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The **Joseph Rowntree Foundation** has supported this project as part of its programme of research and innovative development projects, which it hopes will be of value to policy makers, practitioners and service users. The facts presented and views expressed in this report are, however, those of the authors and not necessarily those of the Foundation.

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First published 2004 by the Joseph Rowntree Foundation

ISBN 1 85935 246 4 (paperback)
ISBN 1 85935 247 2 (pdf: available at www.jrf.org.uk)

A CIP catalogue record for this report is available from the British Library.

Cover design by Adkins Design

Prepared and printed by:
York Publishing Services Ltd
64 Hallfield Road
Layerthorpe
York YO31 7ZQ
Tel: 01904 430033; Fax: 01904 430868; Website: www.yps-publishing.co.uk

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Acknowledgements

A number of people and organisations have made key contributions to the research reported in this report and we would like to express our warm gratitude to them here.

The research reported in this paper was conducted under the project 'The Social Impacts of Environmental Taxes: Removing Regressivity', funded by the Joseph Rowntree Foundation under its Programme on Environment and Social Concerns. First, our thanks go to the Joseph Rowntree Foundation (JRF) for supporting the research and to JRF's Alison Jarvis who monitored its progress and helped it along with many useful suggestions.

Second, we are very grateful to the Project Advisory Group, which met on a number of occasions in a number of different configurations in order to address the different topics with which the research was concerned. The members of the Group are listed in Appendix 1, but we would like to give special thanks here to Derek Osborn who chaired most of the Group meetings and ensured that we derived maximum value from them, and Nick Hartley who not only attended meetings most regularly but also gave us extremely useful written feedback.

Finally, we were helped by a number of people with the research itself. Holly Sutherland at the University of Cambridge carried out extensive modelling for us related to the household energy and transport components of the research, using her POLIMOD model of the tax-benefits system linked to the Family Expenditure Survey. Anglian Water gave us access to their SoDCon data, which was vital to our research in this area, and Amy Walters of Anglian was immensely helpful in helping us prepare and understand the data. Josh Lovegrove of the Office of National Statistics assisted us with analysis of International Passenger Survey data. South Norfolk District Council made available to us its recent data on household waste generation, and Dr Andrew Lovett at the University of East Anglia greatly assisted us both in obtaining access to it and in cleaning it and converting it into a usable format.

We are very grateful to all of them for their help and advice.

Having said that, the usual disclaimer applies. Responsibility for the results, conclusions, opinions and errors in the report rests with us alone.

Summary

Governments continue to introduce, or to explore the introduction of, environmental taxes and charges because of their cost-effectiveness in reducing environmental impacts. However, sometimes, these taxes and charges are also associated with disproportionate impacts on low-income households, which can make them both politically unpopular and socially unjust. This report describes research that sought first to estimate the effects on low-income households of different environmental taxes and charges, and then, where they were disproportionate, to model how they could be reduced. The research investigated four areas in which environmental taxes and charges have been either introduced or are under discussion: the use by households of energy, water and transport, and the household generation of waste.

It became apparent early on in the research that the effects on low-income households of environmental taxes and charges in these areas were very different, so they will be discussed briefly in turn, before some more general conclusions are drawn.

Household energy use

Emissions from UK households of carbon dioxide, which is the greenhouse gas most responsible for climate change, are increasing. This is obviously problematic from the point of view of the desire of the UK government to reduce these emissions. However, the government has ruled out the imposition of taxes on household energy use, which could reduce household emissions of carbon dioxide. This is because of the perceived effect of such taxes on low-income households and, specifically, on those in fuel poverty (a situation in which a household would need to spend more than 10 per cent of its income to maintain an adequate level of warmth). The research investigated whether low-income households could in fact be satisfactorily compensated for such a tax through the benefits system.

The research early established that there is enormous variation in household energy use within income deciles (groups of 10 per cent of households ranked by income, where Decile 1 contains the 10 per cent of households with lowest incomes, etc.). The variation in carbon emissions is not as great, but is still very substantial. It also emerged that poor households pay substantially more per unit of energy than rich households. A carbon tax imposed equally on rich and poor households, without any compensation for poor households, would therefore be very regressive and would add to the unfair price burden these households are already experiencing. A variety of ways of compensating poor households was explored, using means-tested benefits, child benefit, adjustments to pensioners' Winter Fuel Allowance (WFA) and varying the rate of carbon tax.

It was found that, for the lowest decile, all the tax-plus-compensation packages are progressive on average (that is, the average household is a net gainer). The same is true for Deciles 2 and 3, except in respect of one scenario. These results show that it is possible to make a household carbon tax progressive for the average household in the lowest deciles.

However, the enormously skewed distribution of energy consumption *within* the income deciles means that the average result conceals great differences in net gains and losses

within each decile. In fact, none of the investigated compensation packages manages to reduce the proportion of losing Decile 1 households much below 20 per cent. The conclusion is that, although redistributing the revenues from a carbon tax through means-tested benefits would certainly be progressive overall, and would bring some households out of fuel poverty, no way of effecting such a redistribution was found that would not also worsen fuel poverty for those who are already most badly affected by it. This makes introducing a carbon tax on household energy use politically problematic at best, and probably politically infeasible.

An alternative approach to the issue would be to introduce incentives for non-fuel-poor households to introduce cost-effective energy-efficiency measures. A scheme was outlined whereby, starting with the highest-value houses in each region, households would be asked to have an energy audit of their house carried out. A 'climate change surcharge' would be imposed on households that failed to implement cost-effective energy-efficiency measures identified by the audit within a year. The same approach could be adopted when householders move into a new home, by imposing a surcharge on Stamp Duty if audit-identified, cost-effective energy-efficiency measures were not installed within a certain time after the move.

The scheme would effectively abolish fuel poverty, could achieve carbon savings of four million tonnes of carbon (mtc) over ten years and save households nearly £20 billion net present value for an investment of £6.4 billion. It would also eventually permit a non-regressive carbon tax to be imposed, which could militate against the growth of household carbon emissions in the future. Few other public policies have such a positive overall generation and distribution of economic, social and environmental benefits. The fact that such a scheme currently seems not to be considered politically feasible suggests that the public and political will to mitigate climate change is not yet very powerful.

Household use of water

There is a strong environmental case for universal water metering, particularly in southern and eastern England, regions that are already making unsustainable use of their water resources and where the situation is expected to get worse because of population shifts and climate change. There are also arguments against water metering, one of which is that it can lead to disproportionate costs for low-income households (i.e. is regressive). However, a recent international comparison of water charging found that, in England, it is more regressive and more burdensome on low-income households than in any other industrial country examined. It is therefore not true either that metering is *per se* more regressive than non-metered tariffs, or that the UK's present system of water charging is equitable. The distributional impact depends on the detail of the tariff.

At present, there are two methods of paying for water in the UK. Most households pay a bill based partly on a standing charge and partly on the rateable value of the property. The alternative is to be metered. Universal metering could be implemented in the UK through a variety of different tariffs, each with different distributional implications, ranging from an equal charge for all households (at least for a given water company), which would increase the regressivity of water charging (its disproportionate impact on low-income households), to having a lower tariff for those on benefits, giving a 'free' allowance of water to some households, or varying the tariff by an amount related to Council Tax, which could make low-income households better off. These are some of the options explored by this research. All the progressive options involve on average a redistribution of income from better off to less well off households.

The distributional effect of 11 alternative tariff designs was examined with three politically important variables in mind: the average effect on low-income households; the effect on high-water-using, low-income households; and the overall redistributive effect (i.e. the transfer from richer to poorer households). The first major result of the research was that *all* the metered tariffs investigated were less regressive than the present tariffs, on average making those in the lowest-income group better off. In addition, all but one of the investigated options was also progressive for the next income group (those with incomes of £10,000–20,000). There is therefore no basis for supposing that switching to metering will, on average, make low-income households worse off. All the options investigated actually make them better off on average, some quite substantially so.

Second, there is no tariff that does not make 6 per cent or more of the lowest-income households worse off by more than £1 per week. These will be the high-water-consuming households in this income group. For some of them, their high water use will reflect discretionary rather than essential use and a cutback in that use would reduce these extra charges that they would pay under metering. Where their high water use is essential, this is likely to be because of medical reasons and it should be possible to make special arrangements to make rebates of some charges through the benefits system. In these two ways, it is likely that the great majority of low-income households would be able to reduce any extra charges they would face under the metering tariffs.

Third, the tariffs vary considerably in the degree of redistribution from richer to poorer that they bring about (as noted above, all are redistributive in this direction to some extent).

Which of these tariff options is 'best' depends on political perspective. However, the research showed clearly that water metering does not need to have regressive effects.

It is hoped that, should universal metering be adopted in the UK, in some regions or as a whole, such detailed tariff design issues will get adequate consideration, so that the change does not have social effects that were not intended.

Household use of transport

Traffic growth in the 1990s was lower than is expected for the period to 2010 because the annual increase in fuel duties from 1993 made petrol and diesel prices rise much faster than inflation and suppressed the growth in traffic that would have otherwise taken place. Because of the freeze in fuel duty since 1999, which is officially projected to continue for the rest of the decade, fuel prices are falling in real terms.

Transport is the only sector of the UK economy that has increased its emissions of carbon dioxide since 1990. Thanks to increasing fuel efficiency, which offset the relatively small growth in traffic during the 1990s, emissions from road traffic did not increase substantially. The main cause of the increase was growth in domestic aviation.

Road transport emissions are expected to grow 20–25 per cent over 2000–10, and further beyond that date, without further measures to restrain traffic growth. In addition, the government is planning to permit the building of additional runways to enable massive growth in aviation.

Taxation of car use has been a particularly sensitive issue since the fuel protests of autumn 2000. Petrol taxes are not regressive in aggregate because poorer households are less likely to have a car. Nearly a third of households do not have a car and non-car-owning households are concentrated among the lowest-income groups. Nearly two-thirds of households in the lowest-income quintile (the 20 per cent of households with lowest incomes) do not have a car. However, petrol taxes are regressive *among* motorists.

The distributional impacts of several possible measures to restrain the likely future increase in emissions from transport were investigated:

- increasing fuel duties and abolishing vehicle excise duty (VED)
- increasing fuel duties and using the money to subsidise public transport
- increasing fuel duties and using the money to increase benefits
- reform of graduated vehicle excise duty (VED)
- introducing a graduated car purchase tax
- congestion charging
- introducing domestic tradable quotas (DTQs).

It was found that, if fuel duties were increased, the most effective of the three ways in terms of compensating low-income motorists would be to abolish VED. Alternatively, a graduated car purchase tax could replace graduated VED, putting the entire cost at the beginning. However, this would affect decisions only about fuel efficiency, not about use.

The measure that has received the most attention in the last few years is congestion charging. A revenue-neutral congestion-charging system would lead to a redistribution of money from urban drivers to rural drivers. Congestion charging that tackled traffic growth would have to be revenue raising. Revenue raising would also be necessary to fund the improvements in public transport that would be needed in order to cope with a modal switch due to congestion charging. That would inevitably mean that low-income urban households would have to pay more if they continued to drive.

The final approach considered was domestic tradable quotas (DTQs), whereby every adult resident would receive for free an equal number of carbon units to cover their annual carbon emissions, including private transport. Those who used less than their entitlement would sell their surplus units to others who wanted to use more. If a DTQ system covered only the carbon emissions from household energy use and motoring, then it would be progressive, but around 30 per cent of low-income households would be losers. However, if only emissions from motoring and aviation were included, then a smaller proportion of low-income households would lose out, no more than 10–15 per cent.

The conclusion from this research is that a system of DTQs covering motoring and aviation would be an efficient and progressive way of controlling carbon emissions from these sources. In their absence, and in a political context that is unfavourable for increased fuel duties, at least partly because of their impact on low-income motorists, revenue-raising congestion charges could be used to control traffic growth, and hence emissions, with low-income motoring households being compensated through the abolition of VED and further compensation being given, if desired, through the benefits system.

Household waste

Compared with most other EU member states, the UK has a relatively low rate of recycling of household waste and sends a relatively high proportion to disposal in landfill. Under the provisions of the EU Landfill Directive, this situation will have to change radically in the next ten years, with much less waste being sent to landfill, in a context in which the quantity of household waste continues to increase at about 3 per cent per year. Analysis in a report from the Strategy Unit suggests that, in the absence of waste-reduction measures, waste-disposal costs are likely to double to £3.2 billion by 2020.

At present, households pay for waste collection and disposal through the Council Tax. Because the Council Tax is regressive (the charge is proportionately greater for poor households), increasing Council Tax to pay for higher waste costs would also be regressive. Moreover, the increase in charges would, like the current flat-rate waste-disposal charge, do nothing to incentivise householders either to reduce their waste or to co-operate with recycling schemes.

The Strategy Unit recommended that local authorities should be able to introduce variable waste charging, not least to provide an incentive for both kinds of behaviour. Experience in other countries has shown that it can be expected to result in both waste reduction and an increase in the separation of recyclables. A potential concern about the introduction of variable waste charging in the UK is that it might have a disproportionate impact on poor households (as would an increase in Council Tax), because the generation of household waste bears little relation to income and more affluent households tend to recycle more, thereby reducing their residual waste that would bear the charge.

If waste charging was removed from Council Tax by reducing the Council Tax for all households by the same amount, this would be progressive. If a revenue-neutral, variable, weight-based charge was then introduced for all households, and there was no waste reduction, 92 per cent of single-person households, and 76 per cent of two-person households, would be better off, while most larger households would be net losers. Clearly, more households of all sizes would be losers if the charges were set at a level to raise more revenue than is paid at present through the Council Tax, in order to cover the extra costs of increased recycling.

In the revenue-neutral case, with no source reduction, effective compensation for the extra waste-disposal costs could be given through the benefits system to the great majority of households on means-tested benefits. The cost of compensating all those up to the eightieth percentile of waste generation is estimated at £365 million per annum. This is comparable to the £375 million that central government will have to find to fund the increased costs of local authority recycling (assuming that this is funded through Council Tax with the same proportion of central to local revenue as at present).

Of course, all households could reduce their waste-disposal costs by reducing the amount of residual waste they generate, both by producing less waste in the first place and by separating out more waste for recycling. In fact, if variable charging were to significantly reduce the generation of household waste, then the resulting lower waste-disposal charges could offset partially or completely the extra benefits needed to protect low-income households from the initially higher variable waste charges that have helped to bring it about.

General conclusions

In general, it is possible to solve the regressivity problem sometimes associated with environmental taxes and charges through either tariff/charging design or a targeted compensation scheme.

However, the consumption of key environmental resources tends to be widely distributed about the mean within a given income group. This means that, under any practicable compensation system (and assuming no change in household behaviour), some low-income households will end up as net losers from any charging-plus-compensation scheme, even when most low-income households end up as significant gainers. In practice, households will be able to change their behaviour in response to charging (reducing the consumption of the environmental resource in question), and this should greatly reduce both the number and extent of net losing low-income households.

Where reduction would result in real hardship but the affected households could be relatively easily identified (e.g. water use in households with medical conditions), it should be possible to make further special arrangements to ensure that this is relieved. Where the hardship affects larger numbers of households that are harder to identify (e.g. energy), it may be necessary to tackle the underlying cause of the hardship (e.g. energy-inefficient buildings) before pricing is used as an instrument of policy.

In none of the areas studied will charging be an adequate policy instrument by itself. A range of other policy measures will be necessary to provide alternative services or infrastructure (e.g. transport, waste), increase capacity (e.g. energy-efficiency installers) or address barriers to more environmentally conserving behaviour (e.g. lack of awareness/information in all areas). However, it is not clear that the environmental issues discussed in the report can be cost-effectively addressed without the use of environmental taxes and charges. It is hoped that the insights in this report will help ensure that, if they are introduced, they are designed so that they do not have unintended social consequences.

1 Introduction

Introducing environmental taxes and charges

This report is about the social implications of environmental taxes and charges in relation to four environmental issues – the household use of energy, water and transport, and the generation of waste.

