11. Environmental taxation

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Summary

- The government has implemented several tax reforms in recent years that have improved environmental incentives, most notably: linking vehicle excise duty and company car tax rates to the emissions ratings of vehicles; imposing an energy tax on businesses; and developing domestic and international emissions trading.
- Despite these reforms, receipts from environmental taxes have fallen as a share of national income since 1999. The measures announced in the Pre-Budget Report will do little to reverse this. However, the UK still takes a higher share of national income from green taxes than the OECD average.
- The decline in green tax revenue as a share of national income is largely due to the government's decision to abandon annual above-inflation increases in fuel duty. Raising green tax revenues substantially through the existing tax system will be difficult without significantly higher rates of fuel duty.
- Longer-term reforms may dramatically alter the structure of green taxes. But increasing green taxes may conflict with government targets for fuel poverty (or poverty in general) or with the desire to promote business competitiveness.

11.1 Introduction

The environment has risen high up the political agenda in a very short space of time. The publication of the Stern Review in 2006[2] (see Box 11.1) laid the scientific and economic background for a case for further action, and both main opposition parties have argued for raising environmental taxes and cutting others. Perhaps motivated by both these developments, the December 2006 Pre-Budget Report contained several key environmental measures and indicated more to come in Budget 2007.

The case for the use of taxes and other economic instruments such as emissions trading schemes as a part of the arsenal of environmental policy has been known for some time and theoretical developments in this area have continued in recent years. The Kyoto Protocol, committing many developed nations to greenhouse gas emission reductions, was signed in 1997 and in 2000 the government adopted its own domestic targets to reduce carbon dioxide

[1] Data from the Expenditure and Food Survey (EFS) used in this chapter are Crown Copyright and used with the permission of the Controller of HMSO and the Queen's Printer for Scotland. The EFS is sponsored by the ONS and DEFRA, which bear no responsibility for its analysis or interpretation.

[2] N. Stern, *The Economics of Climate Change*, HM Treasury, London, 2006. The full executive summary is at http://www.hm-treasury.gov.uk/media/8AC/F7/Executive_Summary.pdf; the whole report is available on the HM Treasury website.

(CO_2) emissions by 20% from their 1990 levels by 2020. A 2003 White Paper[3] set out an additional longer-term target for a 60% emissions reduction by 2050. More recently, the Climate Change Act outlined in the 2006 Queen's Speech proposes an independent Climate Change Committee to help the government meet its emissions targets.

This chapter focuses on the history and likely future direction of environmental tax policy. The main analysis centres on domestic taxation, though in recognition that emissions trading

Box 11.1. The Stern Review

Given the attention it has received and the government's endorsement of its conclusions, the Stern Review is likely to set the policy agenda on climate change for some time. The Review's main conclusion was that strong and urgent action is needed to tackle climate change: under a 'business as usual' scenario, global temperatures are likely to rise by between 1.4 and 5.8° Celsius by 2100. The expected economic impact would be equivalent to a cut in world national income of at least 5%, with developing countries experiencing a greater cost. This estimate also neglects any non-market impacts of increased disease or loss of biodiversity.

The Review estimated that the optimal policy response implies a cut in world national income that reaches 1% in 2050 and each year thereafter – alternatively expressed as the world reaching the same living standard 6 months later than if there were no global warming. The net present value to the world of optimal abatement compared with business as usual is estimated at $2.5 trillion per year – approximately equal to the current value of UK national income.

The policy recommendations centre on targeting the optimal concentration of CO_2 in the atmosphere, while current policy targets (Kyoto and UK domestic targets being two examples) are expressed as absolute reductions in greenhouse gas emissions. The Review recommends global policy action on several fronts: reducing demand for energy-intensive goods and services, increasing energy efficiency, reducing non-energy emissions (for example, by preventing deforestation) and supporting investment in low-carbon technologies. In terms of immediate action for the UK, policy should try to create a uniform price of carbon across the economy.

Criticisms of the Review mainly centre on the climatic predictions and the weighting given to the welfare of future generations compared with the present. It is claimed that Stern reaches his conclusion by taking only high damage estimates from the literature, and by adopting near-zero discounting, which places far more weight on future outcomes. Nordhaus[a] points out that with near-zero discounting, and standard growth estimates, a policy to sacrifice 15% of consumption this year to avoid a 0.01% reduction in national income from 2200 onwards would yield positive net present benefits.

[a] W. Nordhaus, *The* Stern Review *on the Economics of Climate Change*, 2006 (http://nordhaus.econ.yale.edu/SternReviewD2.pdf).

[3] Department of Trade and Industry, *Our Energy Future – Creating a Low Carbon Economy*, Cm. 5761, London, 2003 (http://www.dti.gov.uk/files/file10719.pdf).

at both national and international level is highly likely to play a key role in environmental policy in the future, we also discuss existing trading schemes and their possible development. We examine the environmental impact of green tax policy and how revenues have changed since the 1980s, placing the current position in both historic and international context. We analyse the crucial issues facing the Chancellor in determining whether and how to raise revenues from green taxes, and how environmental policy objectives can sometimes conflict with other key targets. We also discuss briefly some of the issues to do with longer-term reform of environmental policy.

The chapter proceeds as follows: Section 11.2 discusses briefly the economics of environmental taxation; Section 11.3 details the current system of environmental taxes and revenues; and Section 11.4 looks back at the history of green tax revenue and assesses how the UK compares with other economies. Section 11.5 then discusses options for the Chancellor in Budget 2007 – can additional revenues be raised from green taxes, what issues are faced in doing so, and what longer-term options for reform might exist? Section 11.6 concludes.

11.2 The economics of environmental taxation

The primary rationale for environmental taxation is the externalities argument. This says that in deciding how much, and in what way, to produce or consume, a polluter will not take into account the costs imposed on society at large from their private actions. This means that, from a social point of view, too much pollution will be generated. One solution to this problem, as first advocated by Pigou,[4] is to levy a tax on the pollution-generating activity. If the right level of taxation can be found, the social costs of pollution can be 'internalised' to the agent (who must pay the tax) and the socially optimal level of pollution would occur. This argument recognises that, in general, it is not best to *eliminate* pollution altogether: the cost to society of doing so may well outweigh the benefits of continuing some level of pollution associated with production or consumption.

In deciding at what rate to set a green tax, it is necessary to take into account the cost of abating pollution (either from changing technology or from curbing activity altogether) and the value (in terms of our welfare) of the reduced damage resulting from lower pollution. The socially optimal level of pollution is that where the marginal abatement cost (i.e. the cost to the polluter of eliminating an extra unit of pollution) is equal to the marginal damage cost (the net social damage caused by that last unit).

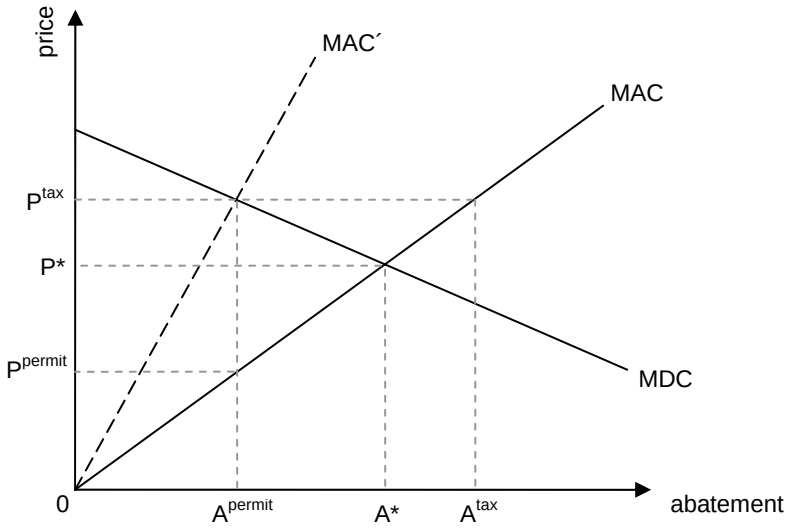
In practice, of course, knowing the 'correct' tax rate is extremely difficult, particularly for large-scale problems such as global warming and atmospheric pollution. The damage costs may include costs to future generations, and, as some of the controversy over the Stern Review suggested (see Box 11.1), estimating and weighting these with any accuracy is extremely difficult. There is also considerable difficulty in estimating abatement costs, such as what is the expected impact of R&D in new abatement or production technologies. Therefore, it is unclear how polluters will respond to tax incentives. This uncertainty may

[4] A.C. Pigou, *The Economics of Welfare*, Macmillan, London, 1920.

lead to too much or too little pollution reduction relative to the desired outcome and therefore some period of tax rate adjustment might be required. However, the trade-off for this uncertain outcome is that taxes will provide incentives for low-cost abaters to reduce pollution more and high-cost abaters to reduce pollution less, preferring to pay extra tax than incur the higher costs of pollution reduction. This would mean a more efficient pattern of abatement than simply imposing targets on each polluter to reduce emissions by the same amount. This 'static efficiency' argument for green taxes is accompanied by a 'dynamic efficiency' argument, that taxes provide ongoing incentives to reduce pollution and therefore tax liability, by investing in new clean technologies, for example. An emissions cap imposed by a regulator does not provide incentives to reduce pollution below the target level.

Emissions trading schemes provide an alternative approach to the problem: the total level of pollution is guaranteed by the number of permits allocated and then the permits are traded such that more efficient abaters can sell excess allowances to less efficient abaters, giving a certain outcome at lowest cost. Both taxes and emissions trading schemes therefore offer efficiency advantages over simple regulation. With taxation, policymakers effectively set the pollution price but leave the resulting emissions level uncertain, whilst with trading the level is fixed and the resulting price uncertain, determined by the market trading patterns.

