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by A. Barrett, J. Lawlor and S. Scott
Ashgate, Aldershot

Introduction

The three environmental services to be discussed in this chapter are:

1. Water supply
2. Waste water treatment and disposal
3. Solid waste collection and disposal.

These services are provided by local authorities, except in a few cases where parts of the service have been privatised under local authorities' direction. Central government, with support mainly from EU Cohesion Funds, provides almost the whole of the capital cost of water and waste water services, but, in the case of solid waste services, local authorities themselves fund capital investment from their various sources of income. Local authorities have a good deal of autonomy over their operations, subject to the usual budget constraints. Until the late seventies the remaining costs, which are largely operating costs, were paid for out of local Rates, but since the abolition of local Rates on households, the revenue shortfall has been made up out of a Rates Support Grant from central government. As funds are inadequate to cover the rising costs incurred in supplying environmental services, local authorities have had to levy charges for these services, often in the face of local opposition.

As will be seen, charges on business probably cover operating costs at least, while charges on households cover only perhaps one third of the total cost of these services. Thus society is paying for the services mainly via taxation raised by central or local government, or via EU funds.[1] This method of paying for services discourages careful use and recycling. In the case of water supply there is much wastage on the part of the user, which would not be so high if there were more widespread charging for water on a volume basis, according to the evidence described below. People tend to take more care if they are rewarded for doing so in lower bills.

The main economic instrument which will be considered in this chapter is **total cost recovery from charges and extension of volume-based charging where it is economically justified**. Why should one depart from the existing subsidised system of supply, a system which reflects the "public goods" aspects of these services? Avoidance of epidemics and the like would be examples of public goods. The answer is that, while avoiding epidemics is still an objective, use of these underpriced services has grown rapidly and as with most underpricing, it gives wrong incentives; they in turn encourage excessive water demand, excessive emissions and pollution content of waste water, and excessive generation of solid waste. Underpricing puts at a disadvantage efforts to reduce, re-use and recycle, as well as discouraging technological developments in these fields. In the past there was an inadequate social welfare system, and so there was a strong argument for subsidised supply of these services, as there was no means for ensuring that low-income households could pay.

It was noted that parts of the service have been privatised in a few instances. Were privatisation to become more widespread, we would witness an extension of full cost recovery as a matter of course. Indeed it could be argued that absence of full cost recovery from the supply of services to industry and commerce is a form of State

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1 [1] As mentioned at several points in this document, EU funds ought not to be viewed as costless since there are many worthwhile projects competing for these funds and therefore expenditure on one project is expenditure foregone on some other project

aid, which the EU Treaty[2] describes as "incompatible with the common market". The Treaty includes here "any aid..favouring certain undertakings.., in so far as it affects trade". The shortfall in cost recovery may indeed be made up by local tax revenue from industry, but explicit payment would be less open to dispute.

We will see that volume-based charging will have good, though unquantified, environmental effects. It will reduce the amounts of water used and waste produced, as well as reduce or delay the need for capital investment in the future. It should also help in establishing correct benchmark prices to help the authorities to make comparisons of resource options. The requirement that costs be recovered means that utilities will have to produce explicit unit cost figures so that, after taking account of local conditions, comparisons of unit costs between regions are possible. Efficiency and careful resource allocation, such as leakage reduction, will be encouraged; it becomes more worthwhile to reduce losses if the "retrieved items" can be sold. The benefits of accountability and efficiency will have to be weighed against the political obstacles and difficulties associated with change, and the requirement that the problems of low-income families and people with special needs be addressed.

Ideally charges should be set to reflect long run marginal costs (LRMC), in order to give the correct resource signals. LRMC is the marginal cost of providing the service, in the long run. It includes not only short run costs but also an element to account for the fact that increased usage of plant brings forward the time when the plant will have to be expanded or replaced. This has implications for the pricing of capital and need not conflict with the practice of cost recovery, which can be ensured in other aspects of the tariff, in a fixed charge for example. The absence of cost recovery at present means that extra funds have to be raised from central government taxation, which can be more distorting than local charges because of, among other things, the effects of grants on local authority behaviour. The demand for items that are "free" tends to be higher than if the item is charged for; and this applies to all agents, including to local authorities. This is not to say that there is no case for central government grants. Grants from central government may be required where a local authority is supplying services to people who live elsewhere and are passing through, eg for trunk roads. Relative local deprivation is another instance. The image of the whole of Ireland may be tarnished, and people outside the region will be affected, if a region has a relatively serious litter problem, or a contagious water-borne disease, and so on. However, a large part of the benefits and disbenefits of the three services discussed here accrue to the people within the region. Furthermore, it is they who impose the costs, so application of the Polluter Pays Principle implies that local people should pay. Though costs may also have been imposed by others, such as the agricultural sector requiring for example extra treatment of drinking water, the aim would be to have these polluters pay also.

This chapter will look at each of the three services, covering industry, commerce and households. There will be an overview of current charging practice and of the current extent of cost recovery. The environmental impact of the present situation and the options for improving the fiscal structure for each service will be considered. We discuss the implications of full cost recovery for the present levels of expenditure, and for the future situation, where more costly standards of environmental services will prevail in conformity with EU directives. A final section will give our conclusions and recommendations for all three services. We can envisage that full cost

2 [2] Article 92 of EU Treaty (OJ, 1992)

recovery will bring about a reduction in central government funding (and hence taxes) when compared to a continuation of the current charging levels. Later, when higher standards are provided, as required by EU law, there is the prospect of a correspondingly greater reduction in central government funding compared to what it would otherwise need to be.

5.1 Water Supply

Some 1.3 million cubic metres per day are sent out to a population of 2.8 million who are served by public water supply schemes (McCumiskey 1991). Approximately 35 per cent of water is used for commercial or industrial purposes, the remaining 65 per cent being used by households. About 38 per cent of water production is apparently accounted for by leakage from the public distribution system, including leakage within private property, on top of unavoidable leakage of about 15 per cent (O'Connell 1992).

The eighties saw the coming on stream of large power stations and big industrial users, and the expansion of water consumption by dairies. All this was accompanied by rising incomes. Consequently costs of supplying water services have risen, as shown in Table 5.1.

Table 5.1: Costs of Supplying Water 1981-1995 (£m).

Current costs plus capital repayments (1)		**Current costs only**	
1981:	51.7	1988:	59.8
1982:	63.7	1989:	63.7
1983:	75.5	1990:	68.4
1984:	87.6	1991:	71.4
1985:	99.0	1992:	74.4
1986:	101.6	1993:	78.5
1987:	110.9	1994:	81.8
		1995:	88.1

Source: Returns of Local Taxation, various issues.
Notes: These figures are not adjusted for inflation.
(1) Capital repayments were made to the Local Loans Fund. The Fund was subsidised by central government, possibly to the tune of 50 per cent.

Note that inclusion of capital repayments up to 1987 makes the pre-1988 figures not comparable with those for 1988 and after. The pre-1988 figures give an indication of total costs. However on account of a subsidy to the capital costs, these earlier figures also understate total costs.

No direct means of obtaining total costs for water supply exist at present, and a figure for cost recovery cannot be calculated. Neither is a firm figure of total supply to hand, so that unit costs are also elusive. Efforts to put figures on these items yield the information given in Table 5.2 for 1994.