Environmental taxes and charges are examples of what are generally known as 'economic instruments' of environmental policy. Other examples of such instruments are emissions trading, which is briefly discussed in Chapter 4, and deposit-refund systems, which this report does not address. Environmental economic policy instruments act by giving direct financial incentives for more environmentally conserving behaviour. The 1990s saw much debate about, and a certain amount of introduction of, environmental economic instruments, including environmental taxes and charges (OECD, 1994; Ekins, 1999).[1] However, it became apparent relatively early on that two issues militated against the widespread introduction of environmental taxes and charges (OECD, 1996). One was their potential effect on competitiveness – discussed in Ekins and Speck (1998), but not further discussed here. The other was their potential regressivity (having a more than proportional impact on poorer households compared to richer households). It is this issue that provides the focus of this report.

This issue was examined in a UK context in one of the final publications of the UK Round Table on Sustainable Development (UKRTSD, 2000), which concluded:

> *It is important that perceived or potential equity impacts should not result in proposed measures being relegated to the 'too difficult' box. Where there are serious potential impacts on vulnerable groups a variety of possibilities are in principle available to mitigate them.*
> (UKRTSD, 2000, p. 17)

The report gave a number of examples of measures and approaches that could be used to ensure that the introduction of environmental taxes and charges was not regressive (e.g. differential tariffs, compensatory measures [UKRTSD, 2000, p. 18]). These approaches provided the starting point for this research, which sought to investigate their feasibility of introduction and their effectiveness in mitigating regressivity. First, however, it is necessary to be clearer about the kinds of environmental taxes and charges that are being considered in this report.

Classifying environmental taxes and charges

There are three different sorts of taxes/charges that might be described as 'environmental taxes and charges':

- upstream charges on resource use or environmental emissions (where upstream refers to a process early in the production process, e.g. for energy, an oil refiner or power generator)
- downstream charges on resource use (where downstream refers to a final consumer, most obviously, in this report, households)
- downstream charges on environmental emissions.

The distinction is important because it has implications for the responses to the taxes/ charges. Economic instruments work in two ways: the response to the price signal can be either to reduce the overall consumption of the good in question or to substitute away from an environmentally harmful version of the good towards one that is less environmentally harmful. The substitution can take place upstream and downstream; the reduction in consumption is a downstream response.

Table 1 gives examples of some the possibilities for environmental taxes and charges in the four areas studied in this report. Those in italics are those that are discussed to some extent in this report. It will be noted that the focus of this report has been on downstream environmental taxes and charges, because it was desired to study the direct effects on households. Not all theoretical options for environmental taxes are practical possibilities. For example, households cannot be charged for emissions to water, because there is no feasible way of identifying and measuring these for all households.

Impacts of and responses to environmental taxes and charges

Downstream consumers can respond to upstream environmental charges only by reducing their consumption of the goods that the charges have made more expensive. This will improve the environment only to the extent that the environmental damage is associated with this consumption.

In general, there are three main aspects to the potential impact of an environmental tax or charge, in particular its impact on poorer households and the possible responses to it.

- The direct cash loss imposed by the tax or charge assuming nothing else changes; for example, if a household has an annual income of £5,000 and an electricity bill of £500, a 20 per cent energy tax will put that up to £600 and raise the proportion from 10 per cent to 12 per cent of income – a very significant increase. These are the kinds of impacts that have been modelled in detail in this report, together with various schemes of compensation to

Table 1 Different types and examples of environmental taxes and charges

	Upstream charge on resource use or environmental emissions	Downstream charge on resource use	Downstream charge on environmental emissions
Energy	Carbon tax on primary energy	Energy tax	*Energy tax differentiated by fuel carbon content*
Water	Charges on abstractions or emissions by water companies	*Metered water charges*	Not possible
Transport	Carbon tax on petroleum producers	Fuel tax	*Fuel tax or vehicle excise duty differentiated by emissions*
Waste	Landfill tax	*Volumetric waste charges*	*Differentiated waste charges*

reduce the impact on low-income households.

- The tax or charge will increase the cost of each unit of the resource in question (by 20 per cent per unit of energy in the example above). The incentive to economise on the resource will have increased significantly. The extent to which consumers do or will respond to environmental taxes and charges by reducing their resource use is difficult to calculate and predict. In this report, there is some discussion of this issue, but, in all the modelling of the financial impacts of a tax or charge, it is assumed that consumers do not change their consumption of the resource in question. This is unrealistic, because these impacts can always be reduced by consuming less, but it provides a worst-case example of the financial impacts of environmental taxes and charges.
- However, consumers on low incomes may already be inclined to stint on the use of essential resources, like energy, to save money for other things, even to the point of damaging their own health. Environmental taxes will reinforce this inclination, perhaps saving energy, but at an unacceptable social cost. In these cases, methods might be sought to provide an incentive to increase the *efficiency* of consumption, such that the quality of service can be maintained or increased with lower resource use. An example studied in this report is giving incentives to improve home insulation.

Scope of the report

This report investigates the impact on low-income households of imposing environmental taxes and charges on four activities that are important for both health and the quality of life: household use of energy, water and transport, and disposal of waste. Each activity also causes substantial environmental impacts, which the imposition of environmental taxes is intended to reduce. The report explores ways to mitigate the impact of the taxes on low-income households, or compensate them for it. Where this seems too difficult, other incentive schemes for environmental improvement are suggested.

Typically, environmental taxes and charges are introduced as parts of sometimes complex 'policy packages'. This research has studied in detail the possible components of such packages that might address any disproportionate impacts of the taxes and charges on low-income households, but has not gone in detail into other considerations. The conclusions and recommendations therefore do not purport to be finished policy proposals, but more outlines of approaches to the issues that seem promising and worthy of further development.

Even so, much of the work carried out in this research has been complex and technical. Much more detail on how the work was carried out, why particular approaches were adopted and the full results are given in the full working papers (Dresner and Ekins, 2004a, 2004b, 2004c, 2004d) produced by the research in each of the areas considered: energy, water, transport and waste.

While it is not the intention of this report to argue the case for environmental taxes and charges, there is in fact little evidence that any of the environmental issues discussed in this report can be cost-effectively addressed, in a context of economic growth, without use of the price signal, which involves introducing environmental taxes and charges. If a government fails to use prices to give signals for environmentally conserving behaviour, because of the difficulties involved in addressing the associated distributional issues, it is likely to find both that the environmental problem will prove intractable to other policy approaches, because with rising incomes people's consumption of the resource will tend to increase, and that the costs of environmental improvement are higher than they need be. This is why governments continue to be attracted to environmental taxes and charges, despite their challenges of implementation. The purpose of this report is to give insights into how one of those challenges, the problems relating to regressivity, can be mitigated.

It became clear early on in the research that the impacts on different income groups of environmental taxes and charges would be very different in the different areas in which they were being applied. Any attempts to mitigate them would also need to be specific to the area under consideration. This report therefore turns now to each of the issues in turn, giving some background to each, and describing the research methods that were used and the conclusions that were drawn. The final chapter draws some more general conclusions.

2 Household energy use

Background

UK households in 2000 produced 23.4 million tonnes of carbon (mtc) emissions from their direct use of fossil fuels (excluding transport) and another 16.1 mtc if emissions from their use of electricity are taken into account, giving a total of 39.5 mtc (DEFRA, 2004a), or 27 per cent of UK carbon emissions. Moreover, their energy use and their carbon emissions are still growing. Between 1990 and 2000, their direct fossil fuel use grew by 13.3 per cent (an average annual rate of 1.25 per cent per annum) and their carbon emissions from this source by 8.8 per cent (a lower rate of growth because of the shift from coal to less carbon-intensive gas). Household electricity use grew by 16.5 per cent over 1990–2000. Carbon emissions from this use of electricity fell, however, by 24.2 per cent, because of the shift in power generation from coal to gas. With household energy demand still growing, and with limited possibilities for further fuel switching in either power generation or the direct household use of fossil fuels, household carbon emissions are likely to grow still further in future. A recent forecast from Cambridge Econometrics (2004) suggests that direct household emissions in 2010 will be 12 per cent higher than in 2000 and those from household electricity use 2 per cent higher (Cambridge Econometrics, 2004, Chapter 5, pp. 3, 12). This is obviously problematic in terms of the government's commitment to reduce carbon emissions by 20 per cent from the 1990 value by 2010 and from a perspective that attaches any kind of importance to reducing the emissions that contribute to climate change.

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

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

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

Approach

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

Poverty in households is often explored by dividing households into ten equally sized groups, called *deciles*, according to their income. Thus Decile 1 consists of the 10 per cent of households with the lowest incomes, Decile 2 the 10 per cent with the next lowest and Decile 10 the 10 per cent with the highest incomes. The distribution of some characteristic within a decile is often expressed in terms of *percentiles*, where the fiftieth percentile is the median value of the characteristic in question. If the characteristic is energy use, then the twentieth percentile, for example, is the amount of energy used by the household that is 20 per cent along the energy distribution.

The first research task for this part of the project was an investigation of the distribution by income decile of UK household energy expenditure, use and carbon emissions. This information was then used to examine the workability of combining a carbon tax to encourage emission reductions with compensation through the benefits system or exemptions from the tax for low-income households. It was found that, because of the extreme variation in the energy use of low-income households, and contrary to the initial hypothesis of the research, it is *not* possible to provide effective compensation to low-income households for the tax in the way that had been envisaged. The corollary is that a different approach is required if the issue of carbon emissions from non-poor households, as well as that of fuel poverty, is to be addressed. The next section goes into these issues in more detail, and outlines a possible policy approach to reducing the carbon emissions from non-poor households.

Results

Examination of the relationship between income and household energy use early established that there is enormous variation in household energy use within income deciles. In fact, those at the eightieth percentile of energy consumption in the lowest (equivalent income) decile[1] consume nearly six times as much energy as the twentieth percentile of the decile and more than three-and-a-half times as much energy as those at the twentieth percentile in the highest decile. The variation in carbon emissions is not as great, but is still very substantial. It also emerged that the poorest households pay substantially more per unit of energy than the richest households: the median price for those in the tenth decile was 2.8p/ kWh, compared to 3.29p/kWh, 20 per cent more, for those in the first decile. A carbon tax imposed equally on richer and poorer households, without any compensation for poor households, would therefore be very regressive and would add to the unfair price burden these households are already experiencing.

One approach to this problem would be to introduce a new benefit for low-income households (for example, for those already on means-tested benefits), which would pay their carbon tax payments for them (analogously to Housing Benefit, which pays eligible households' rents). Establishing and administering such a new benefit might be feasible, but it would certainly be both complex and expensive, requiring the relevant benefit office(s) to obtain information about the annual energy consumption of millions of households. It would certainly be simpler to seek to compensate households for their carbon tax payments through the current benefit system, and this is what has been explored here.

About 70 per cent of households receive a state benefit, including many wealthy households because of universal benefits, while 30 per cent of households receive income-related benefits. The proportion of households receiving income-related benefits is over 60 per cent in the lowest three deciles, but it falls sharply to only a few per cent in the highest deciles.

A variety of ways of compensating poor households was examined, using means-tested benefits, child benefit, adjustments to pensioners' Winter Fuel Allowance (WFA) and modifying the carbon tax. The various compensation packages are summarised in Table 2. Figures 1 to 6 show the results of the compensation packages graphically, for the bottom three deciles, households with equivalent incomes of less than £11,065.

The first point to be seen from Figure 1 is that, for the lowest decile, all the tax-plus-compensation packages are progressive on average (that is, the average household is a net gainer). The amounts gained range from £1.77 per year (Package Number [PN]1) to £118.14 per year (PN13).

Figures 2 and 3 show that the same is true for Deciles 2 and 3, except in respect of PN11 when, not surprisingly, nearly all pensioner households lose out from the redistribution of some of their Winter Fuel Allowance to non-pensioner low-income households. Essentially, these results substantiate the hypothesis on which this research was based, namely that it is possible to make a carbon tax, such as that imposed, progressive for the average household in the lowest deciles.

However, the enormously skewed distribution of energy consumption *within* the income deciles means that the average result conceals great differences in net gains and losses within each decile. Figure 4 shows that none of the compensation packages manages to reduce

Table 2 Summary of compensation packages (package number)

Compensation package	Results
CTPens1 (1)	Pensioner households, with winter heating allowance increased by 90p a week
CTPens2 (2)	Pensioner households, with increase of Minimum Income Guarantee (MIG) of £1.90/3.05 a week
CTChild1 (3)	Households with children, with increase in family element in Child Tax Credit (CTC) of £1 a week
CTChild2 (4)	Households with children, with increase in amount per child in CTC (and Housing Benefit/Council Tax Benefit) of £1.30 a week
CTAllPT (5)	All households, increase in means-tested benefits
CTAllFT (6)	All households 100 per cent take-up, increase in means-tested benefits
MCTAllPT (7)	All households, modified carbon tax, partial take-up, increase in means-tested benefits
MCTAllFT (8)	All households, modified carbon tax, 100 per cent take-up, increase in means-tested benefits
MCTPensFT (9)	Households with pensioners, modified carbon tax, 100 per cent take-up, increase in means-tested benefits
MCTWFA1AllFT (10)	All households, modified carbon tax, 100 per cent take-up, reduce Winter Fuel Allowance by £100 per annum and increase means-tested benefits
MCTWFA1PensF (11)	Households with pensioners, modified carbon tax, 100 per cent take-up, reduce Winter Fuel Allowance by £100 p.a. and increase means-tested benefits
MCTWFA2AllFT (12)	All households, modified carbon tax 100 per cent take-up, reduce Winter Fuel Allowance by £100 p.a. and increase means-tested benefits targeted on Pension Credit
MCTWFA2PensFT (13)	Households with pensioners, modified carbon tax, 100 per cent take-up, reduce Winter Fuel Allowance by £100 p.a. and increase means-tested benefits targeted on Pension Credit

the proportion of Decile 1 losing households much below 20 per cent, and the five that do get slightly below this figure (PN6, PN8, PN9, PN12, PN13) all assume a 100 per cent take-up of the relevant means-tested benefits, which is clearly unlikely to be achieved. With the take-up of benefits at current (partial) rates, none of the compensation packages reduces the proportion of all households in Decile 1 that lose out much below 35 per cent (PN7 gives the lowest result at 34.9 per cent); 1.3 per cent of Decile 1 households in this case lose more than £2 per week.

Figures 5 and 6 show that the pattern is largely repeated in Deciles 2 and 3, except that an even higher proportion of households lose out and, with some packages, a greater proportion by more than £2 per week.

