pension. Reducing the generosity of the means-tested compensation to pay for this would probably create additional losers amongst low-spending non-pensioners, however, and would increase the proportion of winners further up the distribution. These sorts of trade-offs are, of course, inevitable in thinking about a package of measures to compensate households.

Figure 6.9 divides the sample into 13 demographic types and shows the proportion of winners and losers in each from the combined package. A majority of lone parents, workless singles, workless or single-earner couples with children, and 'other' households (those with multiple benefit units living

Figure 6.9. Proportion of winners and losers from the reform package, by household type



Note: Figures are weighted for survey non-response. Excludes Northern Ireland .
Source: Authors' calculations from TAXBEN using 2009 and 2010 Living Costs and Food Survey.

together) with children gain from the reform. A majority of single working households, single-earner couples without children, two-earner couples, pensioner couples and 'other' households without children lose. Single pensioners divide approximately evenly between winners and losers, as do workless couples without children.

6.4 Discussion

There are a number of issues with and limitations of this analysis that would be important considerations for policymakers contemplating reforms of the kind suggested here. Some have been mentioned already, such as the fact that we are unable to model an equivalent to the gas tax for non-metered fuels.

Here we focus on three issues – the labour supply impact, the possible consumer response to the energy tax reforms, and the timing of reforms. We then consider other possible uses for revenues raised by the energy reforms and briefly discuss the potential for other reforms.

Labour supply

Increases in energy prices and compensatory increases in means-tested benefits are both likely to have adverse consequences for labour supply decisions:

- Higher prices weaken work incentives by reducing the real purchasing power of income. As suggested earlier, the energy price reforms could add around 2 percentage points to the average cost of living, with a larger effect for poorer households, where energy is a more important part of expenditure.
- Increases in means-tested benefits also reduce the incentive to earn additional labour income by raising out-of-work incomes and increasing the point at which additional labour income would begin to be partly offset by benefits being withdrawn.

Our illustrative compensation package was designed to show that, in principle, the distributional effects of energy-related tax reforms can be largely offset through other changes within the tax and benefit system. However, if concerns about labour supply effects are very strong, then other reforms may be considered (such as reductions in marginal tax rates) in addition to, or instead of, the package of benefit increases.

Consumer response and the implications for revenues and emissions

So far, we have maintained the assumption that the reforms do not lead to any behavioural response by households in terms of energy demand. This seems unlikely given the large price increases modelled. In the short term, households could respond by reducing the amount of heating, lighting, cooking or powering of appliances they do. In the longer term, they could improve insulation or the efficiency of purchased appliances, or make other lifestyle changes that reduce energy demand.[51] Here we assess what impact allowing for these kinds of responses could have on the revenue raised and on the carbon emissions resulting from household energy use.

We take data on aggregate domestic electricity and gas consumption between 2009 and 2011 from DECC (2012e), averaging over the three years to give an estimate of baseline energy demand.[52] This gives around 116.3 million MWh of electricity use and 338.4 million MWh of gas use. We then take the per-unit price estimates from Table 6.1, which suggested the policy would raise electricity prices by 14.3% and gas prices by 34.0%. Given these price increases, we estimate the effect on aggregate energy demand under different assumptions about the price elasticity and we calculate the total revenue accruing from the reforms allowing for different degrees of behavioural response. We also estimate the impact on emissions from the demand reduction, using the DECC (2012e) estimate that a marginal reduction in electricity use (which we take to come from gas-fired electricity) leads to an emissions reduction of 0.392tCO_2e/MWh and the Defra and DECC (2012) estimate that domestic gas contains 0.185tCO_2e/MWh.[53] The reduced emissions are valued at 2013 estimates of the value of a tonne of CO_2 saved in the traded sector (electricity, £6/tonne) and the non-traded sector (gas, £59/tonne) as used for policy appraisal (HM Treasury and DECC, 2013).

Table 6.5 summarises the main results for different price elasticities. We assume that the same elasticity applies to electricity and gas and that there is no cross-price substitution between the two fuels.

The first row shows the results from this exercise based on aggregate energy consumption data when, as in the analysis based on the household micro-data above, we assume no behavioural response. The revenue effect is extremely similar, £8.2 billion compared to the £8.3 billion we estimate from the data.[54]

As the elasticity increases, the demand response to the price rise also increases and so the revenue falls. For an elasticity of –0.3, similar to the meta-analysis estimate of the short-run elasticity of demand for residential electricity in Espey

[51] There may also be reasons to believe that withdrawing winter fuel payments from some pensioner households would directly reduce their energy demand, based on the findings from Beatty et al. (2011) that these labelled benefits are spent disproportionately on energy. This could reduce the revenues from a gas tax or the full rate of VAT on domestic energy, though recycling the revenue in the form of a similarly-labelled benefit targeted on poorer people may offset this.

[52] We do not have similar figures for total non-metered fuels but, as discussed earlier, they account for a small part of aggregate household energy use.

[53] For large behavioural responses, it may be more relevant to take the average carbon content of domestic electricity if sufficiently large demand reductions lead to a general reduction in the need for generation capacity. This is estimated at 0.520tCO_2e/MWh (Department for Environment, Food and Rural Affairs & Department of Energy and Climate Change, 2012), higher than the marginal carbon content since it includes coal-fired generation.