Table 5.2: Estimation of Cost Recovery from Charges and Unit Cost of Water Supply in 1994

£ million

Current Expenditure (incl. administration)	96
Receipts: Charges (note 1)	72
Current cost recovery percentage	75%
Current Shortfall	24
Shortfall financed by: (note 2)	
Local sources (mainly commercial Rates)	9.6
Central Govt (e.g. Rates Support Grant)	14.4
Capital Expenditure	40
Financed by:	
Govt grant (note 3)	39
Contributions	
from industry (note 4)	1
Total Cost Recovery percentage	54%
Quantity supplied (note 5)	223 million m^3
Current unit cost	0.43 £/m^3
Capital unit cost	0.18 £/m^3
Total unit cost (note 6)	0.61 £/m^3

Notes:

(1) Of which £40 million and £32 million were paid by households and non-households respectively.

(2) Figures for Local and Central Government sources are supplied only as totals (Appendix Table 2.1), so that the breakdown between local and central sources has been applied pro rata 40% and 60%.

(3) *Local Authority Estimates, 1995,* p.31 and Department of the Environment.

(4) Contributions from industry are estimates, therefore capital expenditure is also approximate.

(5) This is an estimate of the quantity actually delivered to consumers. McCumiskey (1991) p. 48, and Environmental Protection Agency (1996) p. 65 give 1.3 million m^3/day or 474.5 million m^3/year, sent out. O'Connell (1992) p. 53 gives leakage of 53 per cent. The household and non-household shares of consumption are estimated at 65% and 35% respectively.

(6) Unit costs would be higher if financing charges were included.

Sources: Department of the Environment, *Local Authority Returns* and *Local Authority Estimates*.

Total unit cost of water in Table 5.2, excluding finance charges, is £0.61 per cubic metre. The figure is speculative as several components are estimates. Judging from the figures for 1987 and 1988 in Table 5.1, financing charges could add considerably to the figure. Bearing this in mind, the estimate of £0.61 is broadly comparable with the cost of £0.70 per cubic metre in Wales and the South West of England (Fehily Timoney Weston, 1995), which include financing charges.

There is no formal or agreed procedure for setting tariffs for water supply with the result that there is considerable variation in tariffs between local authorities, depending on their circumstances. A consequence as we saw is that there are no national statistics of unit costs or cost recovery, with possible disadvantages for resource allocation and policy decisions.

5.1.1 Industry and Commerce

Industrial and commercial customers with demands above a certain level, which varies between authorities, are charged for water. A proportion, consisting mainly of large users, is charged on a metered basis. Only some 35 per cent of the water distributed is used for commercial or industrial purposes, though these users pay 44 per cent of the revenue from charges. As yet there is no firm breakdown of costs incurred for supply to households and non-households, but it would appear that current cost recovery from industry is above break-even level.

However, water charges to non-households (more frequently than with households) include a contribution to waste water treatment, which is often not billed separately from water supply.

5.1.2 Households

There is again considerable variation between local authorities, depending on their circumstances. The costs of providing local water supply, as with other services, have risen and grants from central government have not kept pace. Domestic water charges are now raised by 86 out of 88 local authorities, that is, by all except Dublin and Limerick County Boroughs. These two authorities are relatively well endowed by central government, they have a wide base for business Rates and opposition to charges is strong in some quarters. Elsewhere charges raised annually range from £51 to £145 per household and tend to be a uniform flat fee across households within a local authority area. Some ten authorities impose a charge based on the old valuation of the property which was used under the now-extinct Rates regime. A few authorities charge by type of dwelling, for example according to whether it is terraced, detached et cetera.

The areas where there are higher water charges tend to be areas with no sewerage charges, charges for the two services being effectively combined in about 60 authorities. Local authorities report that it is easier to collect charges for water than for sewerage.

5.1.3 Subsidisation - who ultimately pays?

Nationally, revenue from charges for water supply covers but 75 per cent of *current* costs of supply, as shown in row 3 of Table 5.2. However this coverage is an improvement on the recent past. Taxpayers ultimately pay for these under-priced service. The immediate channels of subsidisation ought to be identified though only broad aggregates can be given.

The government provides a subsidy via the Rates Support Grant, paid to local authorities in lieu of the dismantled household Rates. Industrial and commercial enterprises would also claim to contribute to this subsidy, through the Rates which they have to pay on their property to the local authority (only household Rates were abolished in 1978). The government (and European taxpayer) subsidise practically the entire *capital* cost. A connection charge may however be raised from households, and non-households are increasingly required to pay a "contribution" to the capital costs. To date, contributions have been very small in relation to total capital expenditure, at perhaps 2 per cent of the capital cost.

We estimate that *total* costs of water supply to households are possibly subsidised by some 55 per cent, and to non-households by 30 per cent, disregarding their payment of business Rates. Given that wasteful use is likely due to charging on an unmetered basis, the thrifty are subsidising the profligate. Low-paid and middle-income households may reckon that they are paying more than their fair share of general taxation, and may consider that they are subsidising the rich, who tend to be big users of water.

Low-income households which are deemed to be unable to pay local authority service charges are granted a waiver. Not being directly reimbursed by central government, the local authority has to finance waivers out of its grants from central government, out of commercial Rates or indeed out of other household and non-household charges. Figures from three local authorities on the proportions of revenue due from domestic charges that have been waived are 13, 20 and 24 per cent, the latter proportion relating to a town with very high unemployment. There is no information on this at central level. Some local authorities say that they are awaiting guidelines from central government on the operation of waivers.

5.1.4 The decision to install household water meters

From the point of view of equity it is desirable that households that consume large amounts of water make a higher payment. It is also preferable if households which reduce consumption pay lower bills. This is facilitated if payment is volume-based, which requires a meter to have been installed. However, owing to the considerable cost of meter installation, metered charging is probably not economic on a wide scale at present. To assess whether metering is desirable on economic grounds, it is necessary to estimate the costs and benefits of installing meters. As with any investment decision, domestic metering and unit quantity pricing are to be recommended from a national economic viewpoint if gains outweigh losses. Somewhat simplified, this condition can be expressed as follows (OECD 1987). After metering:

[Reduction in water use] x [long-run marginal cost of water supply] + external benefits >
resource costs of metering and volumetric charging + value of water use foregone.

In other words, if benefits are greater than costs, installation should proceed. Relevant items in the calculation can be expressed as annual equivalents, or as net present values. Owing to difficulties in estimation, the value of external benefits and of water use foregone are frequently omitted from the calculation, but as is now becoming evident the external benefits (or avoided damages of increased abstraction) are considerations to be reckoned with. Potential damages are becoming greater as the most abundant and cheap sources are exploited already. Other benefits include the availability of management information which could help improve performance and forecasting. A by-product of metering is that some repair of leaks can be incorporated at small extra cost. The saved water can reduce costs and be sold for new uses. The resource costs include meter installation and maintenance, and billing costs.