Figure 11.1. Taxes and permit trading under uncertainty



When abatement costs are known with certainty, permit trading schemes and taxation theoretically yield identical results in terms of final pollution and the pollution price. Under uncertainty over marginal abatement costs, however, the results will differ: when abatement costs are overestimated (underestimated), taxes will yield too much (too little) abatement, while a permit scheme will yield too little (too much) abatement. Figure 11.1 illustrates this point. The horizontal axis shows the total level of abatement carried out. The marginal abatement cost (MAC) curve rises with the total amount of abatement – firms will carry out easy abatement first and more costly abatement only once these options are exhausted. The marginal damage cost (MDC) curve represents the benefit to society from reduced environmental damage from each additional unit of abatement. With no tax or trading scheme, no abatement is carried out. The optimal social outcome is for a level of abatement

A*, which generates a tax rate or emissions price P* – at this point, the marginal abatement and damage costs are equalised. Now suppose that the government knows the MDC curve with certainty but overestimates the costs of abatement, assuming a new curve MAC´. Faced with setting an environmental tax under this scenario, the government would choose a tax rate of P^{tax}, too high relative to the correct rate which generates the social optimum. Firms would now find it in their interests to do *more* abatement than is optimal to avoid paying the tax at this high rate. Total abatement at this price is A^{tax}. If instead the government wanted to allocate emissions permits, it would allocate enough that the total amount of abatement was A^{permit} since this would appear to be the social optimum under its assumed abatement costs. This would result in a permit price of P^{permit}, below the actual social optimum.

A key question in the choice between taxes and trading, therefore, has to be the level of uncertainty over abatement and damage costs. Over the short term, the emissions level will not alter the climate significantly and there may be advantages in terms of efficient planning and decision-making over a certain price of emissions generated by a tax. Over the longer term, however, it becomes more important to reach the optimal emissions level: here, it may be better to set quotas through a trading scheme rather than prices via a tax. Trading schemes may also represent the most effective way to reach international or domestic emissions targets for a fixed point in time, such as those set by Kyoto or the British government, as the terms of the scheme can be set so that the amount of permits issued matches the target level in the target period.

In reality, both systems are likely to coexist for different types of pollution and different industries. Trading schemes may be more easily internationally regulated: it is hard to enforce an international common tax rate on emissions, but an international permit trading scheme (the EU Emissions Trading Scheme) is already operating. On the other hand, taxes may be more flexible, and can be levied on consumers and small firms for whom it is currently impractical to measure emissions. The practical issues behind the use of taxes and permit schemes are discussed further in Section 11.5.[5]

The use of economic instruments in environmental policy is not without possible drawbacks. One of the key problems may be the typically regressive nature of taxes on pollution. Taxing energy or transport, key sectors in emissions generation, is likely to impact more on the poor than the rich since both goods are economic necessities (in the sense that the poor spend a proportionately higher share of their income on them than the rich). In addition, if increased environmental revenues are used to lower labour taxes, this might not help make the package of measures less regressive, because such changes typically benefit middle- and high-income taxpayers, and certainly not those with incomes below the personal allowance.

It is also often argued that receipts from green taxes ought to be recycled, either towards green projects or to reduce other taxes such as income tax or National Insurance rates. However, there is no economic logic in tying expenditures on particular items to receipts from particular taxes, or 'hypothecation'. With fully binding hypothecation, where all expenditures are tied to particular tax receipts, the resulting pattern of government spending is unlikely to be optimal (in the sense that money could be reallocated from one project to another to

[5] See also chapter 14 of N. Stern, *The Economics of Climate Change*, HM Treasury, London, 2006 (http://www.hm-treasury.gov.uk/media/8A7/FB/Chapter14_Harnessing_markets.pdf).

improve overall social welfare), and uncertainty over receipts from one year to another will lead to difficulties in long-term expenditure planning.[6] With only partial hypothecation, where some revenues are ring-fenced and others are not, it is extremely difficult to account for any given pound of receipts, which makes the concept essentially meaningless. However, it may be that higher green taxes are deemed more politically acceptable if, in principle at least, the revenue is seen to be used in a particular way.

11.3 Current environmental taxes

Table 11.1 details the current system of environmental taxes in the UK.[7] It covers all the main taxes included in the current ONS classification of environmental taxes (see Section 11.4) and some currently not included but that may have environmental impacts.

Table 11.1. Current UK environmental taxes

Tax	Description	Rate(s)	Latest receipts
Transport taxes			
Fuel duty	A tax per litre of road fuel purchased. Subject to the 'fuel price escalator' between 1993 and 1999 which saw annual real-terms increases in rates. Since the announcement of this being abandoned in November 1999, nominal rates for most fuels have increased only three times, each time in line with inflation.	48.35p/litre for the most commonly purchased petrol and diesel. Reduced rates for alternative fuels and for 'red diesel' for certain off-road vehicles; zero rate for most aviation fuel.	£23.35bn (2005)
Vehicle excise duty	An annual tax on vehicle use. Rates were flat-rate per vehicle until 1999, when a two-tier rate that varied with engine size was introduced. In 2001, six rate bands were introduced that varied according to the CO_2 emissions rating of the vehicle. This was increased to seven bands in 2006, with the rate for the least-polluting vehicles reduced to zero.	Vary according to vehicle type and fuel type. For cars that run on petrol, current rates range from £0 to £210 per year.	£4.81bn (2005)
VAT on fuel duty[a]	VAT of 17.5% is charged on top of the fuel duty rate as well as the pre-tax price of fuel.	Effectively 8.46p/litre on top of fuel duty.	£4.09bn (2005)

Continues

[6] This may be a particular concern for environmental taxes if, in the long term, the revenue base were eroded by changing consumer or producer behaviour.

[7] More details on the current UK environmental tax system can be found in A. Leicester, *The UK Tax System and the Environment*, IFS, London, 2006 (http://www.ifs.org.uk/publications.php?publication_id=3774).

Table 11.1 continued

Tax	Description	Rate(s)	Latest receipts
Company car taxation[b]	A tax on the estimated income value of a company car and fuel as a benefit in kind. From April 1994, the imputed income was taken as 35% of the list value. In 2002, this was reformed so that the percentage of list value taken varied according to the emissions rating of the car provided. The amount of income imputed from company-provided fuel also depends on the emissions rating of the vehicle.	*Company car tax:* Depending on the emissions rating and fuel type, between 15% and 35% of the list value is assumed as imputed income each year. *Company fuel tax:* The same percentage value is applied to £14,400 to derive imputed income.	*Company cars / vans (tax + NI):* £2.13bn (2004–05) *Company fuel (tax + NI):* £0.58bn (2004–05)
Air passenger duty	A per-passenger tax on flights from UK airports. Exemptions apply for passengers under 2 years of age, small pleasure aircraft, connecting flights and flights from the Scottish Highlands or Islands. Rates vary according to destination and class of flight. From February 2007, the rates will double following a policy decision in the December 2006 Pre-Budget Report.	(From Feb. 2007) *Flights within EEA:* Economy £10 Other classes £20 *Flights outside EEA:* Economy £40 Other classes £80	£0.90bn (2005); forecast to double as a result of policy change
Energy taxes			
VAT on domestic fuel[c]	Domestic fuel is charged VAT at a rate of 5%. This was reduced from 8% in 1997. VAT on domestic fuel was originally introduced in 1994 at 8%; a planned increase to 17.5% in 1995 did not go ahead.	5%	£0.88bn (est.)[e]
Climate change levy[d]	A tax on the supply of energy to business. Rates vary according to the type of energy supplied, and energy supplied through renewable resources is exempt. Energy-intensive industries can sign 'climate change agreements' (CCAs), which reduce their liability by 80% in return for commitments to increase energy efficiency.	*Electricity:* 0.43p/kWh *Gas:* 0.15p/kWh *LPG:* 0.07p/kWh *Solid fuel:* 0.15p/kWh	£0.75bn (2005)
Renewables obligation[b]	From 2002, electricity suppliers have an obligation to source a proportion of their total output from renewable resources (6.7% in 2006–07), obtaining a 'certificate' for each megawatt-hour they source from such sources. Failure to receive enough certificates to meet the target incurs a penalty payment into a buy-out fund for each MWh below it. Revenues from the fund are repaid to suppliers according to the number of certificates they present each year.	Buy-out payments are £33.24 per MWh in 2006–07.	n/a

Continues

Table 11.1 continued

Tax	Description	Rate(s)	Latest receipts
Resource taxes			
Landfill tax[d]	A tax levied on local authorities or organisations for the volume of waste sent to landfill. Decomposition of waste in landfill sites accounts for around 40% of UK emissions of methane, a greenhouse gas. 'Inert' wastes such as rocks are subject to a lower rate than other waste products. Since 1999, the 'landfill tax accelerator' has seen rates increase each year. The current target is to reach a rate of £35 per tonne of non-inert waste, though this target may be increased. Landfill owners (on whom the tax is formally incident) can receive credits for up to 6% of their total tax liability each year by donating to approved projects as part of the Landfill Tax Credit Scheme.	*Standard rate:* £21/tonne *Reduced rate:* £2/tonne	£0.73bn (2005)
Aggregates levy[d]	A tax on the extraction of primary aggregates (rock, sand). Aggregates extracted and used in Northern Ireland receive an 80% discount. Clay and coal (amongst other materials) are exempt.	£1.60/tonne	£0.33bn (2005)
Water abstraction charges[c]	A charge levied by the Environment Agency (EA) on businesses that extract under- and over-ground water sources. The tax depends on the volume of water *licensed* for abstraction rather than the actual abstraction itself, and varies according to region, source of water, season and final use. The revenue is used to cover the EA's cost of water resource management.	Varies – for 2006–07 rates, see Environment Agency, *Environment Agency Scheme of Abstraction Charges*, 2006.	£0.13bn (estimate, 2006–07)
Emissions trading			
UK[c]	The UK Emissions Trading Scheme (ETS) began in 2002 and ran until the end of 2006. It involved around 30 'direct participants' and 6,000 firms covered by climate change agreements as part of the climate change levy. Direct participants bid on greenhouse gas emissions reductions in return for incentive payments for hitting their targets. By the end of 2005, total emissions from direct participants were around 7.1 million tonnes of carbon equivalent below baseline.	Total incentive payments were worth £215 million over the period.	n/a
EU[b]	The EU ETS began in 2005 with Phase 2 due to begin in 2008. It is a compulsory scheme for energy-intensive industries. National governments submit an annual allocation of CO_2 emissions permits over a three-year period for firms covered – the UK allocated around 736 million permits in Phase 1. EU emissions after one year were around 1.79 billion tonnes of CO_2, compared with total permits of 1.83 billion tonnes, suggesting some overcompliance.	€40/tonne of CO_2 for each unit of emissions over a firm's allocation.	n/a

Notes: See next page.