Figure 1 Decile 1

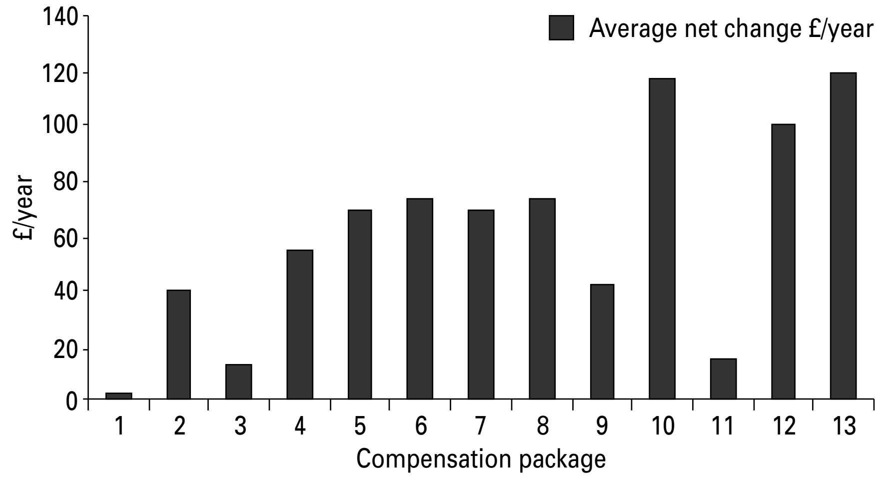


Figure 2 Decile 2

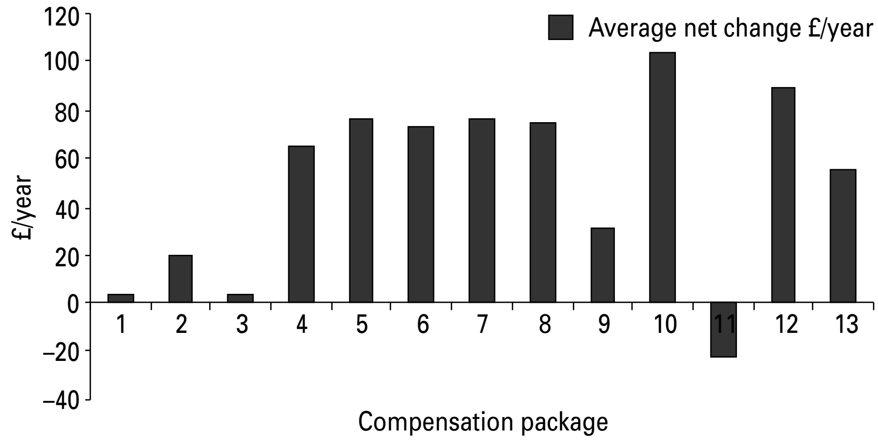


Figure 3 Decile 3

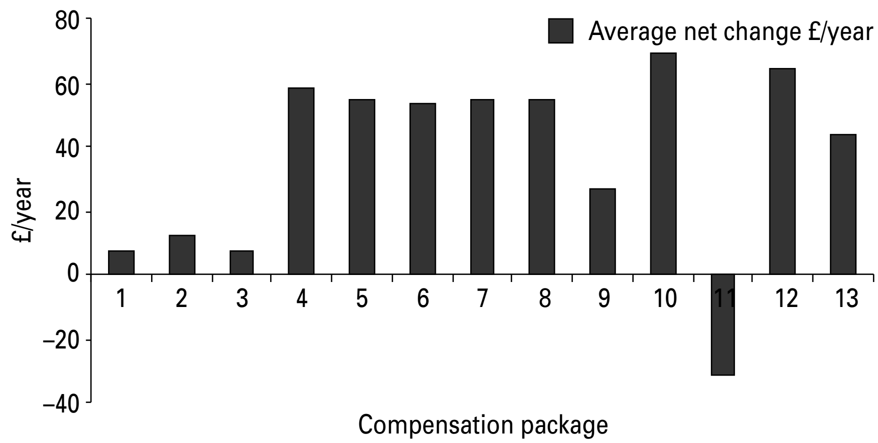


Figure 4 Gainers and losers: Decile 1

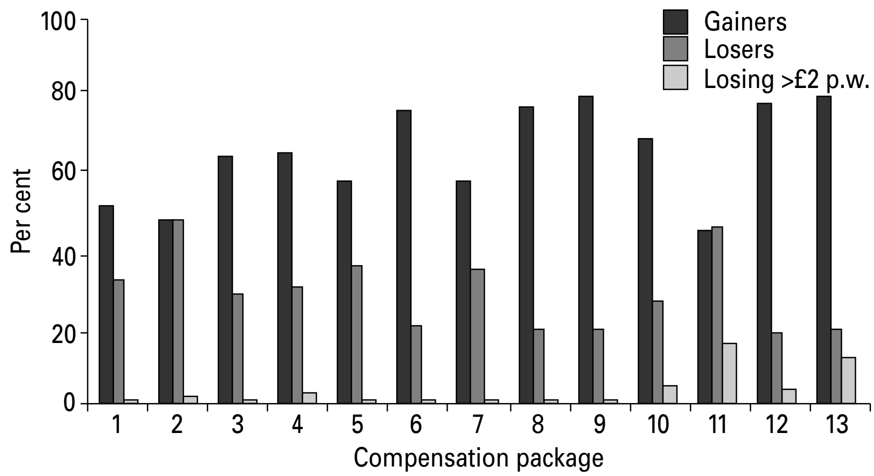


Figure 5 Gainers and losers: Decile 2

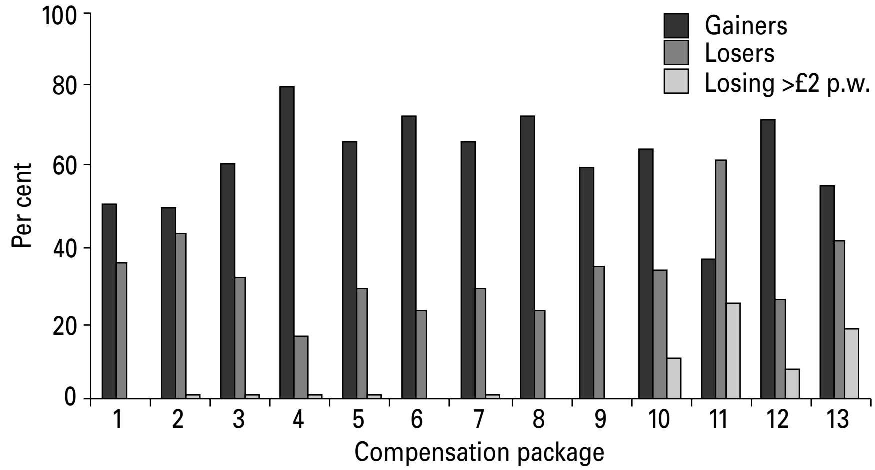
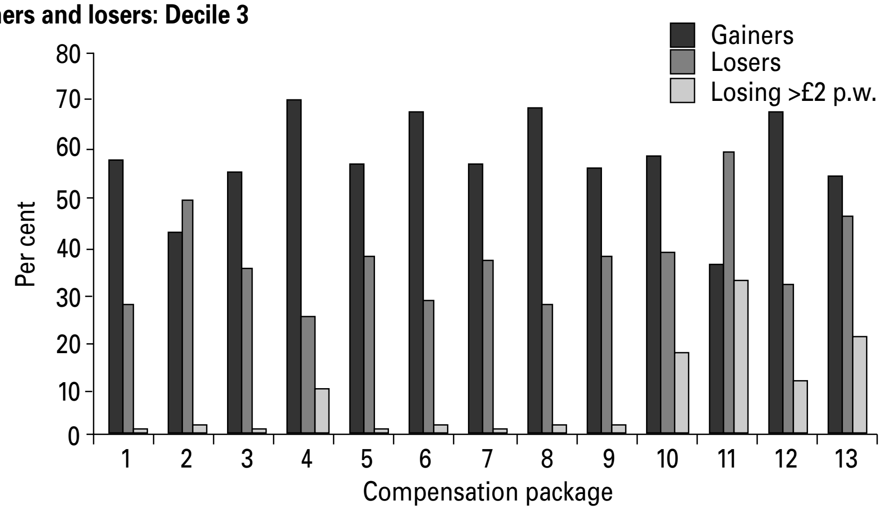


Figure 6 Gainers and losers: Decile 3



It is of course a political judgement whether such an outcome – broadly progressive, with reduced carbon emissions, bringing some households out of fuel poverty but with a significant negative impact on the third of households that are likely to be deepest in fuel poverty – would be socially acceptable. It would of course be campaigned against by those representing those among the fuel poor who are made worse off. Possibly, they would be joined in their campaign by the better off who might also not welcome the substantial overall redistribution in favour of poorer households that a package like PN7 (the partial benefit package with least Decile 1 losers) represents. This makes this approach to increasing household energy efficiency politically problematic at best, and probably politically infeasible.

Alternative approaches

There are a number of government programmes (for example, Warm Front and the Energy Efficiency Commitment) seeking to insulate the homes of low-income households in order to reduce, and ultimately abolish, fuel poverty. One response to the results reported above would be to continue with, or intensify, these programmes, and to return to the issue of imposing a carbon tax to incentivise the take-up of energy-efficiency measures by the non-fuel poor once the fuel poverty problem had been substantially addressed. This would amount to accepting a rise in household carbon emissions over at least the next ten years, which is hardly compatible with the ambitious carbon-reduction targets to which the government says it is committed. Moreover, because the continuation of these programmes would still leave a substantial number of houses, at present occupied by the non-fuel poor, in their current, badly insulated condition, fuel poverty could always return if these houses became occupied by those on low incomes.

An alternative, more ambitious, approach would seek systematically to exploit the fact that many households could make themselves better off by implementing energy-efficiency measures. Such an approach might seek to persuade households to install all cost-effective measures by imposing a 'climate change surcharge' on all households that, after a certain period of time, did not do so.

Under such an approach, to avoid paying the surcharge, householders would first need to have an energy audit of their home. Such audits are currently widely available and, under the EU Directive on the Energy Performance of Buildings, will from 2006 in any case have to be carried out for all houses that are being sold, so that prospective buyers will know their likely energy bills if they were to buy the house.

The energy audit could identify all cost-effective measures that householders would need to implement within a specified period of time to avoid the climate change surcharge. It would probably make sense to administer the scheme through the local taxation system, such as currently through Council Tax, but it could perhaps be administered through the energy billing system. Similarly, an avoidable surcharge on Stamp Duty could encourage householders to install the measures when moving into a new home.

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

Because not enough qualified installers of energy-efficiency measures exist to carry out this work all at once and it would take time to train sufficient installers to increase the current rate of energy-efficiency improvements to the housing stock, the scheme could be implemented over, say, ten years, starting with the highest Council Tax bands (those who could best afford to carry out the home improvements) and working down the bands over the years. Each year, householders in the relevant band for that year could be notified that, if they wished to avoid the climate change surcharge in succeeding years, they would need to implement all cost-effective energy-efficiency measures in their home. They could be advised how to obtain an energy audit of their home, which would deliver them a certificate listing all such measures. On completion of these measures by a qualified installer (chosen by the householder from a list of recommended installers), they would receive an implementation certificate, which they would send to the appropriate office to forestall or cancel the surcharge in the future. All households that implemented all cost-effective measures within a year of notification would therefore pay no surcharge. For most households, the financial savings following implementation of the measures would be substantial.

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

Thirty per cent of Council Tax payers in England are tenants (ODPM, 2002). It would not be fair to expect them to pay for energy-efficiency improvements to the properties they live in or for them to have to pay a surcharge because their landlord did not pay for the necessary improvements. Social landlords already have an obligation to bring their properties up to a specified ‘Decent Homes’ standard, and achievement of this would exempt them from having to undertake further measures over the lifetime of the scheme. One solution for tenants in the private sector would be to give them the right to deduct any imposed surcharge from their rent. In that way, the responsibility for making the improvements would be transferred from the tenants to the landlords with whom it should belong.

Once houses had been made energy-efficient, there would be little continuing rationale for the winter fuel payment to those over 60. This could be phased out, the savings in public expenditure being channelled into energy-efficiency measures for low-income households.

Implementation of such a scheme would save a minimum of 10 per cent of household carbon emissions (about 4 mtc). The measures would cost householders £6.4 billion, but would save them a net present value of £19.7 billion. The average rate of return to householders would be 23 per cent. Overall, it would result in the whole housing stock being brought up to a cost-effective level of energy efficiency over ten years, greatly reducing fuel poverty, as well as saving carbon emissions, in the process. Over the subsequent ten years, a further programme could concentrate on hard-to-heat homes (such as those with solid walls), which would still be excessively energy intensive. The programme could be financed through a carbon tax imposed on those homes that had already been insulated (with redistribution through the benefit system now being able effectively to compensate those on low incomes because the households in hard-to-heat homes could be identified for assistance). Twenty years after the beginning of the process, the UK housing stock would at least have been brought up to the level of efficiency to match the rest of Northern Europe. Fuel poverty would be a phenomenon of the past except in cases of severe under-occupation. Carbon emissions would be substantially reduced. And most householders would be financially better off because of their more efficient use of energy, even taking the carbon tax into account. The only losers would be those householders who wished to continue to exercise their right to use energy in their homes inefficiently, or those whose dislike of the process of upgrading their home (and the inevitable administration and possible disruption this might cause) exceeded the net financial benefit they would receive. Their costs might be considered justified in the light of their excess contribution to climate change.

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

Conclusions

Household energy use varies widely between households, even those with similar incomes. While a carbon tax on household energy use is desirable for environmental reasons, it would have a greater proportionate impact on most low-income households than on richer ones (i.e. it would be regressive), unless the poorer households were compensated in some way. A new benefit, which paid the carbon tax for these households, would remove the regressivity, but would be complex and expensive to administer. Using the current benefit system, it would not be difficult to design a compensation scheme to remove the regressivity for low-income households on average, but their wide variation in energy use means that some low-income households could still be left significantly worse off. This might make such a tax politically unacceptable.

Current government policies in this area rely principally on subsidising the installation of energy-efficiency measures in houses, with the measures aimed mainly at those in fuel poverty. It is unlikely that such an approach will even prevent household emissions from growing in future, let alone result in households making a positive contribution to the government's carbon-reduction targets.

Another way of incentivising the installation of energy-efficiency measures in non-fuel-poor households would be to impose a climate change surcharge on those households that did not install cost-effective energy-efficiency measures within a specified time. The scheme discussed in this report would effectively abolish fuel poverty, could achieve carbon savings of 4 mtc over ten years and save households nearly £20 billion net present value for an investment of £6.4 billion. It would also eventually permit a non-regressive carbon tax to be imposed, which could militate against the growth of household carbon emissions in the future. The fact that such a scheme currently seems not to be considered politically feasible suggests that the public and political will to mitigate climate change is not yet very powerful.

3 Household water use

Background

The need to manage water use
England is generally thought of as a wet country, but in fact rainfall in much of the country is moderate (and East Anglia is officially semi-arid), while the population density is high, especially in the South of England. As a consequence, England has less water resources per capita than Spain or Portugal. In the Thames Water region, water resources per capita are less than in Ethiopia or Sudan (World Resources Institute, 1999).

Water usage in England and Wales rose more or less continually during the twentieth century and particularly after the Second World War. Per capita consumption rose dramatically between 1961 (87 litres per person per day) and 1999 (146 litres per person per day). However, because industrial demand for water has been falling since the 1970s, total water usage increased more slowly. It peaked in 1996 and by 1999 had fallen around 15 per cent to the levels of the mid-1970s (National Consumer Council, 2000, 2002). The main reason for the dramatic fall was that, after the 1996 drought, Ofwat gave the water companies strict and binding targets for leakage reduction. However, leakage reduction is a one-time gain and even by 2001/02 leakage was already increasing again, particularly in the Thames region (Environment Agency, 2002).

Total future water demand in England may either rise or fall over the period until 2025 depending on the extent to which water-conservation policies are followed (Environment Agency, 2001). In parts of the country, particularly the South and East, population increases are expected that would be likely to place additional demands on water resources. Unfortunately, the South and the East are the two regions that already have the greatest difficulties in meeting demand. Many regions already have excessive river abstraction and the southern and eastern regions also have unsustainable groundwater abstraction. The South and the East are beyond their sustainable use of water resources. Other regions are at or near the limits. Only in the North East is there additional water available. In regions other than the North East, there is little capacity to increase the water supply (Environment Agency, 2001). That means that the capacity to meet increased demand is very limited. In addition, expected climate change over the next decades causing hotter and drier weather will reduce the supply of rainwater and is likely to increase demand for water. The effect of climate change on water resources is likely to be particularly pronounced in southern and eastern England.

In this situation, it is curious that the water usage of most households in the UK is not measured. Among OECD countries, only the UK and Ireland do not measure the water use of most households (OECD, 1999). Consequently, UK water companies generally have very poor data on how much water is being used by households in different areas, and what factors influence that use. Their ability to manage the household use of water, and indeed households' ability to manage such use themselves, is low. The contrast between water and other utilities (gas, electricity, telephone), the use of all of which is measured on a unit basis, is marked. The need to measure water use in order to manage it is a strong argument in favour of universal water metering, especially in those regions that have been or may be affected by water shortages.