We are witnessing two trends in the values of the figures which are used in the above calculation for assessing metering. Looking first at the benefits given on the left hand side of the equation, the long-run marginal cost of water supply is rising as water that is most easily accessed is already availed of. Obtaining new water supplies requires higher capital expenditure or removal of supplies from some existing use such as hydro-electricity, or rivers which have amenity value or ecological significance. The fact that money may not change hands is sometimes interpreted, incorrectly, to mean that such supply options are less costly than other options, including options which influence demand (Herrington 1996). Thus the benefits to be used in the above calculation from avoiding or delaying supply expansion are likely to rise, and therefore so are the benefits of metering. The National Rivers Authority (NRA 1995) reports that in the UK where water resource development costs have risen to £1.5 million per Megalitre per day, domestic metering would be only marginally more expensive than expanding supply. This takes no account of benefits to the environment of the reduced consumption. In fact, therefore, if the financial costs plus the environmental costs amount to £1.5 million to install capacity for a Megalitre per day, then metering is worth considering. This merely indicates the possible order of magnitude involved, and the sort of calculations that should be made.

Furthermore the external benefits are also likely to rise. We need hardly be reminded of the shortages of water in the world, with some 25 per cent or 1.5 billion people being seriously short of safe water, and the same again not having enough for daily needs, according to the UNDP (1990) and OECD (1993). Ireland's abundance of fresh water will make it increasingly attractive to foreign investors seeking locations for their water-using industry. The availability of water in certain regions is a known factor in attracting major companies. However, with strong growth in the demand for water in Ireland, this abundance cannot be taken for granted indefinitely and the value of water saved will rise. There are in fact "water shortages" in some regions such as South Dublin, in addition to conflicts of use, such as between angling on the one hand and water abstraction for use by households or industry on the other. The Eastern Regional Fisheries Board, for example, is concerned that Dublin's claim to being the only European capital endowed with a healthy salmon river may become a thing of the past as the demand for water continues to rise (Evans 1996). In another county, extra supply is being sought from a salmon river in the face of environmental objections, to satisfy demand in a rapidly growing town. Owing to a historic agreement, the town at present is being charged but a fraction of the financial cost of water imported from a neighbouring authority.

It is worth noting that attitudes to various aspects of this issue are likely to alter over time and vary from place to place. For Waprog, the water company for the northern province of Groningen in the Netherlands, for example, the aim of meter installation in 1985 was to achieve a fairer allocation of what people paid for water. The "motive of saving water hardly came into it" (Zweegman 1995). Benefits that were external to the utility were therefore the deciding factor. Installation of meters was carried out, reportedly to the satisfaction of all parties, by people who had been unemployed for a long time. This gave them the opportunity, after a brief training course, to gain work experience. More than 100 000 water meters were installed at a cost of little more than 150 guilders each (£45 in 1986/7, or £58 at 1996 prices).[3]

The second trend in the calculation to assess the desirability of metered charging arises in the costs on the right hand side of the inequality sign, namely in the improvements in metering technology. The meter itself now costs some £20 to £40. However it has to be installed in a meter box. The box is easily installed at the time of construction of a dwelling, when the overall cost of meter installation would be some £45. Installation at a later stage after the house is built might cost anything between £70 and £290, because there is the added requirement of reinstating the ground or pavement. OFWAT (1995) reports that in the UK in 1995/6 the average charge for internal installation was £120, and £176 for installation in the highway or on the pavement.

3 [3] The chapter on Energy describes a method used in Sweden for encouraging installation of measuring equipment.

Measurement problems in meters (sometimes cited by opponents of metered charges) tend to result in under-recording rather than over-recording, due to jamming or inhibition of the propeller in the meter. According to the National Rivers Authority (1995) in the UK, while 20 per cent of meters in the National Metering Trials that were randomly tested failed to meet the in-service test requirements, incorrect registering "was considered to be so minor that the effect on a customer's bill would be negligible". In the UK the additional costs of metering of water and sewerage are £26 per customer per year. Meter reading technology is also advancing, with experiments underway in the US with hand-held data-loggers which can read the customer's meter from inside a van on the street. The advances in technology of the last few decades should alert us to the likelihood of further improvements, including the possibility of joint metering and charging of several services, such as fuels and water services, as in the Netherlands.

In sum, benefits of metering can be expected to rise and costs to fall, so that we will see increasing economic justification of meter installation in some areas. Early studies, such as those for Rotterdam in 1968 and for the UK in 1976 and 1985 concluded that metering was not viable (though in the latter case selective metering was recommended), but other studies show viability, such as for Perth in Australia in 1982. It depends on the circumstances of the region. If the cheapest leakage reduction options have been taken, it is possible that there is or will be economic justification for metering in some areas in Ireland where there is water shortage. Metering may be worthwhile if the next unit saved through leakage reduction would be relatively costly. NRA give a broad guide to demand management options including leakage reduction and universal metering in England and Wales, summarised in Table 5.3.

Table 5.3: Demand Management Options in Order of Cost Effectiveness, excluding Environmental Costs and Benefits

Option	Costs Pence/m^3	Cost/Benefit Ratio Low cost development*	High cost development*	England and Wales Water savings Ml per day
Efficient washing machines_	0	0.0	0.0	440
Controllers of urinals	9	0.3	0.1	140
Leakage control	13	0.4	0.2	2340
Low flush WC	18-28	0.6-0.9	0.3-0.4	850
Universal domestic metering	89	2.7	1.3	1060
Shower installation	94	2.9	1.4	610
Low volume shower heads	102	3.1	1.6	40
Lower flush WC (6 litres)	172	5.2	2.6	-
Domestic water recycling	321-493	9.8-15.0	4.9-7.5	1280

Notes: Ml is a megalitre, or a million litres. Costs include capital costs.
* Assuming low and high development costs of water supply at £0.75 and £1.5 million per Ml per day, respectively.
Source: NRA (1995)

The first column of Table 5.3 shows the cost of saving a cubic metre of water by each option. The next two columns show the cost/benefit ratio of each option, a ratio of less than unity indicating that an option is financially feasible. As the table shows, universal metering is not the first option which should be considered, as it is unlikely to be viable except in situations where there are shortages and high development (and/or environmental) costs, and where the options of efficient appliances and leakage control have been exploited. Based on these average calculations we can see that the cost per cubic metre saved by metering is 89 pence. In crude terms, if the cost of alternative options, including their environmental costs, is more than this, then metered charging should be considered. Obviously individual cases would have to be considered on their merits.

The Appendix Table gives a brief summary of water charges in 17 European cities. It is noted that the charges vary a good deal as does the rate of VAT applied. About 7 per cent of households in the UK pay on a metered basis. Generally, households can opt for this method of payment and are given ready reckoners for calculating whether it is likely to be worthwhile in their particular circumstances. They pay for the meter installation costs. The Director of OFWAT believes however that where there is tight water supply, the costs of meter installation should be shared across all customers, as metered charging avoids supply expansion. There are also schemes for households which prefer a Do-It-Yourself arrangement for meter installation.

Different options for calculating the basis on which charges should be made were investigated in the UK by Rajah and Smith (1993). They assumed a switch from the existing charging method which would leave total revenue unchanged. The existing charging method for domestic water and sewerage in the UK was based on rateable valuation of the property, a method that is somewhat regressive, in that the proportion of household income taken in Rates rises as household incomes fall. Not surprisingly it was shown that a flat fee per household was rather more regressive than the rates-based method. Interestingly, they found that a volume-based charge (ie metered), amounting to 91.8 pence per cubic metre, would be nearly identical to the rateable valuation method, in its incidence, the four middle income deciles paying very slightly more, the highest slightly less. In the absence of the rateable valuation method or of metering, they recommend charging on the basis of the numbers in the household. The charge per head worked out at £44.68 and would be marginally more regressive than the existing Rates based system. They also recommended that targeted adjustments to the levels of social security benefits be made to address the distributional effects.