Notes to Table 11.1:
[a] Currently included in official ONS environmental tax revenue data but due to be excluded from Spring 2007.
[b] Not currently included in official ONS environmental tax revenue data but will be included from Spring 2007.
[c] Not currently included in official ONS environmental tax revenue data and not planned to be included.
[d] These taxes were accompanied by a reduction in the rate of employer National Insurance contributions designed to be revenue-neutral.
[e] Estimated for 2006–07 from HM Treasury, *Tax Ready Reckoner*, 2006 (http://www.hm-treasury.gov.uk/media/77C/B3/pbr06_taxreadyreckoner.pdf).
Sources to Table 11.1: Various HM Treasury Budget Documents, ONS Environmental Accounts Documents, EU (http://europa.eu/rapid/pressReleasesAction.do?reference=IP/06/612&format=HTML&aged=0&language=EN&guiLanguage=en), DEFRA UK Emissions Trading Results; authors' calculations.

11.4 Environmental tax revenues

What is an environmental tax?

There is no single 'correct' definition of what should and should not be included in any account of environmental taxes. Eurostat has argued that an environmental tax is 'A tax whose tax base is a physical unit (or a proxy of it) of something that has a proven, specific negative impact on the environment'.[8] This definition ignores the possible *intent* behind taxes that may have environmental effects but were not explicitly introduced as such. One example in the UK is air passenger duty (APD), announced in the Autumn 1993 Budget and introduced in 1994 with the argument that aviation was a relatively under-taxed sector since flights did not incur VAT and aviation fuel is exempt from fuel duty. The Eurostat definition also allows taxes that are clearly not just focused on environmental objectives to be included. Fuel duty, for example, may in part be justified by environmental externalities but is also in principle designed to cover the external costs of congestion, accidents and road damage.

In 2006, the ONS published a review[9] of which taxes should be classified as environmental for the purposes of the biannual *Environmental Accounts* publication, which details revenues from environmental taxes. The report reached two key conclusions: first, to reclassify receipts from company car and company fuel taxes as environmental; and second, to remove the VAT charged on top of fuel duty as an environmental tax. Company car taxes add around £2 billion to the total environmental tax take, but the loss of VAT on fuel duty removes around £4 billion. Typically, the net effect is to reduce estimates of environmental tax receipts by around 5% in each year such that whilst the levels change across the old and new definitions, the trends do not.

The decision to include company car taxes is relatively uncontroversial: the payment depends on the emissions rating of the vehicle and so the structure is very similar to vehicle excise duty (VED), which has always been categorised as an environmental tax.

Removing the VAT component of fuel duty is more debatable. The ONS argues that since VAT does not raise the relative price of goods (because it is charged on most expenditures), it does not affect behaviour in the way other environmental taxes do. Indeed, the Eurostat guide

[8] Page 9 of Eurostat, *Environmental Taxes – A Statistical Guide*, 2001 (http://epp.eurostat.cec.eu.int/cache/ITY_OFFPUB/KS-39-01-077/DE/KS-39-01-077-DE.PDF).

[9] I. Gazley, 'UK environmental taxes: classification and recent trends', *Economic Trends*, 635, October 2006 (http://www.statistics.gov.uk/articles/economic_trends/ET635Gazely.pdf).

goes on to explicitly exclude VAT-type taxes from its definition of green taxes for this reason. However, since the VAT component is charged on top of duty, all it does is effectively raise the rate of fuel duty by 17.5%. The government could conceivably abolish VAT on fuel duty and raise the rate of fuel duty by 17.5% without affecting either the pump price of fuel or the tax component of the price (though clearly there would be an effect on firms that can reclaim VAT but not fuel duties). However, the decision does square with the exclusion of VAT on domestic fuel and VAT on the pre-tax petrol price from environmental tax revenues, which was the case both before and after the ONS review. In addition, the decision will bring UK figures in line with international data from the EU and OECD, which have never included VAT on fuel duty in their figures.

The ONS review also included a provisional decision to include money exchanged between firms as part of the EU Emissions Trading Scheme (ETS) in green tax revenues. It argued that since the scheme was compulsory for some firms in the EU (unlike the UK ETS) and the payments were made for licences to emit CO_2, the EU ETS was in effect an environmental tax where the payments could be treated as imputed taxes and subsidies (i.e. if firm A pays £1,000 to firm B to buy some of its emissions permits, that could be seen as a tax of £1,000 on firm A and a subsidy of £1,000 to firm B). Whilst this is true in an accounting sense, the 'revenues' from the EU ETS are not like tax revenues from other taxes, which the government is in principle free to allocate as it pleases. The money is effectively ring-fenced to be redistributed to other firms participating in the scheme. It is unclear how this decision, and the additional decision to include payments made as part of Renewable Obligation Certificates (see Table 11.1), will affect measures of environmental tax revenues, as no data are currently available.

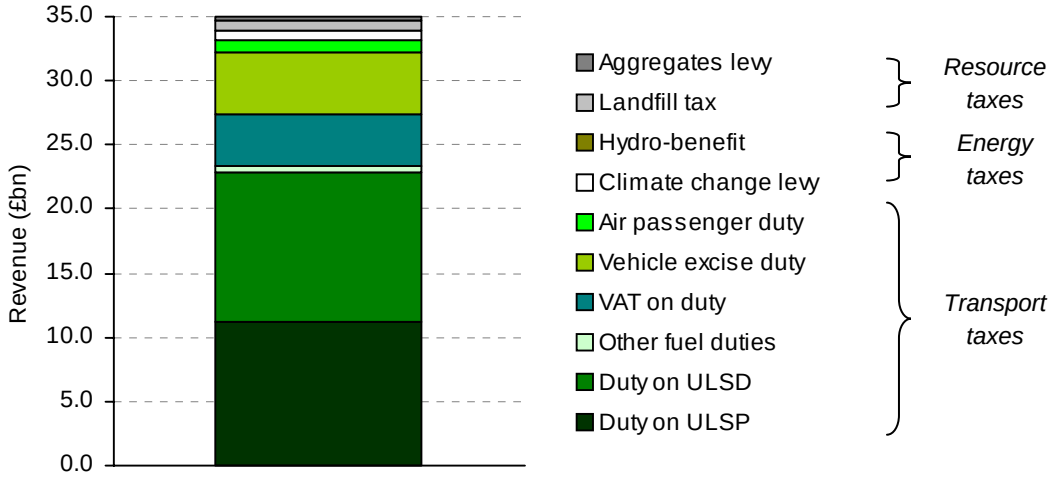
The rest of this section discusses current and historical environmental revenues using the current definition of green taxes. Before discussing total revenue, a couple of words of caution are important. The total amount of revenue received should not necessarily be taken as a direct indicator of the level of importance or significance that the government is attaching to the environment or its own environmental objectives. A high or increasing amount of revenue could reflect a large tax base or high tax rates (perhaps higher than those that might be justified by the external costs of the activity); equally, a decline in revenues may indicate an erosion of the tax base, something we may expect to occur over the long term as people change their behaviour in response to the tax. Further, not all environmental measures are revenue-raising. The UK and EU Emissions Trading Schemes do not raise revenue directly for the government but form an increasingly important plank of environmental policymaking. Reduced-rate VAT on energy-saving materials, introduced in 1998 and since extended, is another green incentive that is not reflected in environmental revenue figures (indeed, it has a negative effect on total revenues). Other policy may also reform existing taxes to make them more environmental in intent without changing revenues substantially – reforms to the taxation of company cars and VED are examples here, as is the use of fuel duty differentials to encourage a shift to less polluting fuels (such as the move from leaded to unleaded to ultra-low-sulphur petrol). Environmental regulation is also a central part of policymaking that does not generate revenues – for example, since 1993, all new cars have had to be fitted with a catalytic converter.

However, green taxes remain a significant part of environmental policy, and trends in revenue over time will tell us something about the range and scale of measures being employed to use the fiscal system for environmental objectives. It is unlikely that revenue erosion through behaviour changes currently represents a major obstacle to collecting significant revenues, and over a short time period revenue trends are probably much more dependent on the tax rates themselves. Indeed, there is no good economic reason why, even in the long run, revenues would disappear completely – as discussed at the start of the chapter, tax rates should be set such that marginal social benefits and costs of a particular polluting activity are equalised, not so that the activity is ended altogether.

Latest revenue data

In 2005, the government received a total of £35.0 billion in environmental tax revenue.[10] This represented 7.7% of total receipts, or 2.9% of national income. Figure 11.2 shows how this was broken down between the various taxes included in the ONS figures.

Figure 11.2. UK environmental tax receipts, 2005



Note: ULSD is ultra-low-sulphur diesel and ULSP is ultra-low-sulphur petrol.
Source: ONS, *Environmental Accounts, Autumn 2006* (http://www.statistics.gov.uk/downloads/theme_environment/EANov2006.pdf).

Clearly, transport taxes, and in particular fuel duties (largely those on ultra-low-sulphur petrol and ultra-low-sulphur diesel, which together accounted for 86% of fuel sold in 2006[11]), dominate the total. Around £11.5 billion was raised from each of ULSD and ULSP and almost £0.5 billion from other duties on fuels, such as leaded petrol, red diesel and AVGAS (aviation gasoline). Total revenue from fuel duty was £23.3 billion, or just over two-thirds of

[10] ONS, *Environmental Accounts, Autumn 2006* (http://www.statistics.gov.uk/downloads/theme_environment/EANov2006.pdf).

[11] Data from table 1 of HM Revenue and Customs, *Hydrocarbon Oils Duties Bulletin January 2007* (http://www.uktradeinfo.com/index.cfm?task=bullhydro). Note that this figure also includes sales of sulphur-free diesel (SFD), which is taxed at the same rate as ULSD but was largely unavailable before 2006 and so is not included in the 2005 revenue series presented in Figure 11.2.

the entire total of green tax revenues in 2005. Adding in receipts from VAT on fuel duty as well brings the total to £27.4 billion, 78% of total environmental tax revenues.