Especially in a context of increasing household water demand, another argument in favour of metering is that it can help to conserve water – metering has been found to reduce water consumption by about 10 per cent on average (National Metering Trials Working Group, 1993). It is in fact not surprising that people tend to use less water when they pay for it on a per unit basis than when it is free at the point of use, and this difference would be likely to become more marked either as people moved towards less water-intensive equipment (which would then save them money), or water became more expensive, because of increasing scarcity.

Concerns over water metering

One argument against metering is that there are cheaper ways of conserving water, as shown in Table 3. For instance, low-flush toilets reduce total water consumption by nearly as much as metering does, but low-flush toilets cost less than metering does. Water metering costs £20–30 per household per annum. However, it is not clear how people will be persuaded to install low-flush toilets, efficient appliances and water-saving taps and showerheads if they do not have any incentive to do it. Nor is it easy to establish how much water they would in fact save when the water consumption to which they relate is not measured. The point of water

Table 3 Cost-effectiveness of different demand-supply options

Demand management option	Demand management cost (p/m^3)	Ratio to cost of increasing water supply: Low-cost supply	Ratio to cost of increasing water supply: High-cost supply	Likely water savings: Ml/day	Likely water savings: Per cent of input
Leakage control target (4.05 l/p/hr)	19.7	0.5	0.3	3,151	18.5
Compulsory universal metering	94	2.5	1.4	1,233	7.2
Voluntary metering	113	3.0	1.7	538	3.2
Compulsory metering – sprinkler users	51	1.3	0.8	240	1.4
Metering as part of rehabilitation works	36	1.0	0.6	1,233	7.2
Converting 9-litre WCs to 7.5-litre	27.2	0.7	0.4	543	3.2
Converting 9-litre WCs to dual-flush	17.2	0.5	0.3	858	5.0
£100 subsidy to replace pre-1981 WCs with 6-litre WCs	74.5	2.0	1.1	268	1.6
Natural replacement of pre-1981 WCs with 6-litre WCs over 20 years	–	–	–	357	2.1

Source: Clark *et al.* (1998a, p. 10)

metering is not just to gain the 7–10 per cent reduction in water consumption that occurs initially, but also to create a situation where people will install water-saving equipment in future, and where the result of them doing so will be apparent.

Another argument against water metering is that increased water demand can be addressed by increasing supply, as has been done in the past. In pure financial terms, as Table 3 shows, increasing supply is more expensive than leakage control, converting 9-litre WCs or metering as part of rehabilitation works (Clark *et al*., 1998a, p. 10). It is about as expensive as the compulsory metering of sprinkler users, but cheaper than universal metering, while voluntary metering (the current situation in the UK) is the most expensive option of all.

However, these comparisons do not take into account the environmental costs of increasing supply in terms of damage to wetlands and estuaries, and consequent loss of habitat and biodiversity (Clark *et al*., 1998a, pp. 6–7). The case for water metering, as opposed to increasing supply, rests on environmental arguments. Increasing abstraction of river water and groundwater is cheap, but unsustainable in the long term. Building more reservoirs is more expensive financially and involves using up land, and may be no cheaper than water metering. It clearly has a much greater environmental impact than water metering. In most of England and Wales, there is little or no capacity to increase water supply without unacceptable environmental impacts (Environment Agency, 2001).

It is also argued that water metering is unfair because most of the costs of the industry are fixed. John Thackray of the Public Utilities Access Forum has estimated that they can be divided as shown in Table 4.

Opponents of metering argue that most of these costs are not dependent on the quantity of water used, so charging on the basis of use is irrelevant. However, the quantity of water used does have an impact on cost. The social costs of additional marginal use of water are high, particularly in regions that are short of supply and are making unsustainable use of abstraction. What is more, the rising water consumption by households in recent years is entirely accounted for by increases in non-essential uses. Not charging for use means that there is no incentive for less wasteful use. It is important to note that, when Ofwat surveyed consumers, they identified water metering as

Table 4 Summary of water industry costs

Industry cost	Per cent
Water supply pipe network	30
Water resources and treatment	20
Sewer network	10
Sewage treatment and disposal	20
Rainwater disposal from properties	10
Highway drainage	10

Source: Thackray (1997)

the fairest way to pay for water (National Consumer Council, 2000).

Another particular concern that is often expressed about water metering is that it can lead to poorer households cutting back on essential uses such as personal hygiene. There is some evidence to support this concern (DoE/ Ofwat, 1992; Consumers' Association, 1996), but attempts to prove that this leads to higher rates of disease have failed to show a link (Clark *et al*., 1998a). Nonetheless, the British Medical Association (BMA) has stated that water is vital to halting the chain of infection and should therefore be available to all at an affordable price (BMA, 1994).

However, it is not the intention of this chapter to seek to adjudicate between the arguments for the various options in Table 3. Rather, the chapter is based on an acknowledgement that there are strong arguments in favour of water metering and that metering may therefore be introduced into the UK on a universal basis, as it has been in other countries. The research described in this chapter is addressed to the question of what charging structures relating to metering could be introduced in order to limit the financial impact of metering on low-income households, should metering be introduced. In order to consider this question, it is necessary first of all to consider how the household use of water is currently paid for in the UK.

Current methods of water charging

The traditional method of charging domestic customers for water in the UK has been on the basis of rateable values (RVs), a hangover from the days of local authority ownership of the water supply. The water bill is divided into a standing charge (the same for each household) and an additional charge based on the rateable value of the home. Some water companies make the standing charge the main element of the bill; others make the rateable value the main element of the bill. RVs were last assessed in 1973, so they bear little relation to present property values. Other anomalies in the valuation system are that RVs are lower for houses than for equivalent flats and that RVs tend to be very low for rural properties and pre-1919 properties, even if they are large and valuable (Thackray, 1997). The rateable value system was abolished for local government taxation in 1989 and nearly all homes built or substantially renovated since 1990 have had water meters installed. In 1989, it was legislated that RVs would be abolished for water-charging purposes in 2000 and replaced with an unspecified alternative system, but the deadline was deferred into the indefinite future by the 1999 Water Industry Act.

Water metering became an option for existing properties in 1990. By 1999, 17 per cent of households were metered (National Consumer Council, 2000). Since 2000, households have had the right to the free installation of a meter and the proportion metered had reached around 23 per cent by 2002 (Ofwat, 2002). A complaint made against the optional metering that exists now is that the people who take it up tend to be small households in larger properties, generally richer than the average. Because variable costs are only a proportion of the costs of the water industry, what happens is that the bills of people who are not metered, generally poorer, increase (National Consumer Council, 2000). Obviously this could be addressed by increasing the volumetric charge to metered customers, but this would reduce the incentive to switch to metering. Another source of contention is that, also in order to encourage people to switch to metering, the additional administrative costs of metering and billing are not borne by those being metered, but shared among all consumers, which is effectively a subsidy of the metered by the non-metered. Since those opting for voluntary metering tend to be the better off who live in high rateable value homes, and the non-metered tend to be poorer, in this respect poorer consumers are subsidising richer consumers. On the other hand, as noted above, the RV system is itself an extensive system of often illogical cross-subsidies. In particular, those in rural areas are heavily subsidised by those in urban areas. They impose higher costs, yet often they actually pay less. An even more illogical subsidy is of those in older houses by those in more modern properties because of the characteristics of the RV system.

As noted above, most households in other OECD countries except Ireland are metered (OECD, 1999), but water charging in England and Wales has a higher proportional impact on poorer households than in any other of nine OECD countries surveyed except possibly Mexico (OECD, 2003, p. 61). Although the average proportion of disposable income spent on the water supply in England and Wales is 1.2 per cent, which is about average, the proportion of income spent by the lowest decile is 3.75 per cent, the second highest among the nine OECD countries compared – Mexico is just ahead at 3.84 per cent. In no other country was it above 2.53 per cent. The ratio of the burden on the lowest-income group compared to the burden on the average is highest in England and Wales (3.1), followed closely by Mexico (3.0). This shows that the widely repeated claim that water metering *necessarily* has a greater proportional impact on poorer households than the RV system used in the UK is quite false.

The reason why the current system of water charging in England and Wales is so regressive is probably because a large proportion of unmeasured water bills consist of a standing charge that is the same across all households in the water company's area. Only a proportion of the bill is based on rateable value. This is one of the aspects examined in the metering tariff structures explored later in this report.

Past research on metering

There is some previous work on the effect of water metering in the UK. The Institute for Fiscal Studies (IFS) examined the question of the regressivity of water metering in England and Wales in 1993 (Pearson *et al.*, 1993). Assuming that there was a fixed charge of £30 per household irrespective of consumption (to cover the fixed costs of metering each household) and that the remainder of the cost would be based on water usage at a flat rate per cubic metre, they found that the bottom three deciles break even on average. The middle four deciles lose a little, the eighth decile breaks even, the ninth decile gains a little and the top decile gains a great deal. That is because the top quintile actually uses less water than the third and fourth quintiles because it tends to live in smaller households.

Because a certain amount of water use is vital for both health and hygiene, a popular idea in the design of socially conscious water tariffs is the idea of a 'lifeline' allowance of free or fixed-cost water to cover essential uses. The intention is to prevent water metering resulting in poor households sacrificing hygiene in order to save money. In Flanders, each individual is given a 'free' allowance of 15 m^3 of water per annum (equivalent to 41.1 litres/day) to cover essential use, with metered payment for use above that amount (OECD, 1999), but, without an identity card system, this would be difficult to implement in the UK. Herrington (1996) instead proposed an allowance of 60 litres per person per day based on one adult plus the number of children in the household, using child benefit records.

A study by OXERA (Clark *et al*., 1998a, 1998b) for UK Water Industry Research used data from the Severn Trent Domestic Consumption Monitor (DCM), which enabled them to predict what would be the effect on individual households of different water-metering tariffs. The tariffs involved different combinations of a standing charge, unit price, free allowances, increasing unit prices for increasing levels of water use (the 'rising block' tariff), selective metering of households in higher Council Tax bands and summer surcharges.

OXERA first attempted to assess the environmental benefits in terms of demand reduction from the different tariffs, based on the ranges identified in a review of the literature. The demand reduction varied from 8 to 28 per cent, depending on whether a low or high demand reaction was assumed, with the latter rising to 36 per cent of summer demand with a summer surcharge. In terms of distributional results, and using pessimistic assumptions about cost reductions from a switch to metering, OXERA found that the first three tariffs – the standard tariff, the rising block tariff and the summer surcharge tariff – make about half of households better off, and half of households worse off.

Approach

The research undertaken by PSI in the present project has used data kindly provided by Anglian Water, divided between metered and unmetered households. The crucial difference between this data and the Severn Trent data used in the earlier studies is that it provides information about household incomes. For the first time in the UK, it is possible to directly examine how water consumption varies in relation to income. That means it is also possible to directly examine the distributional impact of different universal water-metering tariffs.

Although a simple regression analysis found that household income does correlate with household water consumption, a multiple regression analysis gave the rather surprising result that it is not a higher income itself that makes households use more water, but other factors (for example, having a garden, courtyard or sprinkler) that tend to correlate with income. In terms of quantity of water use, the data shows that the first adult in a household on average uses around 140 litres/day (50 m^3/year). A second or additional adult uses around 100 litres/day (35 m^3/year). A child uses around 60 litres/day (20 m^3/year). The figures for unmetered households are somewhat higher and the figures for metered households are somewhat lower.

The range of usage even by households with the same number of adults and children paying on the same basis is quite wide. Households at the ninetieth percentile use between two and three times as much water as equivalent households at the tenth percentile. Households at the eightieth percentile use nearly twice as much water as equivalent households at the twentieth percentile. It is not clear that this extra use by such a large number of households, compared to similar households, can be justified on the basis of medical conditions or similar needs.

A number of approaches were taken to designing metering tariffs, in simulations of metering using the Anglian data, in order to study the distributional effects and, particularly, the effects of metering on low-income households. It has already been noted that the current system of water charging (still predominantly based on rateable values) is more regressive than in other industrialised countries that have universal or nearly universal metering of household water use. It is most unlikely that universal metering will be regarded as politically acceptable in the UK if it makes this existing regressivity worse. At the same time, given the range of water usage even between similar households revealed by the Anglian data, it is also most unlikely that any switch to metering will leave *no* low-income household worse off, unless it involves a degree of cross-subsidy of poorer households by richer households that is also likely to be politically problematic. The politics of water metering needs therefore to take account of three factors: factor one, the overall regressivity of the system; factor two, the negative impacts on individual, high-water-using, low-income households; and, factor three, the degree of redistribution (from richer to poorer households) that is required to reduce factors one and two. The results that are reported from the simulations for different tariff options therefore focus on these factors.

As noted above, a certain amount water use is vital for both health and hygiene. For this reason, a popular idea in the design of socially conscious water tariffs is the idea of a 'lifeline' allowance of free or fixed-cost water to cover essential uses. The intention is to prevent water metering resulting in poor households sacrificing hygiene in order to save money.

The simulations that have been modelled, comprising 11 different tariff options in all, are of five types:

- a simple switch to water metering on the basis of the Anglian tariff (see Table 5)
- a switch to water metering using tariffs that vary by Council Tax band
- a switch to water metering that incorporates a lifeline allowance that may also vary with Council Tax band
- a switch that involves a combination of tariffs and a lifeline allowance that may also vary with Council Tax band
- a switch using the Severn Trent tariff (see Table 5).

In all the simulations, it has been assumed that there were no demand reductions induced by the switch to metering. This is unrealistic. To the extent that metering induces demand reductions (which, in line with the results in the previous section, could be from 7–28 per cent, assuming no summer surcharge), and especially if these reductions are concentrated in high-water-using households, the negative financial effects of the switch on high-water-using households will be reduced.

As can be seen, some of the simulations differentiate between households on the basis of their Council Tax band. Council Tax is regressive,

Table 5 Anglian Water and Severn Trent Water Zone 4 tariffs (£) for April 2002–March 2003

	Water		Sewerage	
	Anglian	Severn Trent	Anglian	Severn Trent
Unmetered				
Standing charge	69.12	0	91.89	0
RV multiplier	0.3678	0.5863	0.4807	0.5290
Metered				
Standing charge	20	16.68	44	8.40
Volumetric charge/m^3	0.8144	0.7077	0.9688	0.4820

Note: in addition, metered Severn Trent customers (but not unmetered ones) pay a property-based fixed charge for surface water drainage of £15.72 for a flat or terrace, £31.44 for a semi-detached and £47.16 for a detached house

in that a Band H property is worth at least eight times as much as a Band A property (and incomes between the top and bottom deciles vary by much more than this), but the Council Tax paid, which is calculated on the basis of the ratio of the band in question to Band D, is only three times as much. In some of the simulations that follow it was therefore decided to use Council Tax bands, but 'stretch' them so that the amount paid was roughly proportional to the value of the property in 1991, in the manner of rateable values. The actual 'stretched' ratios used are reported in Dresner and Ekins (2004b).

Table 5 shows Anglian Water and Severn Trent tariffs for 2002–03, from which it can be seen that the most significant difference is that, uniquely among water companies, unmetered Severn Trent customers pay no standing charge, and metered Severn Trent customers pay lower standing charges.

According to Ofwat, the tariff differential for Anglian Water customers in 2002–03 was £20. That is to say that, if a household with average rateable value switched from the unmetered to the metered tariff and had water consumption equal to the average unmeasured household, they would pay £20 more, calculated as a contribution towards the cost of metering. Of course, households that actually switch to metering tend to have higher RVs and use less water than the average, so that the switch is financially advantageous to them.