5.1.5 Responsiveness of domestic demand to introduction of metered charging for water

Apart from the benefit of "fairness" invoked for metering in Groningen, it is important to see if metering has an effect on demand. If not, the gains in allocative efficiency may be rather small.

Studies applied to widely differing regions have shown that significant and enduring impacts result from metered charging. OECD (1987) listed twenty-two studies with reported consumption reductions usually in the range of 10 to 30 per cent as a result of metering alone. These studies referred to installations in Sweden, Denmark, Norway, Finland, France, the UK, Canada, the USA and Australia.

In the Netherlands, a considerable drop in individual consumption occurred in the Waprog jurisdiction, actually during the installation period, but was viewed initially as merely temporary. It was expected that the public would soon get used to the new but fairly low charges of 1.25 guilders (then 42 pence) per cubic metre. Now that six years have elapsed there has been virtually no subsequent change in individual consumption, the conclusion can be drawn that there has been a permanent drop in consumption of at least 10 per cent, and that this is probably conservative when viewed in relation to what consumption would have been by now. The ratios of maximum day to average day usage, and maximum hour to average hour usage, have also decreased as a consequence of the meter installation, by 11 and 9 per cent respectively.

The results of a study in the Isle of Wight have been analysed and published as part of the National Metering Trials, and they show that response to metering in the UK is in line with studies from elsewhere. The average reduction in household consumption of eleven small-scale sites (not on the Isle of Wight) was 10.8 per cent due to metering. The Isle of Wight was not in fact intended as a specific test of the impact of metering but rather to assess the problem of switching to metering on a large scale, so that there was no control area, and historic data had to be used instead. Again some 10 per cent reduction in household demand ensued, a further 10 per cent reduction being attributable to the replacement of defective supply pipes. From all trial areas, an average 30 per cent reduction was recorded in peak-month, week, day and hour demand. For a typical water company in the south east of England this could enable postponement of a new water source for 13 years, based on average demands, and an indefinite postponement based on peaks.[4]

On the issue of acceptability, 71 per cent of customers regarded metering as a reasonable system of charging. The majority of customers had lower bills, but 4 per cent suffered social or financial hardship as a result of the change, according to the National Rivers Authority (1995). These views on metering are consistent with the responses to a survey conducted by the Flood Hazard Research Centre (1993) in the UK, in which respondents were asked how households should pay for water. The results, with percentages of respondents who agree or disagree with each proposed method, are shown in Table 5.4.

Table 5.4: How Households Should Pay for Water: Percentages Agreeing or Disagreeing.

Method of paying	Strongly Disagree %	Disagree %	Neither %	Agree %	Strongly Agree %	Number of Cases
according to the amount of water used	9	9	14	**27**	**41**	994
according to the number of people in the household	15	13	18	**26**	**28**	995
according to household income	24	16	21	21	19	994
according to the size of their house or flat	**28**	24	17	18	13	991
the same amount as any other household	**36**	**30**	16	10	9	995

Note: Percentages of respondents above 25 per cent have been highlighted.
Source: Flood Hazard Research Centre (1993).

The table shows that 41 per cent strongly agree that payment for water should be according to the amount used, another 27 per cent "agree". These replies correspond quite closely to those for Ireland, given in the chapter on the General Background above, where 42 per cent of females and 51 per cent of males said that drinking water should be charged according to the amount used. Understandably, however, UK support for charging "the same amount as any other household" is rather lower than support for this charging method in Ireland where the charge itself is quite small at present.

5.1.6 Responsiveness to changes in the price of water

Other studies have looked not alone at the effect of introducing metered charging while maintaining revenue constant, but at the effects of price changes on demand. International patterns of water consumption suggest that there is a significant price effect on demand. As a start, one should note that water prices in Europe are 50 to 350 per cent higher than in the US and per capita consumption is accordingly 50 to 75 per cent lower (OECD 1993). Econometric studies, quoted by the National Rivers Authority, undertaken in Australia, Canada, Israel and the USA show that domestic use decreases by between 3 and 7 per cent following a 10 per cent increase in the price of water.

4 [4] Installation costs in the majority of cases in this study came to £165 for internal meters (that is, meters positioned within the customer's property) and £205 per meter for external meters, at 1992 prices. Operating costs per meter came to £19.08 per year

Data from the American Water Works Association, derived from a survey of 430 US utilities, were analysed by Nieswiadomy (1992). The study showed that the response to a 10 per cent price rise would be a decrease in water demand ranging from 1 per cent to 6 per cent. Another US study (by Schneider 1991) indicates that short-run response to a 10 per cent price rise is in the 1 to 4 per cent range, but that long-run response is stronger and is in the 3 to 9 per cent range. Table 5.5 presents these results, and also shows responsiveness of demand to changes in income.

Table 5.5: Estimates of Price and Income Elasticities of Demand for Water Supply

	Price Elasticity		**Income Elasticity**
Type of user	**Short-run**	**Long-run**	**Long-run**
Residential	-0.11	-0.26	0.21
Commercial	-0.23	-0.92	1.97*
Industrial	-0.11	-0.44	n.a.
Government	-0.44	-0.78	0.9
School	-0.38	-0.96	0.89
Total	-0.12	-0.5	n.a.

Notes: Figures show the percentage change in demand resulting from a 1 per cent rise in price or in income.
* Considered unreliable by the author.
Source: Schneider (1991).

The long-run response is generally double the short-run response, showing that behaviour and alterations to water-using equipment do occur. The high long-run response by schools is probably explained by the ease with which schools can switch off water during holidays, or adjust their appliances.

Further studies are summarised by Sanclemente (1995), for Spain. An analysis of nearly 3000 cases in the Metropolitan Area of Barcelona reveals that after the introduction of metered charging, some 24 per cent did not alter their consumption, but that the remaining 76 per cent reduced their consumption by nearly 17 per cent on average. This gives a 10 per cent decline overall. In Terrassa, it is observed that metered customers consume nearly 13 per cent less than customers charged a flat fee. In Mataro, progressive metered charging of customers in the decade to 1993 has reduced consumption per head by nearly 16 per cent "enabling water resources to be released for industrial use without increasing the town's total water consumption". In these three cases the structure of the tariff also played a role. The tariffs consisted of a mains connection fee and two or three consumption blocks charged at progressively higher rates. Other studies were undertaken of the effects of the installation of individual meters in blocks of flats in Paris, Nancy and Rennes, where the decreases observed were larger still.

There are many other worthwhile demand-side measures for constraining the growth in demand for water, which indirectly come within our scope. These measures include the imposition of a tax on appliances which use relatively more water, such as power showers. However, given that water supply constraints affect only certain regions, such measures could be viewed as crude. On the other hand, subsidies for installation of efficient appliances in some regions could be worthwhile.