Vehicle excise duty represents the next-most significant tax, at £4.8 billion or 14% of receipts. Fuel duty, VAT on fuel duty and VED are the only individual taxes to raise more than £1 billion – the next-highest is air passenger duty at £0.9 billion, just 3% of the total (though from 2007 this revenue should roughly double as a result of the doubling of the rates of APD from February). The largest four taxes are all the transport taxes, which collectively account for £33.1 billion of revenue, 95% of the total. When included from Spring 2007, company car tax will probably account for around £1.6 billion and company fuel tax around £0.5 billion, whilst the loss of VAT on duty will see £4.1 billion removed from the transport total.[12] This will represent a net loss to recorded total revenue from environmental taxes, and transport revenue, of around £2 billion from the official figures.

Figure 11.2 makes clear the small scale of most individual green taxes, aside from fuel duty, VAT on fuel duty and VED. The energy taxes – climate change levy (CCL) and hydro-benefit – raise just £0.8 billion, or 2% of total revenues. This is almost entirely CCL – hydro-benefit is a payment to reduce the transmission costs of Scottish hydro-electric power and raises just £10 million. The resource taxes – aggregates levy and landfill tax – raise £1.1 billion, or 3% of the total.

Historical revenue data

Figure 11.3 shows total environmental tax receipts on the current ONS definition between 1987 and 2005. The top half shows the level in nominal terms and after adjusting for economy-wide inflation. The bottom half translates this into shares of total receipts and national income in each year.

UK receipts grew fairly steadily in nominal terms throughout the late 1980s and the 1990s, though after taking inflation into account, real-terms growth in receipts did not begin until around 1993. Between 1992 and their peak in 2000, real receipts rose from £25.7 billion to £37.8 billion, a rise of 47%. Between 2000 and 2001, however, nominal receipts actually fell, and whilst they have risen gradually since, to a new nominal peak of £35.0 billion in 2005, real-terms receipts stabilised, and were 7.5% lower in 2005 than in 2000.

Similar pictures emerge when we look at environmental tax revenues as a share of total receipts and of national income. As a share of total revenue, green tax receipts rose in the 1990s, from 7.8% in 1989 to a peak of 9.7% in 1999. Since then, this share has declined almost year on year and in 2005 it fell to 7.7%, the lowest over the last 20 years. As a share of national income, the upward trend in the 1990s is also evident, from 2.9% in 1989 to 3.6% in 1999. This share has since declined to 2.9% in 2005, the lowest since 1989 and the joint-lowest recorded over the whole period.

[12] Source: I. Gazley, 'UK environmental taxes: classification and recent trends', *Economic Trends*, 635, October 2006 (http://www.statistics.gov.uk/articles/economic_trends/ET635Gazely.pdf).

Figure 11.3. UK environmental tax receipts

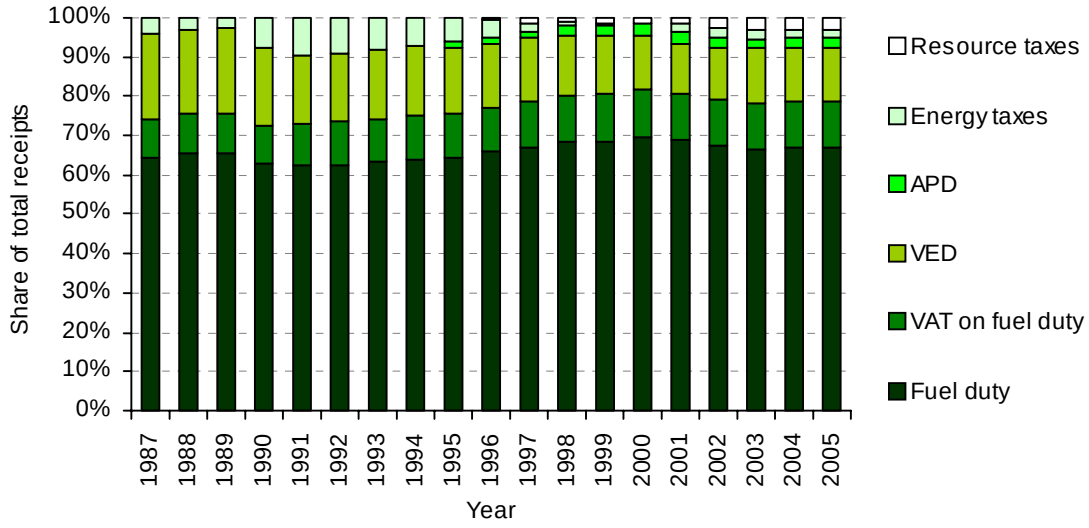
Note: Real series is deflated using a calendar-year GDP deflator calculated from ONS data, to 2005 values.
Source: Authors' calculations from *Environmental Accounts* and ONS data.

Figure 11.3 described the overall revenue, but how has the composition of revenues changed over time? Figure 11.4 breaks down total revenue into six components each year: fuel duty, VAT on duty, VED, APD, energy taxes and resource taxes.

Clearly, fuel duty has always dominated total green tax receipts, by itself accounting for 60–70% of revenues over the whole period. Including associated VAT, fuel duty typically makes up around three-quarters of receipts, peaking at just over 80% in 2000 at the end of the fuel duty escalator period. Since 2000, the share accounted for by fuel duty and the VAT on fuel duty has fallen back slightly.

Other taxes are very small by comparison. VED has accounted for around 15% of receipts since the late 1990s, compared with just over 20% in the late 1980s. Of course, the introduction of other taxes has played a part in the relative decline in importance of VED. APD has typically accounted for around 2–3% of total revenues since 1998 (and around 1–2% in 1995 to 1997).

Figure 11.4. Composition of total environmental tax receipts



Source: Authors' calculations from ONS data.

Energy taxes began to play an increasing role in environmental tax receipts in the early 1990s with the introduction of the fossil fuel levy in 1990, a tax paid by electricity suppliers using non-renewable resources but passed on to consumers. The fossil fuel levy was gradually wound down in the late 1990s (as a result of the privatisation of British Energy and the announcement of the climate change levy). In 1998–2000, energy taxes accounted for less than 1% of total revenues. Another factor was the decline of the gas levy, which raised about £½ billion annually in the mid-1980s but was phased out by 1999. The gas levy was a tax on some gas suppliers who arranged gas supply contracts in the 1970s at substantially lower prices than later market prices and with exemptions from petroleum revenue tax, and so benefited from an economic rent.

Resource taxes – the landfill tax and aggregates levy – have contributed a small but growing share of revenues over time, largely due to the real-terms increases in landfill tax that have been taking place since 1999 and the introduction of the aggregates levy in 2002. In 2005, these together accounted for 3% of revenues, slightly more than either energy taxes or APD.

What Figures 11.4 and 11.2 make clear, however, is that the green tax story in the UK is dominated by fuel duty. No other tax comes close to its receipts – indeed, as a tax measure in isolation, it raises more revenue for the UK exchequer than any other besides income tax, VAT, National Insurance and corporation tax.

What do we know about future receipts?

It seems very unlikely that environmental tax receipts will be significantly different this financial year from last.[13] Figures in the December 2006 Pre-Budget Report for the major green taxes suggested nominal receipts in 2005–06 of £35.1 billion and estimated receipts in 2006–07 at £35.9 billion. Once inflation adjustments are taken into account, real receipts for

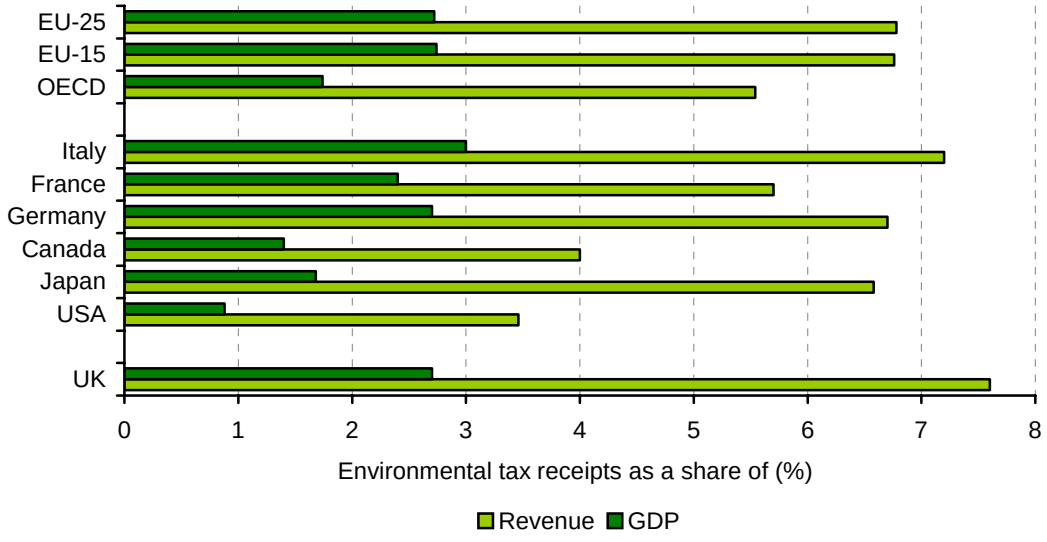
[13] Other than the change in definitions discussed already. The figures here represent a consistent definition of which taxes are included in revenues.

2006–07 will be similar to or slightly lower than those for 2005–06, and as a share of total revenue and national income they are projected to fall. For 2007–08, the figures project nominal receipts of £39.0 billion, which, after adjusting for inflation, will represent an expected increase of 5.8% on the 2006–07 estimates. This comes mainly from higher APD receipts (£1.1 billion in 2006–07, projected to be £2.0 billion in 2007–08) and higher fuel duty receipts (including associated VAT rising from £27.9 billion to £29.6 billion). A real increase of around 5–6% in receipts for 2007–08 would be the highest year-on-year rise probably since the late 1990s, certainly since the fuel duty escalator was abandoned. However, such an increase is forecast to only raise receipts as a share of national income by around 0.1%.