[54] The results differ at all because the estimated energy use from aggregate statistics and from the survey data will be slightly different as a result of sampling and various exclusions from the data. However, the fact they line up so closely gives further reassurance as to the credibility of our data-driven estimates.

Table 6.5. Revenue, consumption and emissions impacts of different own-price elasticity assumptions

Elasticity	Revenue (£ billion)	Relative to elasticity=0 (£ billion)	Change in consumption (million MWh)		Change in CO_2 emissions (million tonnes)			As % of 2011 domestic emissions	Value of emissions reduction (£ billion)
			Electricity	Gas	Electricity	Gas	Total		
0	8.17	–	0.00	0.00	0.00	0.00	0.00	0.0%	0
–0.1	7.94	–0.23	–1.66	–11.57	–0.65	–2.14	–2.79	–2.2%	0.13
–0.2	7.72	–0.46	–3.32	–23.13	–1.30	–4.28	–5.58	–4.5%	0.26
–0.3	7.49	–0.68	–4.98	–34.70	–1.95	–6.41	–8.37	–6.7%	0.39
–0.4	7.26	–0.91	–6.65	–46.27	–2.61	–8.55	–11.16	–9.0%	0.52
–0.5	7.03	–1.14	–8.31	–57.83	–3.26	–10.69	–13.95	–11.2%	0.65
–0.6	6.81	–1.37	–9.97	–69.40	–3.91	–12.83	–16.74	–13.5%	0.78
–0.7	6.58	–1.59	–11.63	–80.96	–4.56	–14.96	–19.52	–15.7%	0.91
–0.8	6.35	–1.82	–13.29	–92.53	–5.21	–17.10	–22.31	–18.0%	1.04
–0.9	6.12	–2.05	–14.95	–104.10	–5.86	–19.24	–25.10	–20.2%	1.17
–1.0	5.89	–2.28	–16.62	–115.66	–6.51	–21.38	–27.89	–22.5%	1.30

Source: Authors' calculations and sources as described in the text. Baseline domestic emissions used to calculate the penultimate column from DECC emissions statistics for 2011 by end user, available from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/193414/280313_ghg_national_statistics_release_2012_provisional.pdf.

and Espey (2004), revenue is £7.5 billion. At this level, electricity demand would fall by around 4% and gas demand by around 10%, leading to an estimated reduction in CO_2 emissions from domestic energy use of 8.4 million tonnes, just under 7% of the total emissions attributed to domestic consumers in 2011. In the long run, Espey and Espey estimate that the elasticity is around –0.8, which would lead to revenues of £6.4 billion and reduce domestic emissions by 18%. Even with a relatively small behavioural response, however, there could be a noticeable reduction in domestic carbon emissions.

At least in the short run, demand responses to these reforms would not lead to revenues that are significantly lower than those estimated under the assumption of no behavioural response. The full redistribution package we simulate costs £1.1 billion per year less than the static revenue estimate from the VAT and gas tax reforms. In the short run, then, the overall reform is very unlikely to have a net revenue cost for the government. In the longer term, the generosity of the compensation package may have to decline slightly to keep the overall reform fiscally neutral, although if (as discussed below) any additional revenues are used to support improvements in the efficiency of residential properties, this might be achievable without particular distributional concerns. In the longer term too, revenues may be higher than the static estimates if wholesale energy prices continue to rise.

Timing of reforms

Our modelling exercise tries to estimate the impact of these reforms and the compensation package as if they were implemented in the current financial year, 2013–14. Of course, such significant changes may take several years to implement. We are not able to project our data sets ahead to, say, 2020 to consider what the impact of such reforms would be implemented in that year. Our data come from 2009 and 2010; it is not at all clear that the distribution of energy use, expenditures and income would be similar in 2020 to what they were a decade earlier.

One obvious reform over the next few years will be the introduction of universal credit (UC) to replace most of the various means-tested benefits and tax credits to which low-income households are currently entitled. UC would significantly simplify the way in which a targeted compensation package could be introduced, since decisions would only have to be taken on a few parameters specific to UC rather than to a range of different benefits. Preston et al. (2013b) estimate the distributional effect of an energy tax and compensation package in 2017 in a world in which universal credit is almost fully rolled out, under assumptions about how the distribution of energy consumption estimated from data collected in the mid-2000s would change by then given existing policies to encourage energy efficiency. They find that UC would be an effective tool to compensate low-income losers from the energy tax reform. One issue with UC is how a number of existing energy-related policies that target support on benefit recipients (such as aspects of the Energy Company Obligation or entitlement to the core and non-core groups under the warm home discount) would be affected by the change.

Wider uses of the revenues from the reforms

Our full compensation package cost around £1.1 billion per year less than the estimated revenue gain. The less generous package designed to compensate low-income households for their average cost-of-living increase following the energy tax reforms cost around £3.5 billion less, though left larger numbers of poorer people worse off. Even allowing for short-term behavioural responses to higher energy prices, the reforms are likely to raise revenue, by anything from £0.4 billion to£2.8 billion depending on the generosity of the compensation package implemented.

Any ‘surplus’ revenue could be used in a number of ways. It could, of course, simply support the public finances more generally. Given the continued persistence of the deficit, and the likelihood of further policy action being needed in the future to bring public finances onto a sustainable trajectory (including longer-term pressures from an ageing population), it is likely that future governments will continue to need to think of ways to raise revenues. Reforms to energy taxes that leave relatively few poorer losers, give more consistent price signals to energy users to help reduce carbon emissions relatively efficiently, and yet still raise some net revenue could be seen as a very attractive option in that regard.