Results

Table 6 sets out a number of the results from the simulations that reflect the three key political factors described above. The analysis focused on whether, on average, households in the lower-income bands (less than £10,000 and £10,000–20,000 per annum) would be better or worse off with the various options than they are with the Anglian tariff (i.e. if options made effects less regressive), and the proportion of households in these income bands whose costs would rise by more than £1 a week. It also considered whether the various options would be redistributive by looking at the extent to which households on incomes of £40,000 plus lost out, and lost out by more than £1 a week.

Table 6 Comparison of results from various metering tariff options

	Households <£10,000		Households £10–20,000		Households >£40,000	
	Average loss or gain £ p.w.	Proportion losing more than £1 p.w. (%)	Average loss or gain £ p.w.	Proportion losing more than £1 p.w. (%)	Average loss or gain £ p.w.	Proportion losing more than £1 p.w. (%)
Option 1	+0.34	8	–0.02	15	–0.09	17
Option 2	+0.67	9	+0.39	10	–0.14	21
Option 3	+1.09	6	+0.81	12	+0.36	37
Option 4	+0.59	9	+0.24	15	–0.50	33
Option 5	+0.31	12	+0.01	15	–0.17	25
Option 6	+0.39	11	+0.08	15	–0.31	26
Option 7	+1.48	13	+0.79	20	–1.83	57
Option 8	+2.20	10	+1.49	14	–3.11	43
Option 9	+1.16	8	+0.93	11	–2.00	45
Option 10	+0.72	12	+0.50	13	–1.19	47
Option 11	+1.57	18	+0.81	23	–1.69	55

The various tariff options are set out below. The results quoted are for both currently metered and RV Anglian customers, apart from Option 1. All results assume that there has been no demand reduction as a result of metering.

Option 1 Metering with existing Anglian Water tariff (effect on RV customers only, no effect on existing metered customers).

Option 2 Metering with the volumetric rate varying according to current Council Tax bands.

Option 3 Metering with the volumetric rate varying according to stretched Council Tax band ratios.

Option 4 Metering with standing charge varying according to stretched Council Tax band ratios.

Option 5 Metering with a fixed lifeline allowance of 15 m^3 per capita and an increased price per litre of water.

Option 6 Metering with a fixed lifeline allowance of 20 m^3 per capita for the first adult and each child and an increased price per litre of water.

Option 7 Metering with an allowance varying according to Council Tax band.

Option 8 Metering with both a lifeline allowance and the charge per litre of water varying according to stretched Council Tax band ratios.

Option 9 Metering with a fixed lifeline allowance of 20 m^3 per capita for the first adult and each child, and the charge per litre of water varying according to stretched Council Tax band ratios.

Option 10 Metering with a fixed lifeline allowance of 20 m^3 per capita for the first adult and each child, and the charge per litre of water varying according to current Council Tax band ratios.

Option 11 Metering with both the standing charge and lifeline allowance varying according to current Council Tax band.

First, from Table 6 and Figures 7, 8 and 9 it can be seen that all the investigated options are progressive from the point of view of the lowest-income households and all but one (Option 1) are also progressive for the next income group (those with incomes of £10–20,000). Moreover, a very similar result for Option 9 was obtained using the Severn Trent rather than the Anglian Water tariff, with its high standing charges. This shows that the result was not a function of the structure of the Anglian tariff. It is likely to hold across all water customers, whatever their water company. There is therefore no basis for supposing that switching to metering will, on average, make low-income households worse off. All the options investigated actually make them better off on average, some quite substantially so. In view of the fact that current water-charging systems are generally regressive, many would consider that a switch to such tariffs entailed a fairer treatment of water customers.

Second, there is no tariff that does not make 6 per cent or more of the lowest-income households worse off by more than £1 per week. These will tend to be the highest water-consuming households in this income group. For some of them, their high water use will reflect discretionary rather than essential use and a cutback in that use would reduce these extra charges they would pay under metering (Options 5–11 include a lifeline allowance, to reduce the likelihood of cutbacks on essential water use). It may be noted again that the calculations above assume no reduction in discretionary use of water as a result of the metering, so they clearly represent the maximum likely cost impacts. Where the high water use of losing households is essential, this is likely to be because of medical reasons and it should be possible to make special arrangements. The government has already introduced a vulnerable groups scheme (DEFRA, 2003), which caps the bills of those identified as having high essential water use and efforts could be made to boost the currently low take-up of the scheme by those who are entitled to its benefits. In these two ways, it is likely that the great majority of low-income households would be able to reduce any extra charges they would face under the metering tariffs.

Third, the tariffs vary considerably in the degree of redistribution from richer to poorer that they bring about (as noted above, all are redistributive in this direction to some extent). The least redistributive (the option that benefits low-income households least) is Option 5, with the average cost to the richest households being only £0.17 per week and only 25 per cent losing more than £1 per week. The option that benefits low-income households most, and in which the richest households lose more than £3 per week, is Option 8.

Which of these tariff options is 'best' depends on political perspective. Option 3 (volumetric rate varying according to stretched

Figure 7 Household income <£10,000 per annum

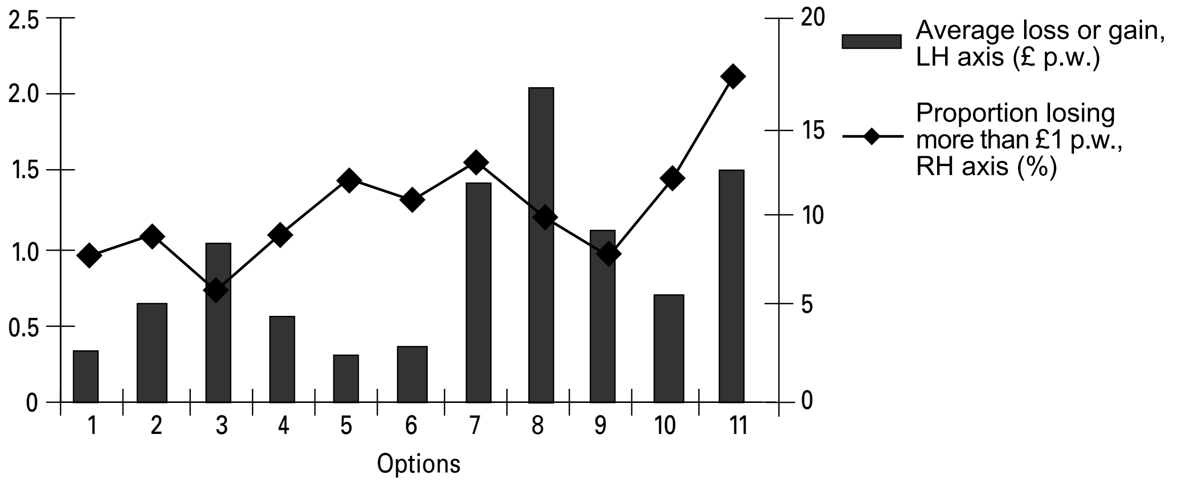


Figure 8 Household income £10–20,000 per annum

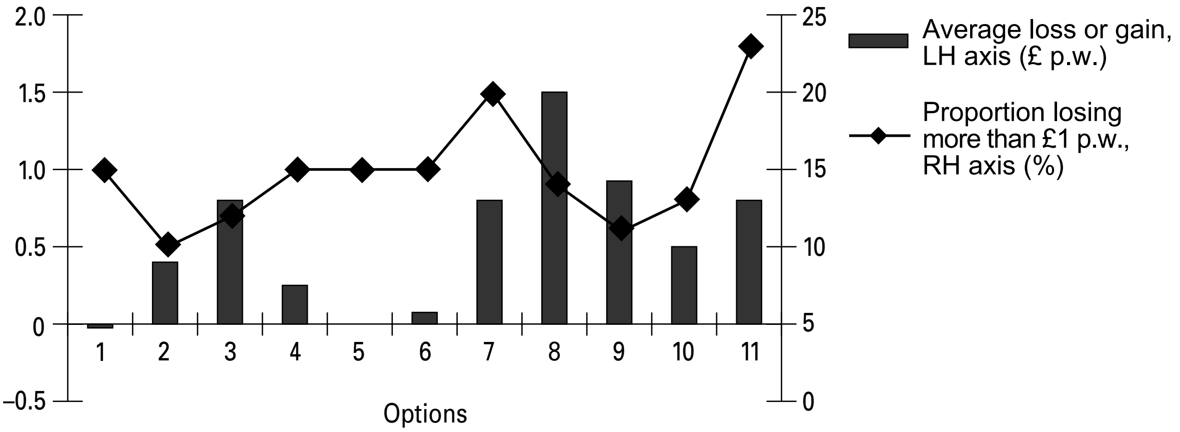
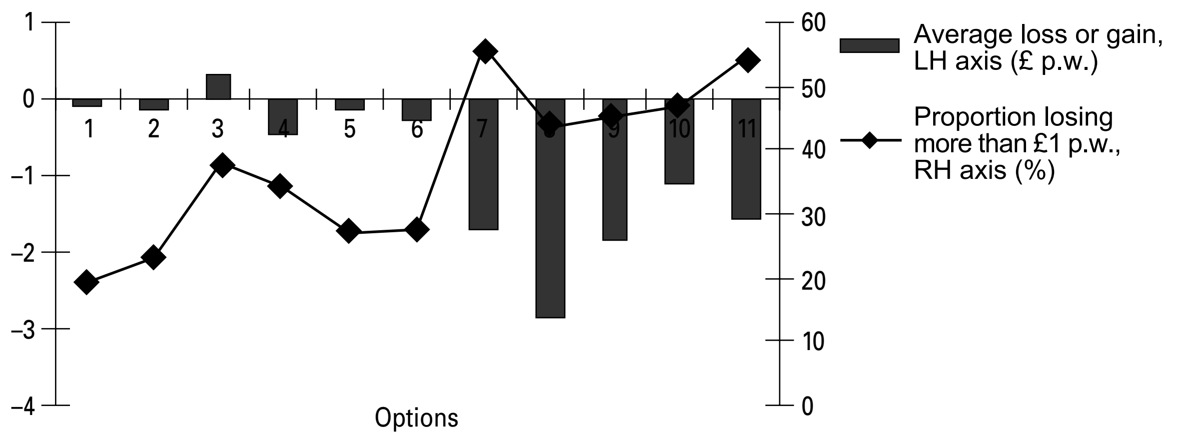


Figure 9 Household income >£40,000 per annum



Council Tax bands) leaves fewest households in the two lowest income groups worse off by over £1 per week. Option 8 (lifeline allowance and the charge per litre of water varying according to stretched Council Tax band ratios) is very similar in this respect, but is substantially more redistributive from richer to poorer households. Option 4 (standing charge varying according to stretched Council Tax bands) is also similar in this respect, but is less redistributive. Option 5 (a lifeline allowance of 20 m^3 per capita for the first adult and each child and an increased price per litre of water) is least redistributive, as noted above, but leaves more low-income households with extra bills in excess of £1 per week (12 per cent as opposed to 6 per cent for Option 3).

It may also be noted that it would be possible to introduce a tariff with a surcharge for significantly greater water use in summer, when water is most scarce and when some people use large quantities of water for their gardens, which may be classed as a discretionary rather than as an essential use. The OXERA study suggested that such a modification of a tariff would have both environmental and distributional merits. Unfortunately, it was too difficult to model here. However, it may be worth consideration if summer water conservation becomes an increasingly important concern.

Conclusions

This research shows that there is no basis for a perception that a move to universal water metering in the UK will be regressive. On the contrary, all 11 of the metering tariff options investigated here made the lowest income group better off on average. This was also true for the second lowest income group for ten out of the 11 options. Some of the options, particularly those based on 'stretched' Council Tax bands, involve quite large transfers from richer to poorer households, but, if this is considered politically problematic, there are other options that do not. Given that current charging tariffs based on old rateable values tend to be regressive, water metering on the basis of the tariffs presented here is more likely to reduce regressivity than increase it.

Because of differences in water use between low-income households, some, especially larger households, would be made worse off by water metering if their water consumption remained unchanged by it. For five of the tariff options, the proportion of households in the lowest income group losing more than £1 per week is less than 10 per cent. For all the 11 options, it is less than 20 per cent. However, most of the options include a lifeline of free or cheap water (which may or may not be phased out for richer households) to safeguard essential uses that are required to maintain health and hygiene. And, of course, all households could reduce their metered charges by reducing their discretionary or wasteful use of water.

It should also be possible to safeguard the relatively few households that have medical conditions that require high volumes of water use, although the take-up of the current government scheme that seeks to achieve this will need to be increased if sceptics on this point are to be convinced.

Metering, therefore, could be financially beneficial for most low-income households, provided that care was taken with the design of tariff structures. It is hoped that, should universal metering be adopted in the UK, in some regions or as a whole, such detailed tariff design issues will get adequate consideration, so that the change does not have social effects that were not intended.

4 Household use of transport

Background

Car traffic has gone up by 79 per cent since 1980, from 215 to 384 billion vehicle kilometres. It grew sharply in the 1980s, but has been rising less quickly since. Road traffic grew by 14 per cent between 1990 and 2000 (DfT, 2003a). Road vehicles currently account for 22 per cent of UK carbon dioxide emissions (Foley and Fergusson, 2003, p. 7), which increased by 7.4 per cent over 1990–2000 (DEFRA, 2004a), despite substantial improvements in vehicle efficiency. One reason why car traffic growth in the 1990s was lower than is expected for the 2000s was because of the fuel duty escalator, which increased fuel duty by 5–6 per cent above inflation each year from 1993 to 1999, since when fuel duty has fallen in real terms. For the first time in a period of rapid economic growth, in the late 1990s, traffic grew less quickly than GDP. Econometric analysis indicates that the fuel duty escalator revealed significant price elasticity (Glaister, 2001).

The overall cost of motoring (including purchase, maintenance, petrol and oil, and tax and insurance) has remained at or below its 1980 level in real terms, although the real cost of fuel in 2003 was 12 per cent higher than in 1980, despite a fall in 2001. In contrast to overall motoring costs, public transport fares have risen in real terms over the last 20 years. In 2001, bus and coach fares were 31 per cent higher and rail fares 37 per cent higher than in 1980. Over the same period, average disposable income has gone up more than 80 per cent in real terms. Transport has therefore become more affordable, with a greater improvement in the affordability of car use than that of public transport (DfT, 2003a).

Although the majority of the growth in transport over the last 20 years has been in travel by car, up from 388 billion passenger kilometres in 1980 to 624 billion in 2001 – an increase of 61 per cent, there were increases in travel by rail and domestic air, of 34 and 157 per cent respectively. Distance travelled by bus and coach fell by 17 per cent between 1980 and 1992, but it has since increased by around 7 per cent. Emissions of carbon dioxide (CO_2) from transport end users increased from 28 to 37 million tonnes of carbon between 1980 and 1990 – a time when road traffic was growing quickly. Despite further growth in traffic since 1990, levels of CO_2 emissions from road transport have been growing at a much slower rate, mainly because of technological improvements and the use of cleaner fuels. Energy consumption by transport has increased continuously since 1981, from 34 to 55 million tonnes of oil equivalent by 2001 – up 62 per cent. Road transport accounted for most of the increase during the 1980s, but has since been fairly stable despite continued growth in traffic. Indeed, most of transport's increase in energy consumption during the 1990s was accounted for by domestic aviation, up from seven to 12 million tonnes of oil equivalent (DfT, 2003a).