The UK in international perspective

How do UK revenues compare with those in other developed economies? Figure 11.5 shows data from 2003 for the percentage of total revenue and national income taken in environmental taxes for the G7 countries and various international averages (all of which exclude the UK figure). The UK appears to take a relatively high share of total revenues from environmental taxes – higher in 2003 than any of the other G7 economies and above the OECD and EU averages. In part, this reflects a relatively low total tax take, since as a share of national income the UK only broadly matches the EU average, though it is still significantly above the OECD average, which is depressed by the very low figure for the US. Indeed, on average, European economies extract a significantly higher share of total revenues and national income from green taxes than other developed nations. There is, however, relatively

Figure 11.5. International green tax revenues, 2003



Notes: EU and OECD averages are weighted by 2003 national income. International averages exclude the UK, the broader EU average excludes Hungary and Slovakia, for which information was unavailable, and the OECD average excludes Australia and Portugal, for which information was unavailable for 2003. The UK figures do not match those in Figure 11.3 for 2003 since the definitions of environmental taxes differ between the ONS and Eurostat.
Sources: UK and European figures from Eurostat; OECD and non-EU national figures from OECD, *Consumption Tax Trends: VAT/GST and Excise Rates, Trends and Administration Issues*, Paris, 2006. Weighted averages calculated by the authors.

little difference between members of the EU-15 and the 10 newest members.[14] The US looks substantially different from other countries, with only 0.9% of GDP and 3.5% of revenues coming from environmental taxes.

Leicester[15] shows that amongst OECD economies, between 1994 and 2003, green tax revenues fell as a share of national income but remained broadly unchanged as a share of total revenues. There was considerable variation across countries, but the UK was certainly not alone in experiencing a decline in environmental tax revenues as a share of national income.

Emissions impact of green taxes

Environmental taxes should not, of course, be considered merely in terms of their revenue but also in terms of their effect on environmental outcomes. It is, however, very difficult to make direct comparisons of the overall effects of different taxes even in terms of CO_2-equivalent emissions reductions. Taxes such as the aggregates levy are clearly not designed to have a direct emissions impact. In all cases, trying to discern the effect of the tax requires estimates of what would have happened to emissions without it, a very difficult counterfactual to construct.

The Treasury publishes estimates for some taxes of the environmental impact of any changes made at the time of the Budget or Pre-Budget Report. For example, it estimates that the CCL will reduce emissions by 3.5 MtC by 2010[16] (and the climate change agreements an additional 2.8 MtC per year). In terms of the two key reforms announced in the December 2006 PBR, the doubling of APD is expected to reduce greenhouse gas emissions by 0.75 MtC-equivalent by 2010 (including the radiative forcing effect of emissions at high altitude), and the revalorisation of fuel duty (an increase of 1.25p/litre plus associated VAT) will reduce emissions by around 0.1 MtC per year. The revalorisation represented a rise of about 2.7% in the rate of fuel duty. Assuming that the behavioural response to price increases is roughly constant around current prices, this suggests that an additional rise in fuel duty rates of some 16.5%, enough to take them back roughly to their peak real-terms values before the escalator was abandoned (see Section 11.5), would generate additional emissions reduction of around 0.5–0.6 MtC per year. To put all these figures into context, total UK emissions of greenhouse gases in 2005 were around 180 MtC-equivalent, and emissions of CO_2 were around 153 MtC-equivalent.[17] To meet the government's domestic target to reduce CO_2 emissions by 20% compared with 1990 levels by 2010, emissions would need to be just under 130 MtC-equivalent in that year, a reduction of 23 MtC-equivalent from 2005 levels.

[14] No data are yet available for Romania or Bulgaria, which joined the EU in January 2007.

[15] A. Leicester, *The UK Tax System and the Environment*, IFS, London, 2006 (http://www.ifs.org.uk/publications.php?publication_id=3774).

[16] Emissions estimates for this and other taxes discussed in this paragraph come from table 7.2 of HM Treasury, *Pre-Budget Report 2006* (http://www.hm-treasury.gov.uk/media/571/CF/pbr06_chapter7.pdf).

[17] Department for Environment, Food and Rural Affairs, *e-Digest of Environmental Statistics*, 2006 (http://www.defra.gov.uk/environment/statistics/index.htm).

11.5 Possible reforms

This section discusses possible ways in which existing taxes could be increased or reformed to raise further revenue and increase their environmental incentives. All the main political parties have more or less directly stated an aim to increase environmental taxes at the expense of other taxes. As far back as Gordon Brown's first Budget in July 1997, the government stated a desire to 'shift the burden of tax from "goods" to "bads"; encourage innovation in meeting higher environmental standards; and deliver a more dynamic economy and a cleaner environment, to the benefit of everyone.'[18] This 'statement of intent' on environmental taxation has been reiterated several times since.[19] The Conservative Shadow Chancellor, George Osborne, has stated a principle of 'pay as you burn, not as you earn' and proposed a new carbon levy to replace the CCL with revenues recycled to business (see below).[20] The Liberal Democrats have been most explicit in announcing a 'Green Switch':[21] they plan to raise £8.1 billion of environmental taxes and to return green tax revenue as a share of national income to the peak 1999 level over the course of a four-year Parliament, mostly through higher VED for the most polluting vehicles and revenue-raising reforms to APD, along with at least inflation-rises in fuel duty; they also plan to reduce other taxes, in particular income tax.[22]

The idea of using green tax revenue to reduce tax rates on income is not new: the introduction of three key taxes (aggregates levy, CCL and landfill tax) was in each case accompanied by a reduction in employer National Insurance contributions. The political rhetoric sounds as if it is endorsing the so-called 'double dividend' of environmental taxes – the idea that a revenue-neutral swap between an environmental tax and an existing tax can create economic benefits over and above those that come from correcting environmental externalities alone. The principle is that taxes on labour or production, say, create distortions whereas environmental taxes correct distortions. Thus such a swap can reduce the overall level of distortion in the tax system. However, the double dividend hypothesis is extremely controversial and there is considerable doubt as to whether green taxes really are a more efficient way to raise revenue than other taxes. For example, a tax on business energy use that is passed on to consumers in the form of higher product prices will raise the price level, reduce real wages and therefore affect labour supply decisions in a similar way to a direct tax on wages.[23] Furthermore, if green taxes are on average regressive, and if (as is commonly assumed) we value the welfare of the poor more highly than that of the rich when determining overall social welfare, then the distributional implications of green taxes may (depending on how the revenue raised is used) make them less desirable. Of course, even if there is no double dividend, there is still

[18] HM Treasury, *Financial Statement and Budget Report 1997*, (http://archive.treasury.gov.uk/budget/1997/report/chap1a.htm).

[19] See, for example, page 5 of HM Treasury, *Tax and the Environment: Using Economic Instruments*, 2002 (http://www.hm-treasury.gov.uk./pre_budget_report/prebud_pbr02/assoc_docs/prebud_pbr02_adtaxenvir.cfm).

[20] http://www.conservatives.com/tile.do?def=news.story.page&obj_id=133795.

[21] http://www.libdems.org.uk/media/documents/parliament/green_switch_180506.pdf.

[22] For figures, see http://www.libdems.org.uk/media/documents/policies/Tax%20Supplement.pdf. Note that inflation-linked increases to fuel duty rates should not be counted as 'revenue gains' to the exchequer, as the default option assumed in the public finances is inflation-indexing.

[23] Sometimes called the 'tax-interaction effect' – see A.L. Bovenberg and R.A. de Mooij, 'Environmental levies and distortionary taxation', *American Economic Review*, 84, 1085–89, 1994.

justification for environmental taxes from the single dividend of environmental improvement alone.

As the earlier sections stressed, revenue-raising should not be the guiding principle for environmental taxes: the aim is to balance the social costs and benefits of particular activities and encourage agents to include the environmental impact of their actions in their private decision-making behaviour. The 'revenue-maximising' set of environmental taxes would almost certainly not be the same as the socially-optimal set. Nevertheless, the recent decline in real tax revenues has been a cause for some concern amongst many[24] and, given the Stern Review and the policy agenda of the opposition parties, it is likely that the impetus for higher green taxes – and higher revenue from green taxes – is set to remain strong. This section therefore analyses the issues surrounding changes to each major tax – how much could be raised, what problems may be inherent with existing taxes and, briefly, what longer-term reforms may be ahead on the policy horizon.

Reforms of existing green tax system

In 2005, environmental taxes raised £35.0 billion, representing 2.9% of national income. In real terms, revenues peaked at £37.8 billion in 2000 – to be at that level in 2007 would require revenue of £39.9 billion once additional inflation is taken into account. As a share of national income, the peak occurred in 1999 at 3.6%. To reach that figure in 2007 would require revenues of around £48.8 billion. Either shift by this year is unlikely, particularly since the 2006 Pre-Budget Report did not contain any indication that substantial new revenues would be raised in 2007–08 from environmental taxes beyond the doubling of APD and a pre-announcement of higher landfill tax. Between 2000 and 2005, the period since the fuel duty escalator was ended, annual changes in nominal revenue have varied only from around –3% to +3%. In the absence of substantial new measures, any movement towards higher revenues is therefore likely to be fairly gradual.

Table 11.2 shows the percentage increase in various key tax rates that would be required to increase revenues from that tax by £1 billion, using information from the Treasury's *Tax Ready Reckoner* published alongside the 2006 Pre-Budget Report. It also indicates the level to which such an increase would take the tax rate, were it to be implemented. Except where indicated, these increases do not take into account *behavioural* responses – that is, they assume that behaviour will be unaffected by the tax increase. To the extent that people change their behaviour, the actual increases required to raise £1 billion would be greater than suggested by these figures.

These figures suggest that a £5 billion green tax-raising package[25] could (but no means necessarily should) include, say, an 8% rise in fuel duties (approximately an additional year of inflation + 6% escalator), another doubling of APD on top of the doubling in the Pre-Budget Report and a doubling of the landfill tax rates. What is also clear is that raising a

[24] See, for example, the House of Commons Environmental Audit Committee, *Pre-Budget 2005: Tax, Economic Analysis, and Climate Change*, Fourth Report of Session 2005–06, HC882, 2006 (http://www.publications.parliament.uk/pa/cm200506/cmselect/cmenvaud/882/882.pdf).

[25] Roughly the increase needed between 2006 and 2007, assuming nominal revenue in 2006 is roughly unchanged from 2005 figures, to return to the real-terms revenue peak of 1999.