Another question is the extent to which an even *more* generous benefits compensation package could further reduce the number of poor households that stand to be net losers from the reforms. There may be some scope, but it would appear to be rather limited. Among households in the bottom half of the income distribution who are eligible for means-tested benefits, only around 10–20% (depending on decile) are net losers from the most generous reforms. Among these households, the average net loss is £3.26 per week at the median and £4.85 at the mean, suggesting further large increases would be needed to significantly reduce this proportion of low-income, benefit-eligible losers still further. On an expenditure basis, the scope to further reduce the proportion of losers through even larger benefit increases is more limited still: only 4% of those in the poorest spending decile that are eligible for benefits are net losers, and only 7% in the second-poorest decile.

An alternative to further benefit increases could be to try to target poor households that lose from these reforms with support in other ways. Net losers from the reform will be those with relatively high energy demand, who are likely to live in relatively inefficient homes. As described in Chapter 4, whilst a number of policies have been implemented to encourage improvements in efficiency, it is clear that there remains considerable potential for improvements to the efficiency of the residential dwelling stock. One option therefore might be to use some of the additional revenue to fund free installation of measures.[55] The final Impact Assessment released for the Green Deal,[56] for example, suggests that the total capital cost needed to implement all the remaining low-cost cavity wall and loft insulation potential in the domestic sector would be around £2 billion, roughly the amount of 'spare' revenue that would be generated from this reform in around one to five years depending on the compensation options chosen. These measures are estimated to have negative effective marginal abatement costs given the short payback period, and could reduce carbon emissions by over 2 million tonnes per year.[57]

Based on estimates of the costs of different measures,[58] even a relatively modest outlay of around £0.5 billion per year could pay for around 300,000 hard-to-treat cavity walls to be insulated, or 100,000 internal solid wall insulations, or 50,000 external solid wall insulations, or 200,000 boilers to be replaced with condensing gas boilers, and so on. Over time, these improvements in energy efficiency would reduce the revenue from VAT on energy and a tax on domestic gas, but the expenditures required to improve the efficiency of the housing stock would also fall as the measures were rolled out. Given that in the latter half of this decade, all properties will be visited as part of the smart meter roll-out programme, there may well be an opportunity to consider how to integrate those visits with offers of improved energy efficiency, paid for by reforms to the taxation of domestic energy along the lines considered here.

Alternative reforms

The most generous reform that we model above shows that it is possible to introduce a reform that taxes energy use in a more efficient way, while ensuring that much of the adverse distributional effect can be ameliorated. However, it is important to note that this is only one illustration of a number of possible reforms that could be introduced to achieve similar objectives.

One alternative reform might consider the way in which bill support is targeted to poor households. The objectives of a policy such as the winter fuel payment are unclear. While the evidence suggests that a greater-than-expected amount of the payment is spent on fuel, the policy remains a cash transfer to older individuals. If the intention of such policies is to reduce fuel poverty, then it would seem sensible to target them on all vulnerable poorer households instead

[55] Energy taxes of the sort considered here would almost certainly raise public awareness of energy costs and the benefits of improved efficiency, and so rolling out a package of support for efficiency alongside the reforms might be particularly attractive as part of the overall package of support that is offered in compensation.

[56] See page 35 of https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42984/5533-final-stage-impact-assessment-for-the-green-deal-a.pdf.

[57] See table 20 on page 102 of the link above.

[58] See tables 27 and 28 on page 108 of the link above.

of all households containing older individuals (regardless of their income). Such a reform would be strongly progressive. The revenues from such a policy decision could also be used in different ways – for example, to reduce marginal tax rates, in order to reduce the impact of the reform on labour supply.

6.5 Summary and conclusions

Reforms to energy taxes that ended the implicit subsidy households enjoy from paying reduced-rate VAT on energy use and that imposed a new tax on domestic gas consumption that equalised implicit carbon prices on gas and electricity would be very significant policies. They could raise in excess of £8 billion per year, and provide much more consistent incentives to reduce energy use in the domestic sector, which could lead to substantial reductions in carbon emissions. These would make a very significant contribution to the challenging emissions-reduction targets that the government has set for itself by 2050. At the same time, the way in which direct support for energy bills is delivered could be changed in a revenue-neutral and yet progressive way.

In isolation, however, the reforms would have adverse distributional consequences. We show that a compensation package made up of targeted increases in means-tested benefits would make the overall reform progressive on average, and leave relatively few net losers among poorer households whether measured by income or expenditure. The precise design of the compensation package, the amount of the additional tax raised that is channelled towards compensation, and the relative weight given to such considerations as potential labour supply effects could all differ from the ones in our illustrative package. In addition, one might want to reconsider the design of winter fuel payments and think about whether there is a better use for that money.

The point is that there are ways of creating a much more rational and consistent set of carbon prices whilst still achieving most potential distributional objectives. The modelled reforms affecting electricity prices also come close to replicating the additional effects of policy changes already in the pipeline. Without compensation, the distributional consequences of those changes could be quite substantial.