5.1.7The impact of full cost recovery

Table 5.6 summarises the situation. This shows the present shortfall in financing the service, plus the likely increase in costs in the future - £19 million - to give the future shortfall in funding the system in the absence of full cost recovery - £82 million per annum. This is also, by definition, the improvement in public finances by moving to full cost recovery, though increased social welfare payments of perhaps £25 million per annum would be required to help low-income households. We assume no change in water usage levels, though it might be more appropriate to assume some reduction. However, it is likely that reductions by existing users would be compensated for by new firms or increased population, so we have not built any reductions into our figures.

Table 5.6: Impact of Full Cost Recovery on public finances - water supply

	£ million
Present shortfall in cost recovery (from Table 5.2)	63.00
Add:	
Expected increase in annual costs (note1)	19.00
Future shortfall in financing the service, if full cost recovery is not introduced = improvement in public finances if full cost recovery is introduced	82.00
Less:	
Increased social welfare expenditure for low-income households if full cost recovery is introduced (note 2)	25.00
Net improvement in public finances if full cost recovery is introduced	57.00

Notes:
1. KPMG (1996) indicates future increases in operating costs of £47 million per annum, for water supply and waste water services combined. We estimate later in this chapter that the figure relating to waste water is £28 million, leaving a balance of £19 million relating to water supply.
2. On the basis that future domestic supply will cost £100 million per annum (65 per cent of the total), and approximately 25 per cent of households will be unable to pay.

5.2Waste Water

As with the other services, waste water falls into two main categories - domestic/municipal and industrial. For the purposes of this chapter agricultural waste is ignored, although it is also a very major source of waste water; it is dealt with in the chapter on agriculture. The level of waste water generation and treatment is given in Table 5.7. As can be seen, the majority of waste is generated by the industrial sector, and this sector also does most of the treatment currently carried out.

Municipal service levels vary by whether an agglomeration is inland or coastal. Most inland towns are serviced by secondary wastewater treatment, while no coastal town or city is as yet (of the latter, only Dublin currently has primary treatment). The coastal regions contain most of the large urban areas, which means that currently the bulk of the population (70 to 75 per cent) is not serviced by wastewater treatment plants. This situation is destined to change over the coming years, as the EU Urban Wastewater Directive is implemented. This will involve a major programme of expansion of municipal waste water treatment. Weston-FTA Ltd (1993) calculates that the current contributing population equivalent (PE) to existing sewerage and treatment facilities in the agglomerations affected by the Directive amounts to 2,715,000, while the future design PE for facilities in these agglomerations is 4,099,000. By the time of full implementation they estimate that 70 per cent of the population will be served by treatment plants.

Treatment conditions for industrial waste water are generally set out in the firms' water pollution licence. Because of the lack of treatment in the main urban areas, and the importance of agri-industry (many large food-processing plants are situated in rural areas or small towns), the majority of firms currently carry out their own treatment, as has already been seen. With the planned increase in treatment levels in the urban areas, more firms are likely to become connected to municipal treatment plants in the coming years.

Table 5.7: Estimated Non-agricultural waste water arising and treated nationally ('000 tonnes BOD per annum)

	Total	*Of which -*	
		Industrial	*Municipal*
Waste water generated nationally	114.00	69.00	45.00
Reduction in waste by treatment			
by industry	46.00	46.00	0.00
by local authorities	12.00	3.00	9.00
Waste discharged to the environment	56.00	20.00	36.00

(Source: Various, cited in Scott and Lawlor, 1994)

In terms of hydraulic flows, we estimate that the total quantity of waste water treated in municipal waste water treatment plants or conveyed in the public sewerage system is very roughly 240 million m^3 per annum[5]. The flow treated by industry is very difficult to estimate, since industrial effluent is of a far less uniform standard than municipal waste water.

5.2.1.Environmental impact

The potential impact of waste water entering open bodies of water is significant, in terms of oxygen depletion, eutrophication (these two factors are mainly responsible for fish kills and reductions in fish populations), health risks from human consumption of the water, loss of amenity, smells, etc.. The actual impact depends on the level of treatment the effluent receives before release, and the assimilative capacity of the receiving waters. In relation to the latter point, one would generally be more concerned about discharges to inland waters than to open marine waters.

5 [5]Weston-FTA (1993) indicate a total flow to the system of 2.7 million PE. The Dry Weather Flow per PE is 82.9 m^3 per annum (domestic sewage strength). 2.7 million x 82.9 = 240 million m^3.

5.2.2.Existing fiscal structure

*Charging for public waste water collection and treatment services*As with the other services, charges under-recover the costs of providing the service, especially in relation to the capital costs. Until recently, charges made no contribution to these costs, with 100 per cent of being paid for by central government (with considerable aid from the EU). More recently, industry has been asked to make capital contributions to the cost of municipal treatment plants to which they discharge. The situation is summarised in Table 5.8.

Table 5.8:Estimation of total cost, unit cost and cost recovery of waste water in 1994

	£ million
Current Expenditure	41
Receipts from charges (note 1)	7
Current cost recovery percentage	17%
Shortfall	34
Financed by (note 2):	
Local sources (mainly commercial rates)	14
Central government (mainly Rates Support Grant)	20
Capital Expenditure	60
Contributions from industry (estimate)	1
Shortfall financed by central government (with EU assistance)	59
Overall cost recovery percentage	8%
Quantity supplied per annum (note 3)	240 million m^3
Current unit cost	£0.17/m^3
Capital unit cost	£0.25/m^3
Total unit cost	£0.42/m^3

(Source:Department of the Environment)

Notes:

1. £6 million of this comes from commercial sources, and the remaining £1 million from households. Many more local authorities levy water supply charges than levy waste water charges; as already mentioned, in many cases the two charges are subsumed into one, and simply called water charges.
2. On a pro rata basis.
3. This is a rough indication of unit cost, based as it is on the hydraulic flow only. Other elements of waste water, such as BOD and suspended solids, are also important cost factors, and can differ from hydraulic flow considerably, especially in the case of industrial effluents.

As regards charging practices, Table 5.9 summarises the results of a survey of Irish local authorities (to which 33 replied). As this survey was carried out in 1994 it is likely that it somewhat understates the current level of charging. Data for 1996 indicate that 31 out of 88 local authorities currently levy separate domestic waste water charges; in all cases the charge is fixed (i.e. not volume-related).

Table 5.9:Charging for waste water services

Type of charge	*No. of respondents to survey*	*Basis of charge*
Capital contributions from industry	12	Half were volume-related
Industrial effluent operating charge	16	Volume-related

Industrial effluent monitoring charge	28	Mainly related to the frequency of monitoring
Domestic charges	10	Fixed charges
Total number of respondents to survey	33	

(Source: Scott and Lawlor, 1994)

Note: In addition to those already levying industrial effluent charges, a further six respondents were considering adopting charges in the future.

Compliance incentives (i.e. financial penalties for non-compliance) Local authorities have at their disposal several pieces of legislation which allow them to impose fines for non-compliance with regulations or for illegal releases of waste water. The degree to which these are used varies from authority to authority. The income from the fines is not known.