Domestic aviation accounts for only 5 per cent of the UK's total aviation emissions, but emissions from international aviation emanating from the UK are not included in UK government transport statistics or counted in the UK's targets under the Kyoto Protocol. The government's Climate Change Programme has policies to reduce emissions from other sectors, but ignores aviation emissions. The effect is far from trivial. Carbon emissions from international aviation traffic to and from UK airports nearly doubled from four million tonnes of carbon (mtc) in 1990 to 7.8 mtc in 2000, and are projected to increase to around 12.3 mtc by 2010. The Intergovernmental Panel on Climate Change (IPCC) estimates that the global warming potential of emissions from aviation is two to four times that of the carbon emissions alone – because of the effect of the emission of water vapour and nitrogen oxide (NOx) at very high altitudes (IPCC, 1999), so the increase between 1990 and 2000 was equivalent to 7.6–15.2 mtc. The expected increase 1990–2010 is equivalent in global warming potential to 16.6–33.2 mtc – or 8–16 per cent of UK baseline emissions. In other words, the UK's 12.5 per cent reduction in domestic emissions between 1990 and 2010 under the Kyoto Protocol will be largely or more than offset by its increase in international aviation emissions. The middle traffic growth projection to 2020 would increase emissions to 18 mtc, equivalent to 36–72 mtc. That is 5.7 mtc more than 2010 emissions, equivalent in global warming potential to 11.4–22.8 mtc or another 6–12 per cent of emissions. The rapid and uncontrolled rise in aviation emissions is likely to overwhelm the effect of other government policies to reduce carbon emissions (Edinburgh Centre for Carbon Management, 2002).

However, emissions from future road traffic growth also present a challenge. Traffic growth was held back in the 1990s by the fuel duty escalator. Road traffic is predicted to grow by 20–25 per cent between 2000 and 2010. Because the average fuel efficiency of cars is projected to improve by 20 per cent over the same period, the result would be broadly stable carbon emissions (DfT, 2003b), at a time when the government is seeking substantial overall emission reductions to meet international and domestic commitments. But even these conclusions have been questioned in a recent Institute for Public Policy Research (IPPR) study (Foley and Fergusson, 2003), which argued that the improvement in fuel efficiency predicted by the National Transport Model (DfT, 2003b) was based on optimistic and somewhat dubious assumptions.

Taxation of car use has been a particularly sensitive issue since the fuel protests of autumn 2000. Petrol taxes are not regressive in aggregate because poorer households are less likely to have a car. However, petrol taxes are regressive *among* motorists (Blow and Crawford, 1997).

Nearly a third of households do not have a car and non-car-owning households are concentrated among the lowest-income groups. Sixty-three per cent of households in the lowest-income quintile and 50 per cent in the second lowest do not have access to a car. By contrast, only 22 per cent of households in the third quintile, 12 per cent in the fourth quintile and 6 per cent in the top quintile are without access to a car (Lucas *et al*., 2001). However, in all quintiles, travel by car (whether as a driver or a passenger) accounted for most of the miles travelled. It is clear that people in all income groups tend to have a strong desire for the greater mobility and independence offered by a car, compared with public transport. The resulting increase in car ownership has led to a decline in public transport, particularly buses, which has accentuated the relative advantages or disadvantages of owning or not owning a car. It has also led to more travel-intensive lifestyles, which are considered to more or less require the use of a car, becoming more of a social norm. Some developments, for example of out-of-town supermarkets and hospitals, seem to reinforce these trends.

A group that is commonly identified as particularly vulnerable is low-income drivers in rural areas, who are particularly sensitive to price increases, but have fewer transport alternatives than people in urban areas. Only 41 per cent of low-income households (the bottom two quintiles) own cars, but 57 per cent of low-income households in rural areas own cars (Skinner and Fergusson, 1998). Low-income car owners tend to spend less on fuel: 78 per cent of the average, and they drive 77 per cent of the average number of miles. Low-income drivers in rural areas drive 22 per cent further than other low-income drivers on average. They drive 94 per cent as many miles as the average among all drivers.

As with household energy and water use, decisions about what would be the best policies to pursue to reduce the environmental impact of transport without causing negative impacts on poorer households depend heavily on political judgements. Unlike household energy and water use, and as shown by the statistics above, motoring is not (yet) an essential need for most poor people in the UK. Measures that increase the cost of motoring are progressive, not regressive, on average. Concern about negative impacts of increased motoring costs on low-income households has therefore been about the impact on the minority of these households who own cars, and has often been expressed in terms of exacerbating social exclusion (e.g. Lucas *et al.*, 2001).

A similar, if less pronounced, issue arises with taxation of air travel. People on low incomes travel relatively infrequently by plane. The relatively rich account for the great majority of air travel. Moreover, the negative impacts of climate change will be felt mostly by very poor people in developing countries. Arguments that we should not impose any restrictions on people's freedom to drive or fly out of concern for social justice miss this wider perspective. Nonetheless, it is reasonable to ask that policies to reduce the environmental impact of transport should not *disproportionately* impact low-income households, as discussed in the next section.

Approach

The research in this component of the project examined a number of options for the future taxation of cars and their use that have been under discussion in recent years. The rationale is that charging can be used to create economic disincentives for car use. The focus of the research was the distributional effects of such measures and how to prevent regressivity. The options investigated were:

1. increasing fuel duties and abolishing vehicle excise duty (VED)
2. increasing fuel duties and using the money to subsidise public transport
3. increasing fuel duties and using the money to increase benefits
4. reform of graduated vehicle excise duty (VED)
5. introducing a graduated car purchase tax
6. congestion charging
7. introducing domestic tradable quotas (DTQs).

The last of these options, DTQs, focuses directly on carbon emissions rather than on motoring charges. With DTQs, each individual would be provided with an annual allowance of carbon emissions. Those who emitted more than their quota would have to buy additional rights from those who produced less. DTQs could apply to all direct carbon emissions, from use of domestic energy, motoring and air travel.

Results

Increasing fuel duties and abolishing vehicle excise duty (VED)

The distributional impact of increasing fuel duties and abolishing VED was examined in some detail by Skinner and Fergusson (1998). Sixty-eight per cent of all households and 41 per cent of low-income households owned cars, but, in rural areas, 80 per cent of all households and 57 per cent of low-income households owned cars. Low-income drivers would on average be better off if there was a shift from VED to fuel taxation because they spent 78 per cent of the average figure on fuel and drove 77 per cent as much distance. However, rural low-income motorists on average spent 90 per cent of the average on fuel and drove 94 per cent of the average distance for all motorists. Skinner and Fergusson calculated that reducing or abolishing VED would on average benefit even rural low-income motorists, although, because of the variation in fuel used, a minority of low-income motorists would have lost out. From figures from the 2000–01 Family Expenditure Survey, it can be calculated that about 30 per cent of low-income motorists (those in the lowest four deciles), about 17 per cent of motorists in the lowest two deciles, would have been losers. The proportion of rural low-income motorists who would have been losers would probably be nearly half.

Increasing fuel duties and using the money to subsidise public transport

When the Chancellor of the Exchequer froze fuel duty in 1999, he promised that any future increases would be hypothecated into transport. An analysis of the distributional impact of putting the money into subsidies for public transport was done using data from the Family Expenditure Survey 2000–01. It was assumed that a carbon tax equivalent to £10 per tonne of carbon dioxide (the effective standard rate of the Climate Change Levy for companies) would be imposed. The tax would raise approximately £633 million per year. Before any compensation measures, it may be assumed that all of the 72 per cent of households with at least one car (DfT, 2003a) would be worse off.

If the revenues were redistributed into subsidies for buses and coaches (which poorer people tend to use more than trains), the 63 per cent of households in the bottom quintile (the bottom two deciles) that do not have a car may be assumed to be gainers to the extent that they use buses and coaches. In particular, the subset of these households that use buses and coaches tend to gain heavily at the expense of the rather larger number of households that rely entirely or almost entirely on their cars. Overall the results are progressive (the poorest households are about £20 per year better off), but the fact that essentially all the households even in the poorer deciles that have cars lose out means that the measure does not address the objection raised to increasing fuel duties: that it would adversely affect car-dependent poorer households.

Increasing fuel duties and using the money to increase benefits

The research then investigated whether it would be more effective to use the revenues to increase benefits instead of subsidising public transport. Targeting benefit assistance at motorists only would be undesirable because it would create a perverse incentive to buy a car. Targeting assistance at people in rural areas would be strange because, in other ways, their cost of living is lower than for people in urban areas. Here the effect has been examined of using the revenues from the carbon tax on petrol and diesel described above to increase means-tested benefits.

When the carbon tax is applied without any compensation measures, households in higher-income deciles pay more in absolute terms, but not significantly more as a proportion of their incomes, and Decile 10 pays less proportionately than the rest.

Using the £633 million of revenues from the carbon tax to increase means-tested benefits reduces the number of losing low-income households from 42 to 17 per cent, although about 47 per cent of low-income motorists, and about 36 per cent of motorists in the lowest two deciles, remain losers. Very few (0.3 per cent in Decile 1) lose out by a large amount, though. However, increasing benefits is less effective than abolishing VED at compensating low-income drivers (where only 17 per cent of motorists in the bottom two deciles were losers, see above), although it is of course more progressive overall because it also helps the majority of those on low incomes who live in households without a car. Another problem is that the low-income households that remain losers are likely to be those that are most car dependent. The particular concern that is not addressed by this approach is about poorer motorists living in rural areas where there is little public transport and it is necessary to travel long distances.

It could also be argued that using the revenues in this way is not very efficient. Nonetheless, the exercise shows that benefits could be used to largely offset the negative effects of such a tax increase on the poorest households.

Reform of graduated vehicle excise duty (VED)

VED graduated according to carbon dioxide (CO_2) emissions was introduced in 2001. For cars first registered before 1 March 2001, the VED rates are £110 for cars up to 1,549 cc and £165 for cars over 1,549 cc. The system for cars registered on or after 1 March 2001 is related to CO_2 emissions and varies from £65 (£75) for the most efficient petrol (diesel) cars, to £160 (£165) for the least efficient (although the maximum rate is only 185 g/km, which does not distinguish between ordinary family cars and those with an engine size of more than two litres, so there is no really strong disincentive to buy ‘gas guzzlers’ such as four-wheel-drive vehicles). The difference in rates of VED is therefore presently very small in relation to the purchase cost of new cars and so unlikely to make any significant impact on buying decisions. Increasing the rates would at present make little difference to poorer households because few of them own post-2001 cars, but over time it would have an impact.

VED could be more effectively related to CO_2 emissions by replacing the bands that currently exist with a more graduated system along the lines of the reform to company car taxation made in 2002. If VED started at the present lowest rate for any car with emissions below 100 g/km and then increased by £5 for every additional 5 g/km then the amount of VED paid would remain almost exactly the same until a car had emissions above 200 g/km. Under such a scheme, the present cap on VED for 'gas guzzlers' would be removed. About 6 per cent of cars owned by low-income households have an engine capacity above 2,000 cc, compared to about 8 per cent of cars owned by all households (Skinner and Fergusson, 1998), so that the impact on poorer households of increasing the rate for the largest cars would be not dissimilar in absolute terms to its impact on car owners as a whole, while proportionally it could be greater. However, it is not clear that arguments based on 'need' apply to vehicles of this size.

Introducing a graduated car purchase tax

The UK had a Special Purchase Tax on cars until its abolition in 1992. Many other European countries have a purchase tax on cars. Low-income motorists buy very few new cars, but changes in the price of new cars are rapidly reflected in the second-hand market, so a graduated purchase tax would also increase costs for low-income motorists unless compensating measures were taken. The way to compensate for a graduated car purchase tax would be to reduce or abolish VED. The buyers of second-hand cars have at most a small and indirect impact on the make-up of the car fleet. It is the buyers of new cars who choose the cars that will be on the roads for the next decade or so, even though new car buyers own the cars for only a few years themselves. Replacing VED with a car purchase tax graduated according to carbon dioxide emissions would mean that buyers of new cars would be faced with a significant direct incentive to choose more efficient vehicles. It would have much more effect on car purchasing decisions than VED because the equivalent of about 14 years of VED for the average life of a car (Burnham, 2001) would be included in the sticker price of new cars and the variation in tax between models would amount to hundreds of pounds paid up front. The change could not be made overnight, as it would distort the market for new and used cars, but it could be brought in with incremental increases in the car purchase tax and compensating reductions in VED for cars first registered in that year over a period of about five years.

However, a graduated car purchase tax would not have much effect on vehicle use. It will encourage people to buy more fuel-efficient cars, but not discourage them from driving. Eriksson (1993) concluded that a combination of carbon taxes and a purchase tax based on carbon dioxide emissions was the best way to reduce emissions, as car buyers substantially underestimate the cost of fuel in their purchasing decisions.

Congestion charging

In the last few years, the major focus for discussion in the area of motoring taxation has been congestion charging, which is the most sophisticated approach to the spatial consequences of traffic growth (although it is not as effective as fuel duty at reducing carbon dioxide emissions). Congestion charging can vary the charge according to the expected driving conditions at any given time or place. It can also be used to target urban motorists who have the most possibility to travel by public transport instead. The attention on congestion charging has intensified with the perceived success of the congestion charging scheme introduced to central London. The revenues raised from this congestion charge are used to pay for improvements to public transport. The Institute of Fiscal Studies tried to work out what the London congestion charge would cost households with differing earnings, using (rather dated) behaviour patterns from the 1991 London Area Transport Study and assuming no change in travel patterns as a result of the charge. The average charge as a percentage of income was about 0.1 per cent for most of the lowest two deciles, it peaked at nearly 0.5 per cent in the fifth decile, just below the middle of the income distribution and then fell to between 0.3 and 0.4 per cent in the upper half of the income distribution (Crawford, 2000). Nonetheless, the outcome was basically progressive.

The case for a nationwide system of road charging with satellite tracking of vehicles using the Global Positioning System was put forward strongly in a report by the Commission for Integrated Transport (CfIT, 2002). Drivers would be charged for travelling on busy roads at different rates according to the road and the time of day, but travel on uncongested roads would remain free. Although CfIT did not model the actual distributional effects of their nationwide road-charging scheme, it can be deduced that a revenue-neutral congestion-charging system would lead to a redistribution of money from urban drivers to rural drivers. If revenue neutrality was achieved by reducing fuel duty then essentially all urban drivers would lose and all rural drivers would gain. That would be the case for both richer and poorer motorists. If, instead, revenue neutrality was achieved by abolishing VED then low-mileage/off-peak urban drivers would generally pay less in congestion charges than they would gain, but high-mileage/peak-time urban drivers would generally lose and rural drivers would still gain.

A relatively small congestion charge that was compensated for with the abolition of VED would cut congestion significantly, but it would reduce traffic and carbon dioxide emissions by only 5 per cent at most (CfIT, 2002), equivalent to a couple of years' traffic growth. As Foley and Fergusson (2003) argue, a congestion charge would need to be revenue raising in order to tackle traffic growth. The revenues that it would be necessary to raise to prevent traffic growth are substantial, of the same order of magnitude as the government spends on transport at the moment (Foley and Fergusson, 2003). A revenue-raising congestion charge would mean that virtually all urban motorists would lose, although rural motorists would be only marginally affected. However, demand for public transport in urban areas would rise, requiring the investment of at least some of the revenues. If VED was reduced to compensate for the congestion charge, demand for public transport in rural areas would fall, as motoring would become cheaper there, making people in rural areas even more car dependent than they already are.

Abolition of VED to compensate for congestion charging would be progressive overall because, on average, poorer motorists drive rather less than the average for all motorists. The poorer rural motorists who drive nearly as much as the average for all drivers would certainly gain because congestion charging would not affect them for most of their driving, but it would have a negative impact on a significant number of poorer urban motorists who drive at peak times.

Reducing fuel duty in order to compensate for the introduction of congestion charging would actually *increase* traffic overall, because the increase in rural areas would outweigh the reduction in congested urban areas, and have negative environmental consequences (Foley and Fergusson, 2003). It would also increase the car dependence of society, particularly in rural areas, further increasing the social exclusion of the poorest and most marginalised members of society (who do not have cars). It would also tend to make poorer urban motorists lose out, although poorer rural motorists would gain.

Domestic tradable quotas (DTQs)

The idea of domestic tradable quotas (DTQs) is rather different from the other schemes proposed. It does not take road travel in isolation, but instead looks at all the direct carbon dioxide emissions of households. The idea behind DTQs is that every adult resident would receive for free an equal number of carbon units to cover their annual carbon emissions, including private transport. Businesses and other organisations would have to buy their quota from government. Those who used less than their entitlement could sell their surplus units to others who needed more (Fleming, 1998).