In either case, public support may be difficult to maintain but is perhaps more likely to be higher if the reforms are shown to be a coherent package of measures designed to help meet emissions targets at least cost whilst delivering support to those most vulnerable to higher energy prices. At the same time, it is important that policymakers consider carefully the various objectives they may want to trade off in considering such significant changes – revenue-raising, support for efficiency, support for poor households, mitigating adverse impacts on work incentives and so on – and do not earmark each pound raised from higher energy taxes for multiple different purposes.

7. Conclusions

Energy is a classic economic necessity. As households get better off, energy becomes a less and less significant part of the budget. In 2011, for those in the poorest 10% by spending, only food is a larger part of the budget than energy among broad commodity groups. For those in the richest 10%, energy is the smallest component of total spending. In addition, considerable heterogeneity in energy needs across individual households (depending on household composition, dwelling size and efficiency, region and local climate, method of heating and so on) means that even within decile groups, there is a large amount of variation in the importance of energy relative to household spending. On average, though, an increase in energy prices is clearly regressive, having a larger relative impact on poorer households than on richer ones.

These concerns explain why households are subject to lower implicit carbon prices on their energy use than firms, despite the inefficiencies in incentives to reduce carbon emissions created by such variation (Advani et al., 2013). They also help explain the significant policy focus on measures designed either to improve insulation and energy efficiency, particularly among poorer households, or to support energy bills directly.

In the case of policies designed to promote energy efficiency, there is surprisingly little direct evidence that allows us to estimate what their distributional impact has been. Households that have received free or subsidised insulation and other energy efficiency measures, and are net beneficiaries, have tended to be poorer. But because the cost of the measures has been funded through increases in energy costs for all households, the overall impact is not so clear. Direct tax-funded support for insulation, which does not impact energy bills for non-beneficiaries (though is, of course, paid for through higher taxes), has now ended with the winding-down of Warm Front. Support for microgeneration, delivered through small-scale feed-in tariffs, has been rather strongly regressive, with those who benefit being richer households able to invest in the technologies in the first place.

Direct cash transfers, aimed at least in principle at supporting more vulnerable households, include the winter fuel payment, the cold weather payment and the warm home discount. The first of these is available to all pensioner households and so is only mildly progressive. Those in receipt of pension credit are the only group entitled to an automatic warm home discount rebate; other poorer households have to apply, and it does not appear that this process has started well. If these payments are genuinely intended to help vulnerable households with their fuel bills, they could clearly be both better designed and better targeted. If, on the other hand, WFP in particular is really intended just as part of the transfer system to pensioners, then, depending on one's distributional preferences, it would presumably be better to consolidate it into the basic pension or pension credit system. More radical reforms would consider a single instrument for supporting bills to replace the current set of policies, perhaps most obviously a bill rebate delivered by energy companies. This could be done by sharing information on eligibility with relevant government departments to minimise both administration costs and the possible informational failures and stigma costs that would be associated with people having to apply. Even more sensible would be to make the payment vary according to local temperature, integrating features of the cold weather payment.

More quantitatively important than these policies providing direct cash transfers are policies that impose effective carbon prices and thus increase the cost of energy. There are several such policies in the electricity market, but virtually none affecting gas. Distributional issues are the main barrier to a more rational, consistent set of carbon prices across the economy, which has the potential to generate significant efficiency gains in the cost of reducing carbon emissions as required by carbon budgets. The main concern is not just that poorer households spend a larger part of their budget on energy than richer households, but that there is so much variation in energy use among poorer households that it would not be possible to adequately compensate everyone using other aspects of the tax and benefit system.

Abolishing the VAT subsidy households enjoy on their energy use, and introducing a new tax on domestic gas consumption that equated implicit gas and electricity carbon prices paid by households, would be significant reforms, raising upwards of £8 billion per year in total. However, it is possible to compensate (indeed, overcompensate) poorer households on average through a targeted set of increases in means-tested benefits. There are many ways in which such compensation could be designed and many trade-offs would need to be made. But it is clear that there is scope for change here that would allow for a more rational set of carbon prices and more effective policy design and that could satisfy most possible distributional objectives.

Appendix. Adjusting Household Energy Expenditure Data

The analysis in Chapter 6 draws on two years of LCF expenditure data (2009 and 2010) to estimate the distributional effects of a package of reforms to energy prices, bill support policies and compensatory increases in means-tested benefits. This appendix details the methods used to adjust the data so that for an individual household, observed expenditure on energy can be taken as a reasonable estimate of its energy use.

In the LCF, recorded energy expenditure exhibits problems with seasonality and infrequency of purchase. These are particularly important when we want to explore how energy spending or energy use varies at the level of individual households. In particular:

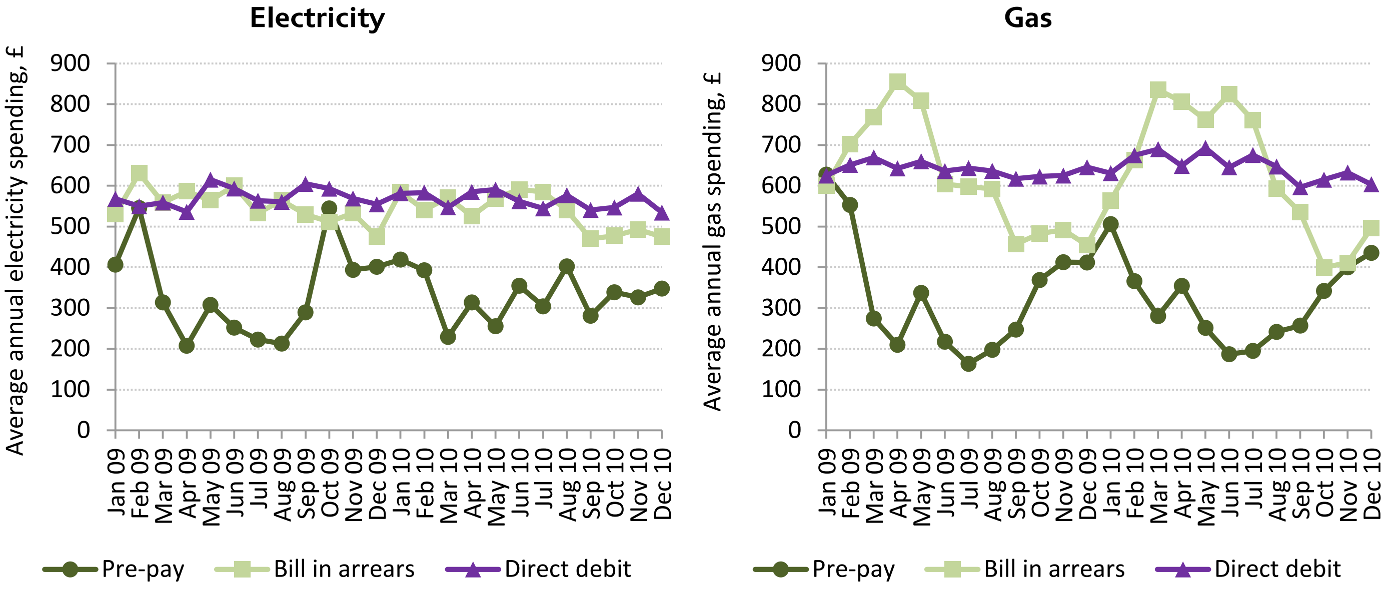
- Households that pay in arrears are asked about how much they spent on their last bill and the period covered (e.g. monthly, quarterly). This is converted to a weekly average figure. People interviewed just after their summer bill will report lower energy spending than people who are interviewed just after their winter bill.

- Households that pay by prepayment meter frequently report zero expenditure on energy. Rather than being asked about their payments in the last month or quarter, they are simply asked to note down any payments made during the two-week period over which they record their spending diaries. These are then averaged into weekly values. However, if households top up only infrequently (once a month, say), then some households will not be observed to spend anything on energy whereas others will be observed spending a large amount, which is mistakenly interpreted as their weekly average spending. Whilst the average spending across all prepay customers may still be a good measure of energy spending (since it includes those who are topping up their payments for future energy use and those who are using up already-purchased top-ups), the individual household measure of energy spend will not reflect its typical use. There will also be seasonal effects in the frequency with which payments are topped up and in energy use.

- There may also be a trend in energy spending over time (driven by long-term patterns such as improved efficiency and by short-term shocks because of weather variation, for example), which is picked up from pooling multiple years of data. In effect, we would like to treat the pooled sample as drawn from a single point in time when looking at the variation in the impact of policy reforms across households.

Figures A.1 and A.2 illustrate the problems in the raw data. Figure A.1 shows the implied annual amount spent on electricity (left-hand panel) and gas (right-hand panel) by month of observation and method of payment. To generate the annual

Figure A.1. Average annual metered fuel expenditure, by month and method of payment, 2009–10



Note: Figures are weighted to account for sampling variation. Excludes Northern Ireland and households reporting negative fuel expenditure.
Source: Authors' calculations from 2009 and 2010 Living Costs and Food Survey.

figure, we take each household's reported weekly spending and multiply by (365/7).

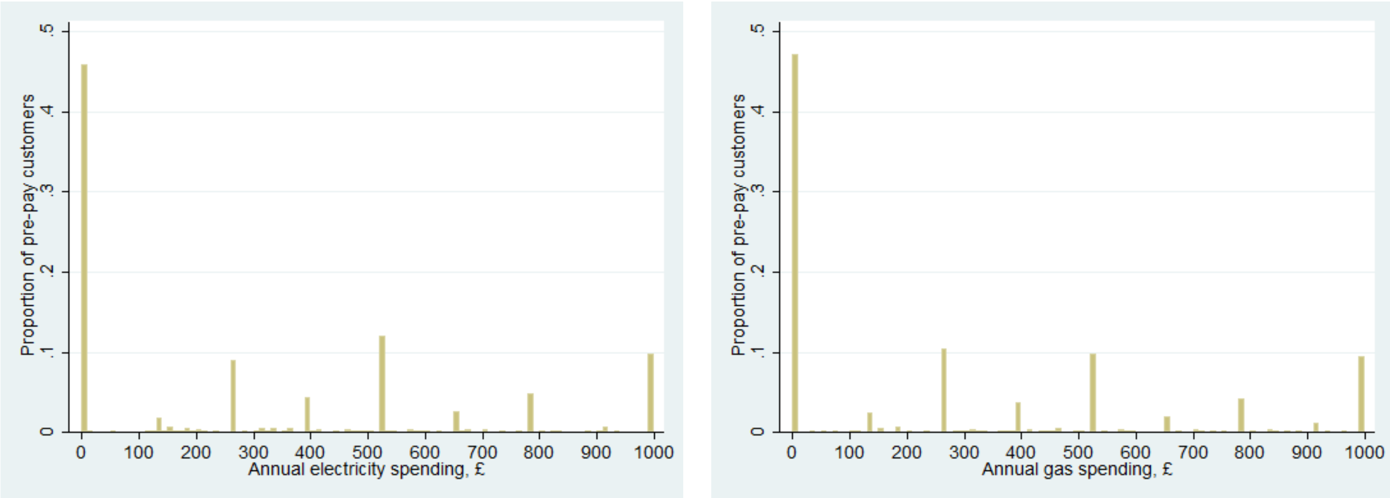
Seasonal effects are particularly clear for gas, and for those using bills or prepayment meters rather than paying by direct debit. For prepay customers, for example, average annual gas bills for people observed in January are typically more than double those for people observed in May to September. Note too that for people paying bills in arrears, the seasonal pattern looks somewhat different: reported spending peaks from around March to July, and troughs from around October to December. This is because people report their previous bill, such that those observed at the end of the year are reporting their summer expenditure.