Table 11.2. Change in tax rates required to raise £1 billion, 2007–08

Tax	Required change	New rate(s)	Comments
Fuel duty + associated VAT[a]	4%	50.28p/litre	In December 2006 prices, a tax rate of this level was last seen in September 2004.
VED	18%	Petrol car band E: £177	Assumes all bands raised by 18%; a more environmentally beneficial alternative would be to raise rates for more polluting cars by more than those for less polluting cars.
APD	50%	Standard rate in EEA: £15	Based on February 2007 rates.
Landfill tax	100%	Standard rate: £42/tonne	Figure based on doubling of both rates (standard and reduced) from April 2006 values. In practice, reduced rate has stayed fixed at £2, so upper rate may have to more than double. Upper rate set to rise to £24/tonne from April.
Climate change levy	200%	100kWh of electricity: £1.29	CCL rates fixed in nominal terms between 2001 and 2006. Set to rise with inflation from April.
Aggregates levy	200%	£4.80/tonne	Levy has remained unchanged in nominal terms since introduction.

[a] Includes behavioural response estimates.
Source: HM Treasury, *Tax Ready Reckoner*, 2006 (http://www.hm-treasury.gov.uk/media/77C/B3/pbr06_taxreadyreckoner.pdf).

substantial amount of additional green tax revenue is hard without including at least some real-terms rise in fuel duties – the scale of increase required for many of the other taxes, even to raise a single billion, is very large. It is no coincidence that it is only since the fuel duty escalator was abandoned that the ratio of green tax revenue to GDP has declined.

Fuel duty

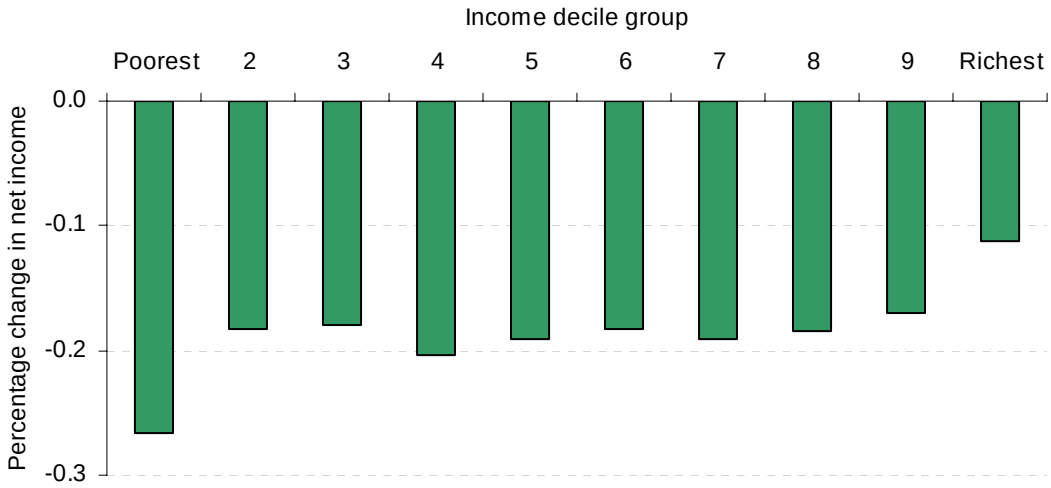
As it is by far the largest green tax, even small changes in fuel duty can have substantial revenue effects – a 1% rise in key fuel duty rates raises an estimated £250 million per year. The increase in nominal fuel duty rates for the most commonly purchased fuels from 47.10p/litre to 48.35p/litre from December 2006 was the first nominal rise in key rates since October 2003 and only the third nominal increase since the abandonment of the fuel duty escalator was announced in November 1999.

As discussed above, the fuel duty escalator was a key policy for both Conservative and Labour governments between 1993 and 1999. Nominal duty rates for diesel, for example, rose from 22.85p/litre in March 1993 to 50.21p/litre in March 1999. Whilst it is often argued that the fuel price protests led to the escalator being abandoned, the protests in fact came around nine months after the policy announcement. However, it may be that the protests have been a factor behind continued freezes in nominal duty rates in recent years and the explicit decision

in the December 2006 Pre-Budget Report not to return to above-inflation increases in duties in 2006–07. Whilst neither the Report nor Mr Brown's accompanying statement ruled out above-inflation increases in future years, there is no evidence that a return to a sustained escalator in duty rates is at all likely.

Adjusting for inflation, duty rates for ULSP and ULSD peaked at around 57.89p/litre (December 2006 prices) in April 2000.[26] Current duty rates of 48.35p/litre are therefore around 16.5% below this peak. An increase in duty rates of this magnitude would generate revenues of around £4 billion per year.

Figure 11.6. Distributional impact of a 5% rise in fuel duty, 2004–05



Note: Households with incomes or expenditures of less than £5 per week are excluded.
Source: Authors' calculations from 2004–05 Expenditure and Food Survey (EFS).

Given the size of fuel duty relative to other green taxes, there may be a very legitimate concern over the distributional impact of higher duty rates. Figure 11.6 shows the effect of a 5% rise in fuel duty across the income distribution. It is not immediately clear that fuel duty increases are regressive – although the largest impact is on the poorest 10% of households, losing on average around 0.27% of income, and the smallest impact is on the richest 10%, losing on average 0.11%, the effect appears to be roughly equal over the rest of the distribution. It is also important to bear in mind that within deciles, there is considerable variation in the impact of higher fuel prices. More than half of households in the poorest decile are not car owners and thus are unaffected directly by the change – the large average effect comes from the minority of households that are quite adversely affected. Some households in the poorest decile will be temporarily low-income – moving between jobs, say, or taking time out from employment. Such households may maintain relatively high levels of spending by running down savings, such that the high proportion of their income lost may be misleading about their actual financial circumstances. This is not to say that all low-income households are in this position, and there may well be a legitimate cause for concern over some poor households that nevertheless have to spend a significant share of their income on

[26] Data from Department of Trade and Industry, *Energy Statistics* (http://www.dtistats.net/energystats/qep411.xls).

fuel, in particular if it is precisely these households that are least able to switch to alternatives as a result of a price rise.

Vehicle excise duty

In 2001, vehicle excise duty was reformed so that the payment depended on the emissions rating of the vehicle. It is not a marginal tax: once the payment is made, drivers can drive as far as they like without incurring additional payments. The key environmental incentives of VED therefore come in terms of encouraging switching to lower-emissions vehicles and the scrapping of older models.

Under the old flat-rate structure, the burden of VED fell, on average, most on middle-income households as a proportion of income.[27] Since the introduction of the graduated rates, it has become more difficult to estimate the progressivity of the duty. To the extent that richer households own larger and therefore more polluting cars, VED may be more progressive than before, but if richer households can afford newer, more efficient cars to replace older models, it may be less progressive.

The structure of VED is unlikely to change substantially in the short term – current receipts of around £5 billion per year make it one of the most significant environmental taxes, and the most likely reforms are to increase tax rates for the most polluting vehicles.[28] The Liberal Democrats propose a large increase in VED rates for the most polluting cars. Within the present six bands, they propose to lift rates from £150 to £810 for cars emitting 160–180 grams of CO_2/km (the average emissions rate for new cars is around 165 g/km), and to raise the top rate to £2,100 for vehicles emitting more than 225 g/km. They also propose to give discounts to people living in rural areas where there is little substitute to car ownership. This would appear to add a considerable layer of complexity to the administration of VED, however, given that they wish to limit the discount to the least densely populated 5% of the country, to first cars and to vehicles not in the top VED band. It might also be difficult to police effectively. They forecast their proposals would raise an extra £750 million per year including behavioural changes.

Air passenger duty

Air passenger duty is forecast to raise £1.1 billion in 2006–07. The government estimates that the doubling of duty rates announced in the December 2006 Pre-Budget Report will approximately double revenues by 2007–08. Although air travel seems to be quite price-elastic – so the increase in the price of flights should reduce demand – it is also highly income-elastic – so the increase in real incomes expected between this year and next should increase demand. As a result, the tax base tends to increase over time, in contrast to other environmental taxes, which might explain the apparent lack of behavioural response implied by the Treasury's estimate. This should not be interpreted as price having no impact on the

[27] L. Blow and I. Crawford, *The Distributional Effects of Taxes on Private Motoring*, IFS Commentary 65, 1997 (http://www.ifs.org.uk/comms/comm65.pdf).

[28] Currently, the least polluting vehicles with emissions of less than 100 grams of CO_2 per km pay no VED, though cars in this emissions class make up a very tiny number of new car sales each year. This may change in the future as technologies change – a similar argument can be made about biofuels and other alternative fuels, which attract lower fuel duty rates but currently power very few vehicles. The aim of low taxes on such cars is to encourage switching as the technologies become more widely available.

demand for air transport – presumably without the doubling of APD, demand growth would have been even stronger.

Good estimates of the distributional effects of APD are difficult to make, as they depend on the number of flights taken, and the class and destination, across the income distribution. In 2005–06, around 78% of passengers flew in the lowest APD class (economy flights within the EEA), though a significant minority of passengers paid a higher rate.[29] Estimates from the ONS suggest that APD impacts most strongly on the very poorest and those in the middle of the income distribution, both losing about 0.1% of their income as a result of the doubling of APD, though these estimates assume the same rate of APD paid on each flight.[30] However, the extent to which those concerned with the detrimental impact of environmental taxes on the poor should be worried about losses among individuals who, despite their low income, make several flights is far from clear.

A study by Pearce and Pearce[31] estimated the marginal external costs of noise pollution and greenhouse gas emissions (including the radiative forcing effect of emissions at high altitude) for flights from Heathrow Airport for various aircraft types and recommended an optimal tax per 'aircraft movement' (arrival and departure). Their figures suggest a tax of £368 for a short-haul A310 movement and of £1,737 for a long-haul movement on the same aircraft. For a Boeing 747-400, they suggest a short-haul tax of £897 and a long-haul tax of £3,753. On a per-passenger basis, these results suggest a tax of typically around £3 for short-haul destinations and £15 for long-haul destinations. These estimates imply that APD has risen above the external costs of aviation. However, their estimates are sensitive to the assumptions made about the costs of emissions and noise, and neglect congestion externalities.