First, the distributional effect of a DTQ system that provided each individual with an allowance based on the *average* carbon emissions from domestic energy, petrol and diesel was examined. Emissions from trains, buses and aviation were not included. Since carbon emissions from cars are fairly progressive (meaning that low-income households produce proportionately less carbon emissions in relation to their income than richer households), while carbon emissions from domestic energy are regressive (meaning that low-income households produce proportionately more carbon emissions in relation to their income than richer households), it is not clear what the overall effect of issuing DTQs in these areas would be.

An issue that arises is the treatment of children. The proposal modelled here compares a scheme with adult-only DTQs with one in which each child also receives a quota of half the adult amount that would be administered by their parents. For the sake of example, it is assumed that the value of a tonne of carbon dioxide on the quota market would be £10 per tonne.

The results show that there is not much difference in the outcomes of the two methods in terms of the percentage of each decile that gains or loses, although quotas for children do lead to fewer losers in the bottom decile. Four to 5 per cent of Decile 1 households lose more than £1 per week. The difference is mostly in which households gain or lose, rather than how many gain or lose at each income level. Quotas only for adults favour households without children over those with children (so that 52 per cent of households with children lose out). Quotas for children as well favour households with children over those without (so that only 37 per cent of households with children lose out).

The objection to providing quotas for children is that it might encourage people to have children in order to get a bigger carbon quota. However, not providing quotas for children would be politically controversial, particularly in the light of government concern about child poverty and the fact that small children are especially susceptible to the health effects of low indoor temperatures. On the other hand, not providing quotas for children allows larger quotas for each adult, which helps another politically important and sensitive group, pensioners (37 per cent of pensioner households are losers from the with-child quota scheme, compared to 31 per cent from the without-child quota scheme).

About 30 per cent of the poorest households (bottom two deciles) lose out if only domestic and motor fuel are covered under DTQs. Flying is the other major source of greenhouse gas emissions that could be directly accounted for. People on low incomes fly very little, while people on high incomes fly a great deal. The relationship is strongly progressive. Bringing emissions from aviation into the equation would not only make the effect of DTQs more progressive, it would also do something to restrict the extremely rapid growth in emissions from aviation that is currently unchecked because international aviation is not covered under the Kyoto Protocol and the UK government's Climate Change Programme.

The distributional impacts were calculated for both without- and with-child quotas, and the results show that, although including aviation makes the measure even more progressive, about a quarter of the poorest households still lose out (compared to about 30 per cent when aviation was not included). The number in Decile 1 losing more than £1 per week has dropped to 3–4 per cent. However, including aviation has not had such a large effect in making DTQs more progressive as might have been expected.

Lumping together emissions from domestic energy, motoring and air travel in a DTQ system does not therefore appear to be the best approach from the point of view of concern about the impact on the poorest households. As discussed in Chapter 2, many low-income households live in older properties that would be expensive to bring up to proper standards of energy efficiency. The emissions that they create to keep warm are for a basic need. By contrast, it is hard to argue that flying away on a foreign holiday is a basic need.

Finally, a DTQ scheme is considered that applies only to greenhouse gas emissions from motoring and aviation. The results show that substantially fewer households in the bottom two deciles lose out from this option – less than 15 per cent in the adult-only scheme, compared to about 25 per cent when domestic energy was included, while only 2 per cent lose more than £1 per week. Allowing quotas for children is more progressive still. A DTQ scheme for transport would therefore appear to be a way of putting a cap on carbon emissions from this source with results that are very progressive overall and include very few significant losers from households with the lowest incomes.

Conclusions

Decisions about what would be the best policies to pursue to reduce the environmental impact of transport without causing negative impacts on low-income households depend particularly heavily on political judgements. Unlike domestic energy, water and waste disposal, motoring is not yet an essential need for most poor people in the UK. Nearly a third of households do not have a car and nearly two-thirds of households in the poorest quintile are without one. Measures that increase the cost of motoring are progressive, not regressive, on average. Concern about negative impacts on poorer households has therefore been about the impact on the minority of such households who own cars. The same issue arises with taxation of air travel, which is undertaken far more frequently by richer people. The concern addressed in this section is that policies to reduce the environmental impact of transport should not *disproportionately* impact poorer households.

Table 7 summarises the results of the various tax/compensation options for both reducing CO_2 emissions and limiting the effects on low-income households or motorists.

It can be seen that, if fuel duties are increased, the most effective of the three ways in terms of compensating low-income motorists would be to abolish VED. Increasing benefits would also have an effect, but not as much, while using the money to subsidise public transport would have almost no effect because households that have cars generally use public transport very little. However, if the aim is to be *progressive*, then increasing benefits is best (although this benefits non-motorists as well as motorists), subsidising public transport is next best (because the poorest are more likely to use public transport than have a car) and abolishing VED is least good. The particular concern about increasing fuel duty is that it would have a negative effect on poor motorists in rural areas. People who live in rural areas tend to drive further and use more fuel than those who live in urban areas.

Of the various charging or taxation methods examined, VED is currently the least effective in restraining carbon emissions, notwithstanding its recent reformulation so that duty rates now reflect fuel efficiency. VED could be made more environmentally effective by increasing the rates or by allowing the rates on the least fuel-efficient cars to increase to reflect their greater carbon emissions. A higher rate of VED for ‘gas guzzlers’ would have little effect on poor households, as few own such large, fuel-inefficient vehicles.

From an environmental point of view, it would be more effective to replace VED by a purchase tax graduated according to CO_2 emissions. A significant difference in purchase price between low- and high-carbon vehicles would be likely to influence purchase decisions more than when the payments are spread out over a number of years. Abolishing VED was also identified as the most effective way to compensate for congestion charging and would benefit low-income rural motorists, and low-income motorists overall, although peak-time, low-income urban motorists could lose out.

In general, subsidies for public transport are an ineffective method of compensation for low-income motorists because most households that have cars hardly use public transport, but the experience in London shows that congestion charging can lead to a shift towards public transport when it is an easy alternative. A way to try to reduce the impact on low-income motorists would be to vary the size of the charge according to the size of the vehicle, although it would have only a limited effect because low-income motorists on average drive only slightly smaller vehicles than richer motorists. It is difficult to see how to restrain

Table 7 Effects on households of various changes in taxation on motoring in order to reduce CO_2 emissions

Tax/charge	Compensation method	Average effect on LIMs[a]	Mean annual change (£) (by decile number)		Per cent gainers	Per cent losers	Per cent losing >£2 p.w.
Increase fuel duties (carbon tax)	None	Loss	1	–9.59	n/a	36	n/a
			2	–8.30		35	
			3	–15.60		51	
			4	–17.88		58	
			All	–25.43		63	
Increase fuel duties	Abolish VED	Benefit LIMs: £38 p.a. LIRMs: £18 p.a.	n/a		n/a	30 per cent (17 per cent) in bottom 4 (2) deciles	n/a
Increase fuel duties	Subsidise public transport		1	+5.93	33	32	n/a
			2	+5.47	31	30	
			3	–3.13	26	44	
			4	–1.39	24	50	
			All	0.00	25	54	
Increase fuel duties	Subsidise buses and coaches		1	+19.82	32	31	n/a
			2	+15.12	30	30	
			3	+6.75	26	42	
			4	+9.51	25	48	
			All	0.00	22	54	
Increase fuel duties	Increase means-tested benefits (100 per cent take-up)		1	43.68	76.6	10.9	0.3
			2	46.64	77.4	12.5	0.1
			3	34.32	71.9	17.4	0.1
			4	18.82	57.3	29.5	0.3
			All	0.00	35.8	47.5	2.6
Reform VED (higher rates by CO_2 emission)	None	Loss for those with large-engine vehicles	n/a		n/a	n/a	n/a

(Continued)

Table 7 Effects on households of various changes in taxation on motoring in order to reduce CO_2 emissions (continued)

Tax/charge	Compensation method	Average effect on LIMs[a]	Mean annual change (£) (by decile number)	Per cent gainers	Per cent losers	Per cent losing >£2 p.w.
Graduated car purchase tax	Reduce or abolish VED	Loss for those with large-engine vehicles	n/a	n/a	n/a	n/a
Congestion charging (London)	None	Loss	As per cent of income 1 and 2 All 0.1 Drivers 0.5 5 All 0.5 Drivers 0.8 9 and 10 Drivers 0.4			
Congestion charging	Abolish VED (reducing fuel duty not considered because it would increase emissions)	LIMs/LIRMs gain overall. Peak-time LIUMs could lose	n/a	n/a	n/a	n/a

a LIMs are low-income motorists; LIRMs are low-income rural motorists; LIUMs are low-income urban motorists traffic growth through congestion charging without having some impact on low-income urban motorists.

As an alternative to taxation, emissions from households' transport and energy use could be limited through the use of DTQs. The research here shows that over two-thirds of households in the bottom two deciles, and nearly two-thirds of all households with pensioners and children, would be made better off through a DTQ system involving motoring and household energy use that gave children half the adult quota. The percentages increase to around 90 per cent if the DTQs do not include household energy but do include motoring and aviation (reflecting the greater involvement of high-income households in these activities), except for households with children, where the percentage falls to 55 per cent.

The main conclusion from this research is therefore that a system of DTQs covering motoring and aviation would be an efficient and progressive way of controlling carbon emissions from these sources. In their absence, and in a political context that is unfavourable for increased fuel duties, at least partly because of their impact on low-income motorists, revenue-raising congestion charges could be used to control traffic growth and hence emissions, with low-income motoring households being compensated through the abolition of VED and further compensation being given, if desired, through the benefits system.

5 Household waste generation

Background

This component of the research examined the possibilities for and implications of variable charging for household waste in the context of the UK's poor record of recycling and waste reduction or minimisation.

According to the Strategy Unit (2002), household waste production in the UK is growing at a rate of 3 per cent a year, exceeding the rate of growth of GDP. Until recently, waste policy was afforded little attention at either a national or local level in the UK. The UK has historically relied upon landfill as its primary waste-disposal option. Compared to most other industrialised countries, the UK has a poor record on developing alternatives to landfilling and on recycling.

Factors underpinning the UK's poor environmental performance on waste include the ready availability of cheap landfill sites, weaker regulatory controls and the absence of incentives for recycling, low public awareness and an inability or unwillingness on the part of many local authorities to invest in more expensive recycling and waste-disposal options. However, recent developments in national policy are now beginning to feed through to the local level and, with further changes in the pipeline, these will increasingly impact on individual households and consumers over the next two to three years.

A major driver of these changes in the area of waste management is a number of European directives, principally the 1999 Landfill Directive. This requires the UK to reduce the tonnage of biodegradable waste going to landfill to 75 per cent of its 1995 level by 2010, 50 per cent by 2013 and 35 per cent by 2020. The UK is not currently on track to meet the targets set in the Directive. Although the proportion of municipal waste sent to landfill declined from 84 per cent in 1996/97 to 78 per cent in 2000/01, the *amount* landfilled actually increased from 20.6 million tonnes to 22.1 million tonnes (DEFRA, 2001). The total amount of municipal waste continued to rise to an estimated 29.3 million tonnes in England in 2002/03 compared to 28.8 million tonnes in 2001/02, an increase of 1.8 per cent. However, the amount recycled increased, from 13.6 per cent in 2001/02 to 15.6 per cent in 2002/03, and the proportion disposed of in landfill decreased from 77 per cent in 2001/02 to 75 per cent in 2002/03. This meant that, for the first time in recent years, the actual tonnage of municipal waste disposed of in landfill also decreased slightly from 22.3 million tonnes in 2001/02 to 22.0 million tonnes in 2002/03 (DEFRA 2004b).

A new waste strategy for England (*Waste not, Want not: A Strategy for Tackling the Waste Problem in England*) was proposed by the Strategy Unit at the end of 2002 (Strategy Unit, 2002). The Strategy Unit (SU) proposed a number of targets related to waste reduction and increased recycling, and recognised the need for a comprehensive framework of economic and regulatory measures to ensure that these objectives were met. It pointed out that householders currently pay the same Council Tax no matter how much waste they produce or whether they recycle or not. Some local authorities in many other industrialised countries have variable charging for household waste. The SU report suggested Council Tax discounts or reward schemes for people who compost or recycle regularly, or variable charging where households pay according to the amount of unrecycled and unsorted waste they produce.

The SU also calculated that, however the UK disposes of its waste in the coming years, and in the absence of waste-reduction measures, waste-disposal costs are likely to double to £3.2 billion by 2020. The increase will be much greater if the landfill tax increases from its current rate of £14 per tonne (for active waste) to £35 per tonne in the medium term, as announced by the Chancellor in the 2003 Budget.

The SU's strategy involved reducing the rate of growth in waste, 45 per cent recycling, 10 per cent incineration, 20 per cent mechanical biological treatment (MBT) and other recovery technologies, and 25 per cent landfill. The present mix is about 80 per cent landfill, 10 per cent incineration and 10 per cent recycling. The SU estimated that the cost of implementing the strategy would be only about 10 per cent greater for local authorities than the costs of continuing present waste-disposal practices and trends over the 18 years to 2020 (£29.6 billion versus £26.7 billion).

Access to appropriate composting and recycling facilities is a key issue for consumers. In particular, it has been shown that access to kerbside recycling facilities is a major determinant of household recycling behaviour (Resource Recovery Forum, 2002). Recycling behaviour varies with household income, with the affluent more enthusiastic about recycling, while members of socially excluded groups are more likely to belong to the 10–15 per cent of the population who say they would not recycle in any circumstances (MORI, 2002). The local authorities with the highest recycling rates are among the least socially deprived, while the authorities with the lowest rates are among the most socially deprived.

Approach

Probably the most effective way of getting consumers to reduce the amount of waste they produce is through variable waste charging for unsorted waste. Under these schemes, people are charged according to the quantity of residual (non-recycled) waste they produce. Variable charging for waste not only encourages people to recycle, but also makes them more conscious about avoiding producing waste in the first place. Variable charging schemes in North America have reduced the amount of residual waste disposed of by 15–45 per cent without any apparent problems of additional unauthorised dumping (Enviros Aspinwall, 2000). Similar results have been found in Europe (Eunomia Research and Consulting, 2001).

At present, households pay for waste collection and disposal through the Council Tax. Because the Council Tax is regressive, increasing Council Tax to pay for higher waste costs will also be regressive. Moreover, the increase in charges would, like the current flat-rate waste-disposal charge, do nothing to incentivise householders either to reduce their waste or to co-operate with recycling schemes.

The Strategy Unit recommended that local authorities should be able to introduce variable waste charging, not least to provide an incentive for both kinds of behaviour. However, a potential concern about this is that, like an increase in Council Tax, it might have a disproportionate impact on poor households, because the generation of household waste bears little relation to income, and more affluent households tend to recycle more, thereby reducing their residual waste that would bear the charge. This was the issue that was the subject of this research.

There are essentially four different kinds of systems of variable rate charging for household waste.

1 Bag or tag/sticker schemes: the waste collector only picks up waste that has been placed in specially identified bags or containers. Householders may purchase either special bags or tags/stickers, which must be fixed to the standard bags or containers used.

2 Volume-based schemes: householders choose a waste container or bin of a certain volume and an annual charge is based on container volume and often the collection frequency as well.

3 Frequency-based schemes: householders choose the frequency of their collection (usually either weekly or fortnightly) and pay accordingly. Alternatively, they pay only when they put out waste for collection.

4 Weight-based schemes: collection vehicles are fitted with automatic weight-recording devices, which record the weight of the waste collected. Each household's bin is fitted with an electronic identification transponder to identify it.

The different types of scheme have different advantages and disadvantages in different circumstances. A comparison of international experience suggests that weight-based schemes are most successful in achieving waste reduction. In some cases, these have been able to reduce waste such that their higher cost compared to the other schemes is more than offset, so that they become the cheapest scheme as well as the most effective in changing behaviour (Eunomia Research and Consulting, 2003). However, this cannot be guaranteed and there are many factors to be taken into account in considering which scheme should be introduced in different circumstances.