Figure A.2 shows the distribution of expenditure across households from the pooled sample among prepay customers for electricity (left-hand panel) and gas (right-hand panel). For both fuels, just under half of prepay customers report zero expenditure. The distribution also contains a number of spikes reflecting certain regular top-up amounts. For example, people who top up £10 over the two-week diary period have an implied annual spend of £260.71, those who top up £20 have an implied annual spend of £521.43 and so on.

Figure A.3 shows that the problem with prepay customers reporting zero expenditure is one that grew markedly in the 1990s, suggesting that, over time, the frequency with which people top up their meters has been decreasing. It may well be that, over time, 'prepayment' has come to mean something different: in the past, prepay households may have topped up small amounts regularly (the 'coin in the slot'), whereas now it is possible to top up much less frequently by

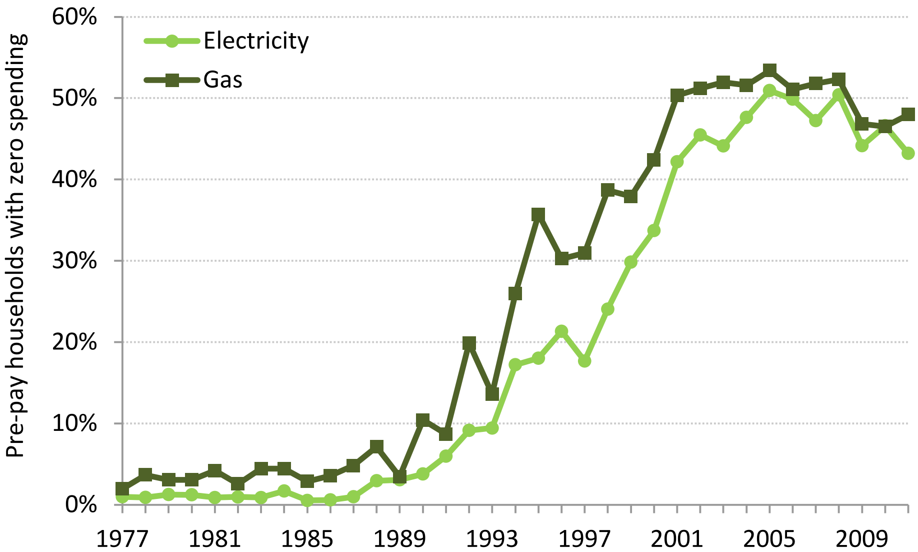
Figure A.2. Distribution of annual metered fuel expenditure, pre-pay customers, 2009–10

Electricity *Gas*



Note: The upper tail is truncated at £1,000: those who report in excess of £1,000 are bunched at this point. Proportions are shown in £10 bands. Excludes Northern Ireland and households reporting negative fuel expenditure.
Source: Authors' calculations from 2009 and 2010 Living Costs and Food Survey.

Figure A.3. Proportion of prepay households reporting zero spending on gas and electricity, 1977 to 2011



Note: Figures are weighted to account for survey non-response. Excludes Northern Ireland and households reporting negative fuel expenditure.
Source: Authors' calculations from LCF data.

making payments onto electricity and gas keys or cards that then last some time.[59] There is some evidence that as energy prices started to rise from the mid-2000s, prepay customers began to top up more frequently: the proportion of zeros in the data has fallen slightly in recent years, but even by 2011 more than 40% of prepay customers report zero spending in a two-week period.

The evidence from Figures A.1 to A.3 suggests that taking an individual household's implied annual spending on metered fuels may not be a good representation of its actual fuel spending over a year, either because of seasonal variation or because of infrequency of purchase and a limited number of regular top-up amounts. Since we are concerned with how policy reforms would affect individual households, we need to address these issues, adjusting the observed expenditure data to account for them as best we can.