At present, the taxing of aviation fuel for international journeys is banned under the 1944 Chicago Convention,[32] and the US and Australia are opposed to altering this arrangement. The British government has therefore supported the inclusion of aviation in the EU Emissions Trading Scheme as soon as possible as a means to tackle emissions on intra-EU flights. If international agreement can be reached, aviation seems ideally suited to the EU ETS, given the high industrial concentration in civil aviation, though there are fears over legal action by non-EU countries if flights into the EU from outside are included in the scheme.[33] Until this reform to the EU ETS, and following the doubling of APD in the December 2006 Pre-Budget Report, it is unlikely that APD will change again in the short term. Interestingly, however, a note in the 'Budget measures' table that accompanied the PBR suggests that the default option from 2008–09 onwards will be price-indexation of APD rates at each Budget. This did

[29] See table 2 of UK Trade Info, *Air Passenger Duty Bulletin*, December 2006 (http://www.uktradeinfo.com/index.cfm?task=airpass).

[30] F. Jones, *The Effects of Taxes and Benefits on Household Income 2004–05*, ONS, London, 2006 (http://www.statistics.gov.uk/articles/nojournal/taxesbenefits200405/Taxesbenefits200405.pdf).

[31] B. Pearce and D. Pearce, 'Setting environmental taxes for aircraft: a case study of the UK', University College London, CSERGE Working Paper GEC 2000-26, 2000 (http://www.uea.ac.uk/env/cserge/pub/wp/gec/gec_2000_26.pdf).

[32] http://www.icao.int/icaonet/dcs/7300.html.

[33] Current proposals are to include intra-EU flights from 2011 and all flights into the EU from 2012. See http://news.bbc.co.uk/1/hi/sci/tech/6195567.stm.

not appear to be the case before, as previous freezes of nominal rates in Budgets and Pre-Budget Reports were not counted as revenue losses.[34]

The Liberal Democrats propose to replace APD with an aircraft tax, levied on all departures, including freight and transit flights.[35] The tax would adjust with the emissions level of each aircraft (in much the same way as VED varies with vehicle emissions) and the congestion at each airport. One effect of the tax would be to encourage higher load factors on flights and technological improvements to emissions levels. The Democrats also propose to increase the tax rate sufficiently to raise £3 billion, but argue that since the tax base is enlarged and the tax would fall disproportionately on less popular flights, the tax increase on full flights would be limited. In the longer term, they propose to tackle congestion externalities by introducing the auctioning of landing slots. However, they recognise that such a scheme would require changes to EU legislation and so is some way off.

Climate change levy

The climate change levy operates as a downstream energy tax for industry and services. The December 2006 Pre-Budget Report claims that the levy, alongside the climate change agreements,[36] will deliver over 6 MtC of emissions savings by 2010. The CCL or a similar alternative is likely to be in place for the foreseeable future, as it covers small and medium enterprises (SMEs) too small to enter the EU ETS and delivers the benefits of a certain price on carbon. The main criticism of the tax has been that it is a blunt instrument for pursuing its environmental objectives. In particular, the tax has a flat rate on electricity generated from non-renewable sources regardless of how it is generated, though electricity generated from renewables is exempt. Therefore, most policy discussion has focused on reforming it to become more like a carbon tax. The Conservatives have stated their intent to pursue this aim[37] and are investigating raising the tax, recycling revenues through a reduction in rates of National Insurance contributions, and investigating alternatives to the CCAs, although they have not specified detailed proposals.

If the CCL were extended to all small consumers of electricity, gas and coal (i.e. including domestic use, but not necessarily including transport fuels), then it could be simplified greatly by becoming an upstream tax. It would then be easy to apply a variable rate to electricity, as well as to minimise transaction/monitoring costs and evasion. Under this system, all (large) companies in an emissions trading scheme could gain a rebate on their fuel purchases. However, both the government and the opposition have ruled out extending the tax to cover households through concerns about the distributional implications. The feasibility of ultimately covering domestic use of fuel under a carbon tax is discussed below.

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[34] Source: Footnote 4, table 1.2, page 10, of HM Treasury, *2006 Pre-Budget Report*, December 2006 (http://www.hm-treasury.gov.uk/pre_budget_report/prebud_pbr06/prebud_pbr06_index.cfm).

[35] See page 27 of Liberal Democrats, *Fairer, Simpler, Greener*, Policy Paper 75, 2006 (http://www.libdems.org.uk/media/documents/policies/PP75%20Fairer%20Simpler%20Greener.pdf).

[36] An agreement by some industries to reduce emissions in return for a discount of 80% on the levy.

[37] Conservative Party, *An Effective Carbon Levy for the UK: A Consultation*, 2006 (http://www.conservatives.com/pdf/carbonlevy.pdf).

Landfill tax

Fiscal policy on landfill seems to be driven by the need to meet targets on the proportion of waste sent to landfill set in the EC's 1999 Landfill Directive. These include a requirement to send to landfill no more than 75% of the 1995 level of biodegradable waste by 2010, 50% by 2013 and 35% by 2020. The landfill tax is augmented by the Landfill Allowance Trading Scheme, which allows municipalities to trade permits to landfill, and the Landfill Tax Credit Scheme.[38] The major criticism of these policy objectives is that the tax rate is now far above the estimated negative externalities of landfill. A 1993 report by CSERGE and others[39] estimated marginal external costs of landfill at £7 per tonne of active waste and £2 per tonne for inert waste, matching initial rates of the tax in 1996. The present rate (£21 per tonne for active waste, rising to £24 from April) is far above these costs, unless they have changed significantly or the estimates were too low.

The landfill tax is still on course to reach the medium-term objective of £35/tonne by 2011–12, driven by the need to meet the Directive. Beyond that tax rate, much will depend on progress towards hitting the targets and contributions made to that by the Landfill Allowance Trading Scheme. The government stated its intention in the December 2006 Pre-Budget Report to consider a higher target rate and/or to increase the level of annual increases towards the target from 2008.

Aggregates levy

The 2006 Budget forecast revenues from the aggregates levy of £300 million in both 2005–06 and 2006–07. There appears to be little sign that the rate or structure of the levy will change in the immediate future. The government has left the rate unchanged for four years; the most likely change will be a 'correction' for inflation sometime in the next few years.

Longer-term reforms

One of the key policy conclusions of the Stern Review was the need to achieve a uniform price for carbon across the economy as quickly as possible. This can be achieved either explicitly, through taxation or allocation of permits, or implicitly, through regulation. Stern also urged that this price mechanism be credible (i.e. that agents believe that carbon pricing will persist indefinitely), in order to create the right incentives for investment, and flexible, to allow for changes or revised estimates of the cost of carbon or to allow for the sensitivities of a particular industry. This section considers two longer-term reforms that might help achieve this through economic instruments: an economy-wide carbon tax and the use of emissions trading schemes in the context of the existing UK and EU measures. It then goes on to consider longer-term transport policy reform in the context of road pricing.

Carbon tax

A tax on carbon provides one obvious way to create a national carbon price. As direct carbon emissions by households or individuals are not observable, the way such a tax would be

[38] For an account of these schemes, see pages 49–50 of A. Leicester, *The UK Tax System and the Environment*, IFS, London, 2006 (http://www.ifs.org.uk/publications.php?publication_id=3774).

[39] CSERGE, Warren Spring Laboratory and EFTEC, *Externalities from Landfill and Incineration*, HMSO, London, 1993.

introduced would be to tax energy according to the carbon content of the fuel. Households would face the price in their fuel bills. Business fuel use is already subject to the CCL, which makes some differential for different energy types but is not directly targeted on the carbon content of fuels. A carbon tax would provide direct incentives to switch supply to low-carbon generators. One concern over any business carbon tax would be the impact on national competitiveness, since it would clearly raise the production cost for domestic firms. If it led to consumers switching towards imported goods that were produced in countries without such measures, the impact on global emissions might be reduced. Typically, though, recent green taxes that have been incident on firms have been offset by reductions in employer payroll taxes.

A key issue in any carbon pricing scheme is the impact on domestic households. Any increase in input prices resulting from the tax applied to the business sector is likely to be passed on to some extent to the household sector in the form of final product prices. A carbon tax applied to the domestic use of fuel, however, would be much more controversial. The present government has been strongly opposed to further taxes on domestic fuel use as this would counteract its policy objective of ending fuel poverty for vulnerable households by 2010 (a household is defined as being in fuel poverty whenever it needs to spend 10% or more of its income on heating).[40] Indeed, the government reduced the rate of VAT on domestic fuel consumption from 8% to 5% in its first Budget in 1997, fulfilling an election manifesto promise, and has ruled out any extension of the CCL to the household sector. The Conservatives, proposing a carbon tax for the business sector, have also explicitly stated it would not apply to households.[41] In addition to the problem of a household carbon tax conflicting with the desire to reduce fuel poverty, any increase in fuel bills would be highly regressive: since fuel is a necessity, the poor would lose a greater share of their income as a result than the rich. Dresner and Ekins[42] estimate a putative household carbon tax that applies at the same rates as the existing CCL for businesses as costing on average 0.22% of household incomes, with the poorest households losing over 0.5% compared with just over 0.1% for the richest households. Attempts to mitigate regressivity by using the revenue from a carbon tax to compensate poor households may be partially successful, but there is considerable variation in energy use even within income bands, such that it would be hard to compensate all badly-affected lower-income households.

As an alternative to a carbon tax, the 'personal carbon allowance' could be introduced – individuals would be allocated a certain amount of carbon they could emit each year that is 'spent' on heating, motoring, aviation and so on. In principle, this is similar to emissions trading with allowances being bought and sold. Both Labour and the Liberal Democrats have pledged a long-term commitment to developing personal carbon allowances.[43] If this scheme

[40] Estimates for 2004 put the level of fuel poverty amongst vulnerable households at around 1.5 million (Department for Environment, Food and Rural Affairs, *The UK Fuel Poverty Strategy: 4th Annual Progress Report*, 2006, London (http://www.dti.gov.uk/files/file29688.pdf)). This may have risen in recent years as a result of higher energy prices.

[41] Conservative Party, *An Effective Carbon Levy for the UK: A Consultation*, 2006 (http://www.conservatives.com/pdf/carbonlevy.pdf).

[42] S. Dresner and P. Ekins, 'Economic instruments to improve UK home energy efficiency without negative social impacts', *Fiscal Studies*, 27, 47–74, 2006.

[43] See, for example, http://www.defra.gov.uk/corporate/ministers/speeches/david-miliband/dm060719.htm and Liberal Democrats, *Fairer, Simpler, Greener*, Policy Paper 75, 2006 (http://www.libdems.org.uk/media/documents/policies/PP75%20Fairer%20Simpler%20Greener.pdf).

were to be introduced, it would have to replace many of the existing taxes, so would radically change the public finances of environmental taxation. Whether or not each individual would be given a free personal allowance and how large this would be will most likely be a political decision; clearly, the larger the free allocation of permits, the more progressive would be this 'tax', but the lower would be the revenues. Any such reform would be some time ahead.