If waste charging was removed from Council Tax by reducing the Council Tax for all households by the same amount (the average per household cost of waste collection and disposal), this would be progressive (i.e. poorer households would be proportionately better off compared to richer households).

Because household waste generation is not related to income, any kind of single-rate variable charge for waste generation, whether it is based on bags, stickers, volume, frequency or weight, will tend to be regressive. For example, if the waste charge averaged out at £50–100 per household across the income distribution, this would correspond in the average household in the lowest-income decile to 1–2 per cent of their expenditure, compared to less than 0.3 per cent in the highest-income decile. For those households in low-income deciles that generated more than average amounts of waste, and had lower than average incomes, the waste charge percentage of their expenditure would be much higher. On the other hand, it could be argued that, if the scheme was structured so that people could reduce their payments by both reducing their waste and participating in recycling initiatives, this would give an opportunity for low-income people (and others) to reduce their waste charges.

Results

Until recently, the only available data on waste production according to size of household was from a one-week survey conducted for the Environment Agency (University of East Anglia *et al*., 2000). As would be expected, larger households tend to produce more waste. One-person households in the study on average produced 9 kg of waste per week, two-person households 13 kg, three-person households 17 kg, four-person households 17 kg and households with five or more 18 kg. These averages hide large variations between individual households and enormous overlap in the amount of waste produced by households of very different sizes. The amount of waste produced by manual and non-manual households did not vary significantly.

A better and more reliable source of data became available at the end of 2003. It comes from a trial by South Norfolk District Council, using lorries equipped to weigh the waste produced by around 3,000 households in the authority. A survey was conducted and sufficient data was collected on 244 households for their patterns of waste production to be analysed.

The 244 households provided information about the number of members of the household and the ages of each of them. The households' Council Tax bands were already known to the local authority. Information on Council Tax bands was the only socio-economic variable collected. Because all the homes were in the same small area and there was a good spread of Council Tax bands among the sample, it can be taken as a reasonable proxy for socio-economic status.

Table 8 shows that production of total waste varies considerably between households of the same size, typically by around a factor of two between households that produce a little waste for their size and ones that produce a lot of waste for their size. Strikingly, one-person households at the ninetieth percentile (of waste production) produce more waste (14.8 kg per week) than five-person households at the tenth percentile (14 kg per week).

Additional household members lead to additional waste. The largest change in terms of both residual and total waste is from a two-person household to a three-person household, which seems to add around twice as much to waste production as an additional person does above this household size.

Table 8 Weekly production of total waste (residual plus recycled) in kilograms according to household size in the sample

Number of people	Mean	10th percentile	20th percentile	Median	80th percentile	90th percentile	*n*
All households	15.0	8.1	9.6	14.4	20.1	23.0	244
1	9.9	5.6	6.3	9.2	12.3	14.8	36
2	12.7	7.8	8.7	11.5	16.3	19.7	89
3	16.5	9.3	11.6	16.4	20.3	24.8	38
4	18.6	11.9	14.3	17.6	22.6	24.9	55
5	20.5	14.0	14.4	19.4	25.3	29.1	26

Council Tax band has absolutely no effect on total waste production in the multiple regression analysis. If a system of variable waste charging by weight was introduced for residual waste and Council Tax was reduced by the average amount that households pay at the moment, then, with revenue neutrality and assuming no waste reduction, the effect on households of different sizes would be as shown in Figure 10.

Figure 10 shows that most one- and two-person households would gain and most larger households would lose from the simple variable waste-charging scheme modelled. Although the proportion of households in each Council Tax band is particular to South Norfolk and not representative of the distribution found more widely, the outcome is a matter of some concern in terms of the regressive effect for larger low-income households. One way in which this concern could be addressed is through the benefit system.

Figures from Eunomia Research and Consulting (2003) suggest that the average cost of household waste disposal to meet the requirements of the Landfill Directive might rise from £50 to £70 per household per year, or by £500 million per year in total, assuming greatly increased provision for recycling and reduced waste generation through variable waste charging. If this increase in expenditure was to be funded through Council Tax at the same proportion of local to central government revenues as at present, central government would need to fund £375 million (three-quarters) of the £500 million increase.

The amount of waste that households produce varies according to size. Figure 11 shows the average amount that households of different sizes would pay if average waste costs rose to £70 per year and the charges were per kilogram of residual waste. On average (and assuming no waste reduction), one-person households would then pay £43 and couples would pay £56. If we assume that they have on average received a deduction of £50 in their Council Tax bill, the result is a difference of less than 15p per week either way.

Figure 10 Gainers and losers from variable waste charging with no compensation

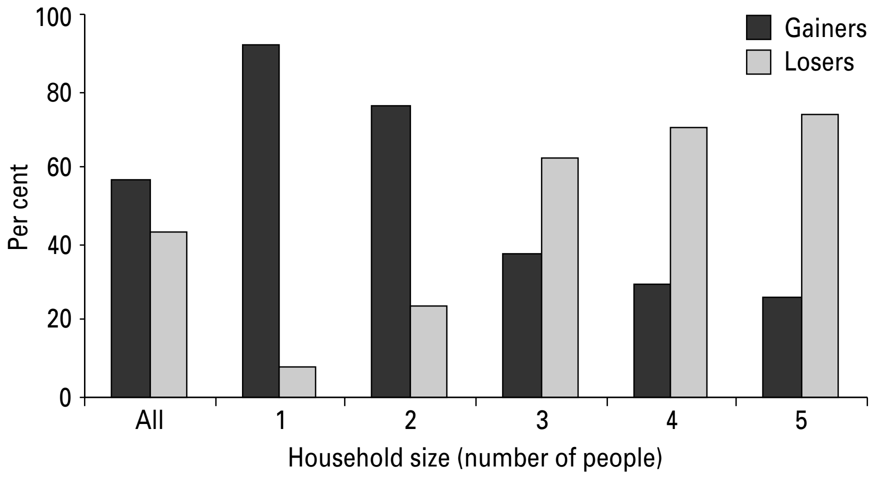
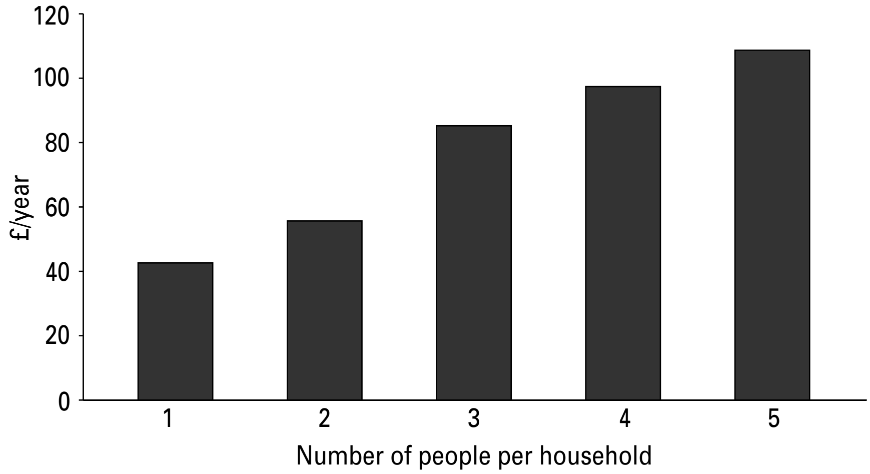


Figure 11 Annual average waste charge per year, with variable waste charging, for households of different sizes (with an average charge across households of £70 per year).



One-person households at the eightieth percentile in their production of residual waste would pay about £61 per year (i.e. they would lose about £11 per year) and two-person households at the eightieth percentile of residual waste would pay about £77 per year (a loss of about £27 per year). If there was serious concern about the impact on households like these at the upper end of the waste-distribution curve, there could be an increase of 25p per single person, and 50p per couple, in Income Support, Job-Seeker's Allowance and Pension Credit, and an increase in Working Tax Credit of 25p per claim. That would cost about £150 million per year.[1] However, it is not clear that this would be necessary, since even most two-person households would not lose without any such benefit increases.

In order to protect larger low-income households, it would be necessary to provide extra benefits for additional members. As shown in Figure 11, the average waste bill for a three-person household would be about £85 per year, so an additional £35 a year would be needed to compensate them. The average extra cost for each of the fourth and fifth members of a household would be about £12 per year, taking them to an annual waste cost of £97 and £109 respectively. To compensate, 50p per week could be added to Child Tax Credit for all families on benefits and low incomes. This would cost approximately £165 million per annum (Child Poverty Action Group, 2003). If the intention was that no household below the eightieth percentile would lose out, then the increase in Child Tax Credit would need to be slightly higher at 65p per child, costing about £215 million per annum.

It can therefore be seen that the cost to taxpayers of protecting 80 per cent of the poorest households from the additional cost associated with introduction of such a variable charging scheme to create a more sustainable waste-management system, even if they changed their waste-disposal habits no more than other members of society, would be about £150 million for increases in means-tested benefits and £215 million for increases in Child Tax Credit, or about £365 million per annum in total.

It may be noted that, under this scheme, central government would be spending through the benefits system about the same as the £375 million it would need to spend in support grants to local authorities to cover the additional costs of higher recycling rates, if these were to be funded through Council Tax. In reality, without variable charging, central government, local authorities and ultimately taxpayers would have to spend far more on waste management and probably still fail to meet the requirements of the Landfill Directive because the growth in waste production is unlikely to be restrained without it.

The biggest issue raised by seeking to use the benefits system as a compensation mechanism is that it works on a national level, whereas at present it is envisaged that decisions to implement variable waste charging are likely to be taken locally. It is in fact not clear why this should be the case. It could be argued that, once pilot projects had demonstrated the benefits of variable waste charging, it could be made a national requirement. Compensation through the benefits system for the extra costs for low-income households, and especially for larger low-income households, as described above, would then provide an efficient and effective means of ensuring that it was not regressive.

Conclusions

Introducing more environmentally sustainable waste-management practices, as required by the EU Landfill Directive, is likely to increase the costs of household waste disposal above current levels. There are three broad possibilities for funding these increased costs. Either they could be funded through Council Tax, either fully or with the central government paying 75 per cent as at present, which would be regressive (especially the full Council Tax option), unless benefits were increased to compensate for this. Or they could be funded through general taxation, by keeping household waste charges unchanged and increasing the grant from central government. In both these cases, household waste generation would seem likely to keep on rising at 3 per cent per year, so that waste-disposal charges would double over 15 years, as foreseen by the Strategy Unit report (Strategy Unit, 2002).

If local authorities were permitted to introduce variable waste charging, then the waste-disposal costs of those that did so would rise less slowly than the charges of those that did not, because of the incentive to reduce waste generation. Low-income households could reduce their charges still further by taking more aggressive action to cut their waste. Such savings would not arise if household waste disposal continued to be paid for through Council Tax. In due course, it might come to be perceived that the continuing payment for household waste collection and disposal through Council Tax was in fact both inefficient and regressive, and local authorities be required, rather than permitted, to introduce variable waste charging.

The analysis in this chapter has indicated that, once variable waste charging was widely implemented, the savings to society that it would be likely to engender from reduced waste generation would outweigh the additional cost to the social security system of a compensation mechanism to ensure that families on low incomes were not disproportionately affected by the additional waste-disposal costs.

6 General conclusions

It should be clear for each of the four environmental issues considered – household use of energy, water and transport, and household waste – that the distributional implications of different systems of charging or environmental taxation, and the detail of how regressivity can be mitigated or removed, are very specific to the issue concerned. The differences for the different issues have been rehearsed in the conclusions of each of the chapters above and will not be repeated here. This chapter is devoted to the general conclusions that can be drawn from the analysis that has been carried out.

The first result that applies to all the issues is the very limited correlation between the use of environmental resources and income. The correlation is non-existent for waste generation and is very limited for water and energy use. It is most pronounced for transport, but there are many low-income households, especially in rural areas, that own cars. The lesson here is that environmental taxes and charges will always need to consider and compensate for their effects on low-income households if they are not to have a disproportionate effect on them, i.e. if they are not to be regressive.

The second general result is that there is a very wide range of environmental resource use between households in the same income decile. In Decile 1 (with lowest incomes), households at the eightieth percentile use six times as much energy, emitting nearly four times as much carbon, and nearly twice as much water as those at the twentieth percentile. Nearly 40 per cent of households in this decile own a car. One-person households at the eightieth percentile generate nearly as much waste as five-person households at the twentieth percentile. This variation between households of broadly the same socio-economic status makes the design of compensation schemes very difficult, because, although on average it is possible to solve the regressivity problem through either tariff/charging design or a targeted compensation scheme, compensation of the average low-income household will still leave many low-income households worse off, some of them significantly so. Compensation of the high-resource-using households either requires a degree of targeting that can be administratively difficult, if not infeasible, or results in very large redistribution between income deciles (with most low-income households ending up very much better off), which is likely to be politically problematic.

In practice, households will be able to change their behaviour in response to charging, reducing the consumption of the environmental resource in question. This of course is a major reason for taxing or charging for the resource in the first place, but this project was not able to study this issue in any detail. However, it needs to be remembered that reduced resource consumption could greatly reduce both the number and extent of net losing low-income households from any tax or charging system.

However, the implications of reduced consumption are very different for different resources. For energy and water, it could result in serious health effects. For transport, it could increase social exclusion. For waste, the implications seem on the face of it less serious, but residual waste reduction is crucially dependent on possibilities for recycling, which may be limited for poor households in flats or with less space.

Where reduction in resource consumption would result in real hardship but the affected households could be relatively easily identified (e.g. water use in households with medical conditions), it should be possible to make further special arrangements to ensure that this is relieved. However, where the hardship affects larger number of households that are harder to identify (e.g. energy), it may be necessary to tackle the underlying cause of the hardship (e.g. energy-inefficient buildings) *before* pricing is used as an instrument of policy.

In none of the areas studied will charging be an adequate policy instrument by itself. A range of other policy measures will be necessary to provide alternative services or infrastructure (e.g. transport, waste), increase capacity (e.g. energy-efficiency installers) or address barriers to more environmentally conserving behaviour (e.g. lack of awareness/information in all areas). The policy complexity, and the inevitability of *some* losers, even in low-income groups, mean that there is a real danger of governments opting out of environmental taxes and charges as they relate to households altogether.

However, this possibility raises again the issue mentioned in the introductory chapter to this study, namely that it is very unlikely that any of these environmental issues can be cost-effectively addressed *without* use of the price signal (and, if an issue cannot be addressed cost-effectively, this greatly reduces the likelihood of it being addressed at all). As incomes increase, households are likely to continue to increase their use of energy, water and cars unless prices give them incentives not to do so, or to obtain the energy, waste or transport services more efficiently. This suggests that, if the UK, or any other, government fails to use prices to give signals for environmentally conserving behaviour, because of the difficulties involved in addressing the associated distributional issues, it will find that the environmental problem will prove intractable to other policy approaches. The challenge presented by this conclusion to the government of the UK, where household energy is nearly untaxed and energy prices are relatively low, where water is still largely unmetered and where household waste-disposal charges are unrelated to the amount of waste produced, seems particularly acute.

Notes

Chapter 1

1 It was not the purpose of this project to rehearse the reasons in principle for considering the use of economic instruments, as they have already been given in such publications.

Chapter 2

1 Deciles by absolute income are often converted to 'equivalent income' deciles to take account of differing household sizes. Further information about this is given in the working paper (Dresner and Ekins, 2004a).

Chapter 5

1 This and subsequent figures about the benefits system in this section are extrapolated from other calculations made by Holly Sutherland of Cambridge University for the project team.

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Appendix

Project Advisory Group

The following served in an individual capacity (institutions are for identification purposes only) as members of the Project Advisory Group:

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