We use two methods, with different approaches for prepay and other customers.[60]

For those using **bills or direct debit**, we want to remove seasonal and secular time trends from reported spending. We run a simple OLS regression model of the log of household energy expenditure on a set of dummy variables for each year–month of the period (January 2009 to December 2010) and a number of other control variables.[61] The model is run separately for each metered fuel and payment method, giving four models in total. We use the coefficients on the year–month dummies as estimates of seasonal variation in expenditure, which are then taken out of each individual observation. For example, because the model is run with log expenditure on the left-hand side, a coefficient of 0.1 on a particular dummy tells us that expenditure is roughly 10% higher in that month on average than a base month excluded from the model.[62]

In principle we can adjust each household's observed expenditure by the percentage given by the specific coefficient for the month they are observed to get a revised distribution of expenditure without seasonal effects. However, this means that the choice of base month will affect the level of spending: for example,

[59] Note that from the 2013 survey, the LCF plans to ask prepay customers to recall their last energy payment and the duration for which that purchase is expected to last, rather than recording energy payments only through the two-week diary.

[60] Note that 54 households (0.5%) use some other method of payment besides prepay, bill or direct debit for electricity and that 50 households (0.5%) do so for gas. We do not exclude these households from our analysis, but we simply use their unadjusted reported expenditure.

[61] Region, household composition, characteristics of the household head (age, gender, education, marital status, employment status), after-housing-costs equivalised income decile, housing tenure, number of cars, type of dwelling, duration of tenure, number of rooms, council tax band, central heating fuel and presence of various durable goods.

[62] The other control variables are included in the model only because the LCF is not sampled randomly month-by-month; instead, the sample is designed to be nationally representative within quarters. As a result, we want to strip out any possible correlation between month and other observed demographic characteristics; for example, if for some reason there was an oversampling of a particular region in a given month, we want to avoid conflating regional and month-specific effects.

if we pick a base month in November for households paying bills in arrears, average spending will be much lower than if we pick a base month in July given the pattern of seasonality shown in Figure A.1. This will affect our estimates of the impact of policy reforms (for example, the revenue potential from a new tax on gas will look much higher if we use July as a base month). To avoid this, we instead use all 24 year-month coefficients for each household, estimating what their expenditure would be had they been observed in each month and then averaging across all months to get the adjusted spend.

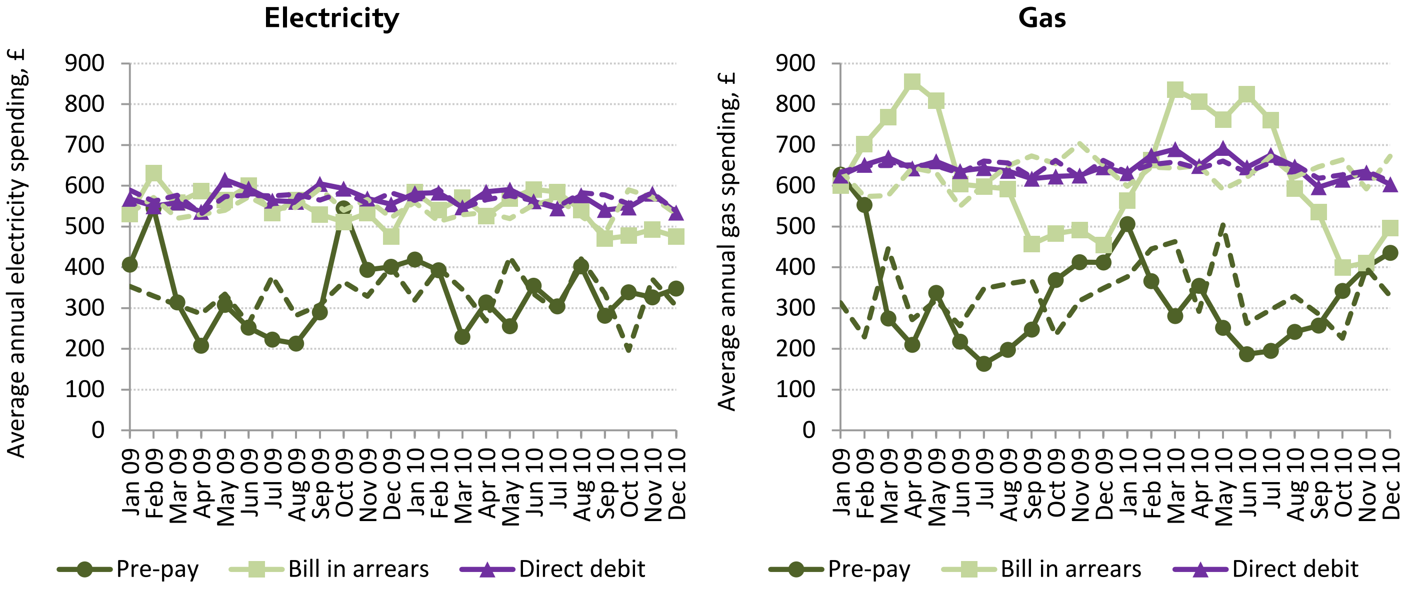
For those using **prepay**, we cannot use the same approach given the large number of zeros in the expenditure data. Instead, we run a separate Tobit model for each fuel, where the dependent variable is the level of expenditure and the independent variables include the same controls included in the bill/direct debit model and a large number of interaction terms between them (for example, we interact region with tenure, accommodation type, the number of rooms and the council tax band to allow for different impacts of region by those characteristics).