Environmental effects of the existing structure The environmental impact of this fiscal structure - characterised by under-recovery of costs, and non-volume related charges - is that there is likely to be an excessive amount of waste water being generated. One would expect this over-generation mainly to occur at the industrial level (to the degree that firms are connected to the public waste water system), since the capacity to reduce waste water generation at the domestic level is more limited. This assertion is backed up by actual experience where some local authorities have introduced volume-related charges for industrial waste water services: firms responded by reducing their waste water generation quite significantly (Lawlor, 1996). Some reduction might be expected at the domestic level also, if volume-related charging was introduced: there would be an incentive, for instance, to buy domestic appliances that used less water.

5.2.3. Options, from experience in Ireland and Overseas

Charge the full cost of municipal waste water services This would include the full capital and current cost on all users of their treatment plants and sewers. For industry, the charge would be made up of a LRMC charge, which would cover roughly 75 per cent of the capital costs, and the variable element of the operating costs. In addition there would be a fixed charge to recover the balance of the capital and operating costs. A possible design for a capital charging system for industry is given in Scott and Lawlor (1994).

At the domestic level, waste water volumes are of necessity proxied by water supply volumes. Thus volume-related charging would require the metering of water supply to each household. This has already been discussed in detail in the section on water supply, and we saw that the economic viability of universal domestic metering is unclear.

Introduce charging for discharges to water, even where no treatment is carried out This would be a pure pollution tax, based on the damage cost of the discharges. It would give an incentive to carry out the maximum amount of treatment, up to the point where further treatment is more expensive than paying the tax. It would be levied on discharges by industry *and* the local authorities, and would be administered by some central body, such as the Environmental Protection Agency (EPA). The amount of the tax would vary from place to place, depending on the sensitivity of the particular location. This approach is used in a number of European countries, including The Netherlands and France.

*Subsidise or give grants for the capital cost of improved waste water treatment*While in Ireland there is an implicit subsidy to users of municipal waste water services, in other countries the authorities often provide grants to industry to introduce improved treatment. However, the funding for these grants usually comes from general charges or levies on industry.

5.2.4.The impact of full cost recovery

What might be the impact for local and central government finances of full cost recovery? Two factors need to be considered:

(i) Operating costs are due to increase significantly as new treatment plants come on stream. We estimate that operating costs will increase by very roughly £28 million per annum as a result of this[6].

(ii) What would be the revenue from a pollution tax on waste water discharged to the environment? This depends on the extent to which the tax is levied (on all waters or just sensitive waters?), the level of the tax, and the level of pollution going into the relevant waters[7]. How much of this would be subject to a tax, and how much the tax would be are also unclear, so it is difficult from the current standpoint to estimate how much revenue this tax might raise.

Table 5.10 summarises the situation. This shows the present shortfall in financing the service, plus the likely increase in costs in the future - £28 million - to give the future shortfall in funding the system in the absence of full cost recovery - £121 million per annum. This is also, by definition, the improvement in public finances by moving to full cost recovery, though increased social welfare payments of perhaps £20 million per annum would be required to help low-income households[8]. We assume no change in pollution levels, though it might be more appropriate to assume some reduction, especially by industry. However, it is likely that reductions by

6 [6]Department of the Environment (1993) gives illustrative costs of operating new treatment plants of £11.38 per Population Equivalent (PE) per annum for a small treatment plant (capacity 15,000 PE) and of £4.06 per PE per annum for a large treatment plant (capacity 94,000 PE). If we take current municipal secondary treatment capacity from Table 5.7 of 12,000 tonnes of BOD per annum, this converts to 0.5 million PE (on the basis that one PE generates 60 grams of BOD per day). There is a further 700,000 PE of municipal primary treatment capacity in place. The planned future secondary treatment capacity as already mentioned is 4,099,000 PE. We assume that half of this is treated in small plants and half in big plants (including the upgrade from primary to secondary treatment, which we assume costs 2/3's as much as building a secondary treatment plant from scratch) and add 5 per cent for inflation

7 [7] Taking the estimated total waste generated from Table 5.7 of 114,000 tonnes of BOD per annum, this converts to 5.2 million PE. Existing municipal secondary treatment capacity is 0.5 million PE, rising to 4.1 million PE, and current industrial capacity is 2.1 million PE. This seems to suggest that the pollution load arising will be more than catered for by future treatment facilities, but treatment will only reduce the pollution (BOD) content by 80 per cent, future municipal capacity is likely to replace some existing industrial treatment capacity, and future industrial load and treatment capacity are unknown. Hence, it is not clear how much pollution will be released into the environment in the future, except to say that the quantity is not likely to be very large.

8 [8]Future design PE is 4.1 million, while the human population covered is estimated to be 70 per cent of the total, i.e. 3.6 million x 70 per cent = 2.5 million. Therefore roughly 60 per cent of the future treatment capacity will relate to the domestic sector. Given future costs of £129 million per annum (from Table 5.8 and above) full cost recovery will require the raising of £77 million per annum from households. If we assume that 25 per cent will be unable to pay, roughly £20 million per annum will have to be provided in increased social welfare payments.

existing firms would be compensated for by new firms or increased population, so we have not built any reductions into our figures.

Table 5.10: Impact of Full Cost Recovery on public finances - waste water

	£ million
Present shortfall in cost recovery (from Table 5.8)	93.00
Add:	
Expected increase in annual costs	28.00
Future shortfall in financing the service, if full cost recovery is not introduced = improvement in public finances if full cost recovery is introduced	121
Less:	
Increased social welfare expenditure for low-income households if full cost recovery is introduced	20
Net improvement in public finances if full cost recovery is introduced	101.00

Note: Any revenue from a possible pollution tax is ignored.

5.3.Solid Waste

Industry is the major source of solid waste in Ireland, generating over 7 million of the 11 million tonnes or so arising each year (see Table 5.11). Commerce generates over 500,000 tonnes per annum, while households generate over 1.3 million tonnes. A further 240,000 tonnes of hazardous waste arises, and this is subject to various forms of treatment and recovery processes. We do not consider this waste here, as hazardous waste is more properly the subject of regulation than of fiscal instruments.

Table 5. 11Solid waste arising and disposal routes in Ireland, 1995

Source	*Waste arising*	*Disposal methods*						
		Landfilled	*Incineration*	*Disposed to waters*	*Biological/ chemical treatment*	*Recovered/ reused*	*Other*	*Total*
	Tonnes	*Tonnes*	*Tonnes*	*Tonnes*	*Tonnes*	*Tonnes*	*Tonnes*	*Tonnes*
Commercial	523,711	443,339				80,372		523,711
Domestic	1,324,521	1,267,035				57,486		1,324,521
Industrial non-hazardous	7,688,808	5,855,217	8,014	357,681	34,412	1,207,392	226,093	7,688,808
Industrial hazardous	243,754	4,884	45,613		70,590	103,481	19,186	243,754
Municipal sludges	493,323	493,323						493,323
Dredge Spoils	784,600	784,600						784,600
Miscellaneous	202,040	202,040						202,040
Total	11,260,757	9,050,438	53,627	357,681	105,002	1,448,731	245,279	11,260,757

(Source:Environmental Protection Agency, 1996b)

5.3.1. Environmental impact

The environmental impact of this waste is varied, and depends both on the type of waste and its disposal route. Considering industrial waste, the vast majority (almost 6 million tonnes) is landfilled. The major components are mining and quarrying waste (2.3 million tonnes) and construction and demolition waste (0.6 million tonnes). Much of these wastes are quite inert, however the mining waste would include some hazardous substances, and so has a potentially large impact, particularly on water quality. Also, the construction and demolition waste could possibly be put to a better use, if it were recycled into higher grade materials and reused directly for construction (see Box 5.1).