Emissions trading systems

Emissions trading will almost certainly play a key role in economic environmental policy in future years. The EU ETS is the largest cross-national scheme in the world and a longer-term objective may be to bring in other developed and developing economies as part of the scheme, moving towards the creation of a global carbon market. The scheme is likely to expand with the eventual introduction of aviation and possibly even road transport, though neither will happen in the very short term, which still leaves a key role for national taxation policies.

The UK ETS expired at the end of 2006 and DEFRA is currently consulting on its replacement, at the moment entitled the 'Energy Performance Commitment' (EPC).[44] This will likely lead to some specific recommendations as part of the forthcoming Energy White Paper. The EPC will restrict its attention to emissions of CO_2 (the UK ETS considered a basket of Kyoto-relevant greenhouse gases) and will operate as a compulsory cap-and-trade system for medium-sized energy-using firms (those with bills in excess of £250,000 per year). This will make it much larger in scope than the UK ETS and will make the features of the domestic scheme look much more similar to those of the EU system, which also focuses only on CO_2 and is compulsory for large energy users.[45] Smith and Swierzbinski[46] argue that one of the problems with the UK ETS was that whilst it was aimed as a forerunner of the EU system to give UK firms and the London trading markets a 'first-mover' advantage in emissions trading, the differences between the UK and eventual EU schemes reduced the potential benefits of such an advantage and also made integration of the two systems harder. The proposed EPC will cover medium-sized enterprises not currently covered by the EU scheme, but closer alignment of the structures might reduce any future integration problems should the EU scheme also expand to cover smaller firms.

Unlike the EU and UK ETSs, the EPC proposes to auction permits (with revenues recycled to business) rather than 'grandfathering' them (allocating them for free). Auctioning ought to provide proper incentives for firms to reveal their abatement costs. One of the key issues with grandfathering permits to firms is that the government is at a severe informational disadvantage in terms of the firms' ability to abate emissions; firms acting strategically may therefore be able to procure more permits than they might otherwise require by withholding information, effectively handing them free excess permits that can be sold, raising profits for the firm.[47] Oversupply of permits has been a feature of both the UK and EU schemes – in

[44] See http://www.defra.gov.uk/corporate/consult/carbon-emissions/consultation.pdf for full details.

[45] Though the EU ETS is considering including other greenhouse gases from its Third Phase, beginning in 2013.

[46] S. Smith and J. Swierzbinski, 'Assessing the performance of the UK Emissions Trading Scheme', *Environmental and Resource Economics*, 2007, forthcoming.

[47] Even under a cap-and-trade system using full auctioning, this informational problem can still exist. Governments need to set the overall level of emissions allowed under the scheme and this assumes they know what the optimal

each case, the 'price' of permits traded has been far below expectations, suggesting excess supply, and in the UK, 'over-abatement' relative to target levels was a feature even in the very first year of operation, which led many to criticise the scheme as essentially paying firms to do what they would have done anyway.[48] The Stern Review was, however, sympathetic to grandfathering and to regulation in the short term as a way to price carbon without causing disruption and loss of competitiveness to (energy-intensive) industries, though argued it should not become a long-term feature of such schemes.[49] Stavins[50] argued that the focus on grandfathering in practice thus far has been driven by political acceptability: it allows closer control by governments over who receives permits (which might allow it to mitigate against particular distributional or regional concerns) and is more acceptable to business since the price is not upfront and is therefore more 'hidden'.

Road pricing

Road pricing schemes have been reasonably high on the political agenda for some time, but the publication of the Eddington Review in 2006 brought the issue to wider attention (see Box 11.2). Even before this, the government had been contemplating road pricing – a 2006 Department of Transport study examined public attitudes to road pricing and a 'lorry road user charge' (LRUC) was planned to be launched in 2008, until it was abandoned as a policy in 2005.

A road pricing scheme works in a similar way to fuel duty, acting as a marginal cost of each journey. However, unlike fuel duty, which charges a fixed amount for each litre of fuel purchased, a road pricing scheme would charge different amounts for driving a fixed distance in certain locations or at certain times of the day, with cars fitted with a location monitoring device. Driving in central Birmingham at 8:30am would attract a much higher charge than driving in a rural area at 4:00am, for example. From an economic efficiency point of view, road pricing is preferable to fuel duty as a marginal motoring charge because the external costs of motoring vary according to time and location. Work by Sansom et al.,[51] for example, concluded that the marginal external congestion cost on non-major rural roads was around 1.3–2.9p/km, compared with around 85.8p/km in peak-time Central London.

There may be considerable practical and political (possibly legal) opposition to a system that required accurate monitoring of vehicle location at all times. Other possibilities could be a growing use of road tolls or zonal congestion charges, such as that in central London, which charge drivers a fixed one-off payment to enter the zone on a particular day but allow unlimited driving within the zone once paid. Clearly, these alternatives do not quite accurately

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level of permits to allocate in total is or at least have information on projected 'business as usual' emissions without the scheme being in place in order to set a target below this level.

[48] For a summary, see the same Smith and Swierzbinski paper.

[49] See page 319 of N. Stern, *The Economics of Climate Change*, HM Treasury, London, 2006 (http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm).

[50] R.N. Stavins, 'What can we learn from the grand policy experiment? Lessons from SO2 allowance trading', *Journal of Political Economy*, 12(3), 69–88, 1998.

[51] T. Sansom, C.A. Nash, P.J. Mackie, J. Shires and P. Watkiss, *Surface Transport Costs and Charges: Great Britain 1998*, Institute for Transport Studies, Leeds, 2001 (http://www.its.leeds.ac.uk/projects/STCC/downloads/SurfaceTransportCostsReport.pdf).

Box 11.2. The Eddington Review and road pricing

The Eddington Review on the future of UK transport policy was published in December 2006.[a] With regard to transport's impact on climate change, the Review accepts Stern's view that transport is likely to be the last sector to reduce CO_2 emissions substantially, and that it will likely still be oil-based in 2050. With this in mind, Eddington stressed that, although environmental externalities should be priced into all end-user and investment decisions, there are still great welfare gains from many transport projects. The report concludes that policy should focus on improving the existing transport network rather than building extensive new ones, with a priority placed on three key areas: congested urban centres, key inter-city arteries and international trade hubs (principally airports, with support in the Review for an expansion of runway capacity in the south-east).

However, the most important conclusion of the report is the need for road user pricing. Eddington estimates the potential welfare benefits from pricing at £28 billion per year, including a £15 billion per year increase in national income and direct environmental benefits of £500 million per year. Road user charging could cut congestion by 50% and reduce the need for additional investment by 80%: Eddington stresses that unless road user charging is operable by 2015, substantial new investment in road building would be needed to avoid excessive congestion.

[a] R. Eddington, *Transport's Role in Sustaining UK's Productivity and Competitiveness*, HM Treasury, London, 2006. See http://www.hm-treasury.gov.uk/media/39A/41/eddington_execsum11206.pdf for a summary. The full report is available at http://www.hm-treasury.gov.uk/independent_reviews/eddington_transport_study/eddington_index.cfm.

create the 'right' price of motoring in the same way as a road price, but this needs to be weighed against practical considerations from a policy point of view.

From an environmental perspective, the key consideration is whether and how environmental incentives could be built into the road pricing system. Whilst marginal costs of congestion, noise and accident risk vary by time and location, the cost of a tonne of CO_2 emissions does not. It may be possible to include as part of the price an estimate of the external cost of carbon emissions, which could vary according to vehicle type in the same way that VED varies with emissions ratings now. However, even if the environmental costs were accurately incorporated into any road pricing scheme,[52] it is still conceivable that road transport emissions could *rise* rather than fall, depending on how the scheme was implemented. By providing the right incentives to drivers, road pricing would presumably distribute the flow of vehicles more efficiently, encouraging drivers to choose different routes or different periods in which to travel. Reduced congestion as a result may make driving a more attractive option and increase total distance driven. The key question is how existing policies are reformed in the event of road pricing being introduced. One possibility would be to abolish or substantially reduce VED and fuel duty, leaving overall revenue broadly unchanged. Glaister and Graham[53] suggest that in that event, there would be an increase in traffic volumes of

[52] The same Sansom et al. study suggested that, *on average*, congestion costs dominate the total externalities of motoring, being responsible for perhaps 90% of the total marginal external cost. Where congestion costs are low, such as in rural areas, the environmental consequences would make up a much higher share of the total costs.

[53] S. Glaister and D. Graham, *Road Pricing in Great Britain: Winners and Losers – Technical Report*, Imperial College London, 2006 (http://trg1.civil.soton.ac.uk/itc/rpgb_main.pdf).

perhaps 25% across much of Scotland, Wales, East Anglia and the South West, and a reduction in volume of one-third in urban centres. The overall environmental impact would be unclear. However, introducing road pricing *on top* of existing motoring taxes – and, for example, using the revenue to reduce other taxes – might be politically difficult.

11.6 Conclusions

With green issues high on the political agenda, there will doubtless be considerable pressure on the Chancellor to further raise the total level of receipts from green taxes in the forthcoming Budget. At a time when even a modestly generous spending settlement in the 2007 Comprehensive Spending Review might require additional tax revenues (see Chapter 7), green taxes could be a tempting option if their benefits beyond revenue-raising provide sufficient public support for any increase. However, within the existing framework of tax options, the scope to raise significant sums of money is fairly limited unless above-inflation rises in fuel duty rates are once again enacted. Experience since 2000 suggests this is unlikely.

The government will be keen, and will be correct, to point out that its environmental policy should not be judged on green tax receipts alone. There has been considerable development in recent years that does not show up in these figures. Looking ahead, there is also considerable uncertainty about the long-term structure of environmental taxes – any move towards carbon pricing, personal carbon allowances or road pricing would mean significant changes to the existing system. Nevertheless, given the findings of the Stern Review and the developing environmental agendas of the opposition parties, it would be surprising if the fall in green tax revenues in real terms and as a share of national income that has been seen in recent years were allowed to continue in the near term.