As mentioned above, when infrequency of purchase is an issue, average expenditures across households may still be a good measure of average spending across the population since those who are consuming previously-purchased credit balance out those who stock up for current and future consumption. The aim of the Tobit model is essentially to predict these averages for different groups of households based on their observable demographics. The Tobit model is well-suited to the prepay case because it explicitly accounts for the prevalence of zero expenditures in the data. From the parameters of the model, we predict two measures for each household in each month – the probability they would report non-zero expenditure and the amount they would report conditional on being positive. Multiplying these two values gives an expected expenditure for each household in each month. We average over all months for each household to get its predicted energy spending.

Figure A.4 shows the average unadjusted energy spending (as shown in Figure A.1) and adjusted figures (shown by dashed lines) for each method of payment. Within a payment method and month, the sample sizes are relatively small, so there is still some variation in average expenditures, but obvious seasonal trends have been removed.

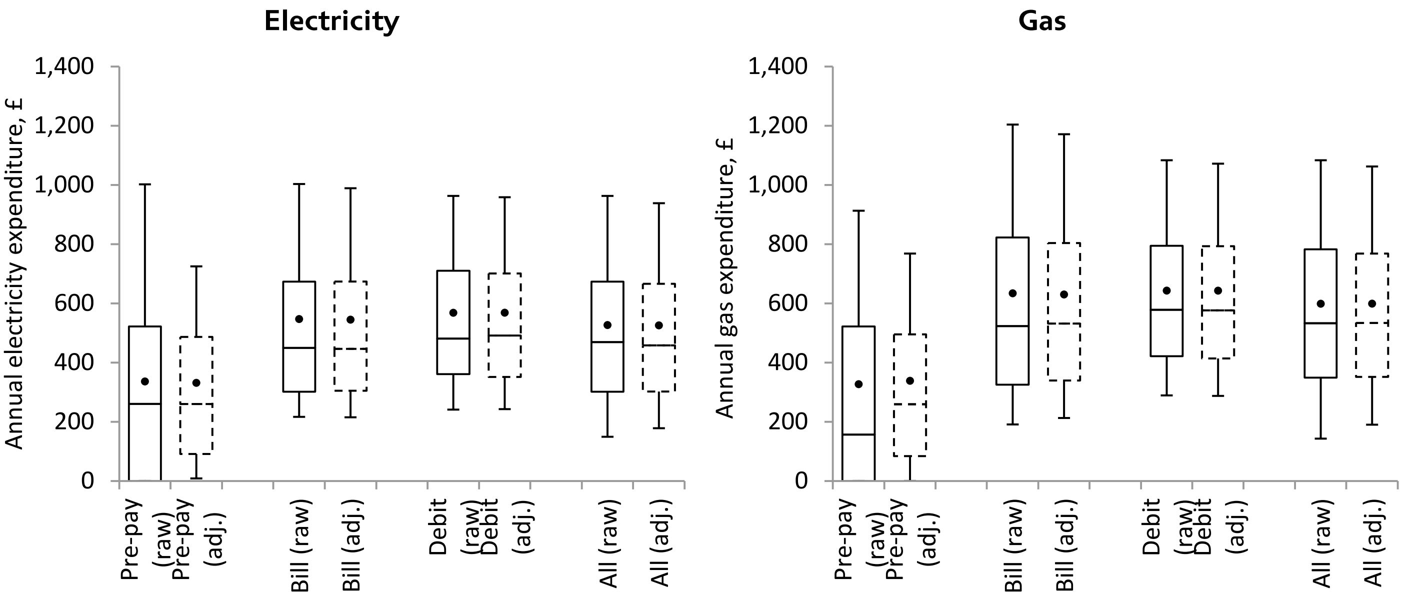
Figure A.5 shows the distributions of adjusted and unadjusted spending by payment method. Average (mean) spending is barely affected by the adjustment. For bill and direct debit customers, there is only a small compression of the distribution resulting from the seasonal adjustment. For prepay customers, there is a larger compression, though this of course is to be expected since we are trying to adjust for the fact that the distribution is artificially wide because of the substantial issue of infrequency of purchase. Although the adjustment reduces the prevalence of zero gas and electricity spending among prepay customers, it

Figure A.4. Average adjusted and unadjusted annual metered fuel expenditure, by month and method of payment, 2009–10



Note: Dashed lines are adjusted figures. Figures are weighted to account for sampling variation. Excludes Northern Ireland.
Source: Authors' calculations from 2009 and 2010 Living Costs and Food Survey.

Figure A.5. Distributions of adjusted and unadjusted annual metered fuel expenditure



Note: Top whisker is 90th percentile within payment method, top of box is upper quartile, middle line is median, bottom of box is lower quartile and bottom whisker is 10th percentile. The black spot is the mean. Dashed boxes are the adjusted data. 'All' excludes those who do not use electricity or gas.
Source: Authors' calculations from 2009 and 2010 Living Costs and Food Survey.

does not remove it entirely.[63] The proportion of prepay customers reporting zero gas spending in the raw data is 47%; this falls to 13% in the adjusted data. For electricity, the figures are 46% and 7% respectively.

Having generated adjusted electricity and gas expenditure figures by payment method, we create new total expenditure and total fuel expenditure data for each household, replacing the observed data with the adjusted data.

Note that we do not make any adjustment to non-metered fuel expenditure, or to other categories of spending that might suffer from similar problems (for example, spending on food may be higher in December and spending on household goods may be relatively infrequent).

[63] This happens because, essentially, some households are predicted to have a 100% chance of recording zero energy spending given their observable characteristics.

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