The other substances that end up in landfill, from industry, commerce and households, are the usual range of solid waste materials - plastic, paper, metals, etc., and these will have various impacts on the environment, namely:

(i) land usage, visual impact, etc., through the existence and use of the landfill;
(ii) air pollution and global warming through the generation of methane, from the anaerobic decomposition of organic materials;
(iii) ground and surface water pollution from the leaching of liquids from the landfill into nearby waters; landfill leachate is highly toxic, and once again is generated from the decomposition of organic materials.
(iv) transport impacts from the carriage of waste to the landfill.

Box 5.1 Demolition and construction waste.

This represents a very significant proportion of the waste generated and disposed of annually. While most of this waste is used for land reclamation and site engineering, there appears to be scope for recycling it into higher grade material. A study of this issue in the UK (Department of the Environment, UK, 1994) indicates that in that country approximately 30 per cent of demolition and construction waste is reused on-site, 30 per cent is reused for landfill engineering, and a further 37 per cent is dumped in landfill. Only 4 per cent is recycled to secondary aggregate. The option of increased recycling is being pursued in a number of European countries, in the context of minimising waste going to landfill in general. For example, the French government proposes that by the year 2002, 40-50 per cent of this waste will be recycled, whilst in The Netherlands the target is 90 per cent by the year 2000.

A case in point is the city of Copenhagen (population approximately 1.3 million), where in recent years the percentage of the city's waste going to landfill has fallen from 48 per cent to 11 percent of the total (Fonteyne, 1995). This has been achieved almost totally by a very substantial increase in the recycling of demolition and construction waste, encouraged by a high landfill levy (DKR195 or £20 per tonne) and restrictions on the type of waste allowed into landfill. There are indications that the main use of this recycled waste was for road construction (DRI *et al*., 1994). However, we do not know the economic cost of the Copenhagen approach; it may be that construction costs have had to be increased to pay for the recycling. The approach suggested in this paper, whereby the full LRMC of landfill disposal is charged, including a levy to cover the external costs, would automatically encourage construction and demolition waste recycling if this is the economically and environmentally better option.

5.3.2.Existing fiscal structure

Charges for public waste collection services[9]We are concerned here with that element of solid waste that ends up in public landfills, i.e. approximately 2.2 million tonnes per annum (Environmental Protection Agency, 1996). As already seen, the majority of industrial waste is dealt with on-site, by industry itself, and so this is not directly affected by the fiscal structure. There is no fixed fiscal structure for the entire country, as each local authority is free to set its own charges. Table 5.12 shows the total and unit costs of providing the service, as well as cost recovery levels.

9 [9]This issue is considered in detail in Barrett and Lawlor (1995), and most of the following discussion is drawn therefrom.

Table 5.12:Estimation of total cost, unit cost and cost recovery of solid waste in 1994

	£ million
Expenditure (note 1)	
Collection	35
Landfill	17
Total (note 2)	52
Receipts from charges (note 3)	12
Cost recovery percentage	23%
Shortfall	40
Financed by (note 4):	
Local sources (mainly commercial rates)	16
Central government (mainly Rates Support Grant)	24
Quantity landfilled per annum (note 5)	2.2 million tonnes
Unit cost of collection (note 6)	£38/tonne
Unit cost of landfilling	£8/tonne
Total unit cost	£46/tonne

(Source:Department of the Environment)

Notes:

1. Unlike the other environmental services, both capital and current costs of the solid waste service tend to be financed at a local level (i.e. there are no capital grants from central government). As a consequence it is difficult to split costs between capital and current.
2. Total expenditure on solid waste services in 1994 was £73 million. This includes roughly £20 million for street cleaning and litter prevention, which are not included above.
3. £5 million of this is from households and £7 million from commercial sources.
4. On a pro rata basis.
5. A certain amount of this waste is collected by individuals and firms other than the local authorities.
6. A recent survey of the major local authorities (Barrett and Lawlor, 1995) indicates costs for collection ranging from £22 - 65 per tonne, with an average of £38 per tonne.

Concerning the level and types of charging that local authorities use, complete data are not available, but Barrett and Lawlor (1995) provide some survey data, presented in Table 5.13. As can be seen from the Table, volume-related charges are quite widely used, especially for commercial users of the service, though the level of charge varies from authority to authority. It can also be seen that quite a sizeable proportion of households - 42 per cent - pay nothing for solid waste services.

In theory, it is preferable that the charge should represent the long run marginal cost (LRMC) of providing the service. We have seen already that charges do not recover the full costs of providing the service, but do they cover the LRMC? A number of local authorities have indicated that they do try to recover their (short run) marginal costs in providing services to the commercial/industrial sector. In general, LRMC will be higher than short run marginal costs, so it is probable that LRMC is not being recovered in most cases.

Two further considerations would lead us to suspect that public solid waste management services are being under-priced. Firstly, future waste management costs will be considerably higher than current levels, and when using LRMC we need to use future costs, rather than current costs levels, since the former is the cost to society of using up the existing facilities. Secondly, the above discussion relates only to internal costs - external or environmental costs are ignored. In Ireland external costs are estimated to add £4 per tonne to the LRMC and £7 to the average cost of disposing of solid waste to landfill (Barrett and Lawlor, 1995).

Table 5.13:Local authority solid waste collection and disposal charges, survey results

Charge system	*Percentage of respondents (weighted by population size)*		
	Domestic collection/disposal	*Commercial collection*	*Landfill only*
	%	*%*	*%*
Volume-related	13	64	56
Fixed charge	30	14	0
No charge	42	3	9
Privatised service	15	19	1
No landfills in area			34
Total	100	100	100

(Source:Barrett and Lawlor, 1995)

In relation to the increased costs of running the solid waste service, Barrett and Lawlor (1995) present a model of the expected future costs of modern landfill. This model indicates that the cost of replacing all the current landfills with modern facilities will entail a capital expenditure over the coming years of up to £400 million, depending on the number and size of facilities built. As a result annual expenditure on landfill facilities will increase to £45 million, from the present level of £17 million (from Table 5.12). On a per tonnage basis, costs could increase from a current level of £8 per tonne to up to £25 per tonne. Assuming no increase in collection costs, total collection and disposal costs are likely to increase from their present average £46 per tonne to an average of perhaps £63 per tonne (excluding administration) in the coming years. This will obviously have major repercussions for local authority finances and levels of solid waste management charges. We are assuming that the public sector incurs the cost of building all new landfills. It may be that the private sector will build and operate at least some of these facilities. While this may or may not change the cost to the economy of providing solid waste services, it will take the financing burden away from the public sector.

*Grants and subsidies*Apart from the implicit subsidy in the under-charging for public solid waste services, the central government and local authorities provide grant aid to a number of recycling projects. Most of these are aimed at recycling domestic waste, although some commercial and industrial waste would also be recycled in these projects.

*Compliance incentives (i.e. financial penalties for non-compliance)*As with the other environmental services, local authorities have at their disposal several pieces of legislation which allow them to impose fines for non-compliance with regulations or for illegal dumping. The degree to which these are used varies from authority to authority.

*Environmental effects of the existing structure*As with the other environmental services, the under-charging for solid waste services will tend to lead to an excessive amount of solid waste being generated. This will obviously have a detrimental effect on the environment. Artificially low waste disposal costs will also discourage reuse, recycling, and waste reduction, which are the main means by which solid waste can be avoided.

5.3.3.Options, from experience in Ireland and Overseas

*Charge the full cost of public waste management services*The charging system would be volume-related, and based on the LRMC of waste collection and disposal. In addition, the local authorities would want to recover the balance of costs (including administration) where LRMC is lower than average cost, and this would be achievable by applying an additional fixed charge. Volume-related charging is a practical option for both the domestic and commercial sectors, using systems such as tag-a-bag, or charges by reference to size of bin. In the future, more sophisticated approaches may be appropriate (see Box 5.2).

A concern with volume-related charging for solid waste services is that it gives an incentive to dump illegally. Indeed, this is often used as an argument for not introducing such charges. Discussions with local authorities that have introduced volume-related charges in Ireland indicate that while illegal dumping was an initial problem, the enforcement of anti-littering regulations and the threat of prosecution have been effective in discouraging such activity. In addition, the general public are becoming less tolerant of illegal dumping, and this is also discouraging the practice (Lawlor, 1996).

*Charge a landfill levy to cover the external costs*This would represent revenue over and above the cost of running the service, and might be collected by a central agency. Given an average external cost to be £7 per tonne (Barrett and Lawlor, 1995), and the present quantity of 2.2 million tonnes landfilled annually, the revenue might amount to £15 million per annum.

The question of what to do with the levy revenue arises. Theoretically it should go into general revenues, to be used for the highest priority purpose. However, there are likely to be increases in exchequer expenditure related to the solid waste area, such as subsidies to recycling (see discussion later), and social welfare compensation for those households that are unable to pay the full charge for waste disposal as envisaged here. So the revenues from the levy can help to finance these.

Another use may be to reduce labour taxes, as is being planned in the UK at present (Smith, 1995). France, which has an up-and-running landfill tax of FF20 (£2.50) per tonne of household and commercial waste, uses the revenues to finance a public body called the Modernisation Fund for Waste Management. This grant aids research into innovative methods of dealing with solid waste, the construction of modern waste management facilities, and the upgrading and restoration of existing landfill sites. However, as a result of lobbying, many elements of industrial waste are exempted from this tax, as are industrial on-site dumps (Fernandez and Tudenham, 1995). In return for this exemption, industry agreed to set up its own fund (which was subject to legal agreement) to finance the closure of illegal industrial dumps. A major proportion of solid waste in France, be it from household, commercial or industrial sources, goes to illegal landfill sites. Part of the aim of the law that introduced the landfill tax is to close down these sites, and to ensure that the direct disposal of waste to landfill is ended by the year 2,002 (i.e. that waste would go through some other route such as incineration or recycling before going to landfill).

Box 5.2 Weighed refuse collection trials in Denmark (an experiment in pure weight-based charging).
Specially designed vehicles are being used in Denmark which can weigh the refuse left out by households and can charge accordingly. In the trials to date, the vehicles are rear-loaded and the same amount of labour is employed as before (side loaded-vehicles are under development which will only require one man to operate them). The vehicles have two compartments, one for material that can be composted and the other for all remaining refuse which is landfilled or incinerated. The waste is collected from the household in 240 litre bins which are divided into two compartments, 40 per cent for compostible material and 60 per cent for the remainder. The new weight-based charge did not constitute a rise in price. If the household left out the same weight of refuse as before the trial, the average household's payment would be the same.

The result so far has been a 15 to 20 per cent reduction in weight of refuse collected. As the charge did not change, this reduction has been caused by the fact that payment was weight-based, rather than due to a price rise. One might say that households were responding to the opportunity to reduce their bills. Households can take their recyclables, that is bottles, plastics, paper etcetera to recycling centres.

It is hoped that economic analysis of the investment will be undertaken and that price responsiveness will be estimated. The question is: in present value terms, would the savings on the costs of landfill and incineration outweigh the extra capital costs of this equipment? As the vehicles are rather more expensive than traditional vehicles, the economics of the system would be more favourable where there are high landfill and incineration charges, and strict regulations, as is the case in Denmark.

*Charge the landfill levy on industry's own landfill sites, to the degree that external costs exist*The majority of industrial waste (over 5 million tonnes) is disposed of in industry's own sites. As mentioned, much of the waste is inert, but some would have an environmental impact. Given the quantities involved, this levy might raise considerable sums of money. The practical problems of calculating the amount of levy payable in each case may of course be large. More research would also be needed to consider the actual external cost applicable to these wastes, and the quantities involved.

*Privatisation*An alternative approach, which would automatically lead to full charges being applied, is to privatise public waste management services. This is already done to varying degrees, especially in the area of collection of waste. Of course, the landfill levy would still be imposed, by some public agency.

*Subsidise recycling to the degree of its external benefit, or preferably introduce an energy tax*Charging the full LRMC for disposal to landfill would give an automatic boost to the alternative disposal routes, i.e. recycling, re-use and reduction at source. In addition, these could be subject to a tax or subsidy to reflect their marginal external costs or benefits. The main alternative route currently in use in Ireland is recycling, so it would be important for this at least to have its environmental costs and benefits taken into account. The calculation of this is difficult, and Barrett and Lawlor (1995) take the approach of valuing the energy saved in the recycling of these materials, and treating this as an environmental benefit. They estimate rates per tonne of material recycled (see Table 5.14), but make the point that a general energy tax, equal to the marginal external cost of energy usage, would achieve similar results automatically, without the need for a separate bureaucracy to administer the subsidy[10]. Such an energy tax would also automatically benefit any other waste management route (e.g. re-use, reduction at source) that saved energy, and would improve the efficiency of the economy on an overall basis, not just in the case of waste management.

How much the subsidies would cost if implemented cannot be estimated, as the quantities of industrial recycling is not well known, and perhaps more importantly the reaction to the subsidy is unknown. A benefit of the energy tax in this context is that it raises revenues for the exchequer, which can be used to reduce other taxes.

Table 5.14: External benefits of recycling, in terms of energy saved

Material	*Value of energy saving per tonne of material recycled* £
Aluminium	186.00
Glass	2.00
Paper	24.00
Tinplate	16.00
Plastics (average)	148.00

(*Source: Barrett and Lawlor, 1995)*

*Product or packaging taxes*Product or packaging taxes are taxes on goods or packaging which relate to their waste component, at the end of their useful lives. Such a tax can be used to achieve a number of objectives, but from an economic point of view the objective is to include the cost (internal and external) of the disposal of the product and its packaging, in its price. By making products with a higher "waste content" more expensive, the tax provides an incentive for the consumer to alter consumption patterns, and for the producer to alter production patterns. As a result, one would expect the production and consumption of relatively waste-intensive products to decline, thereby reducing the total amount of waste arising. An example of a packaging tax is a tax on plastic bags, currently provided free in shops and supermarkets in Ireland. These bags tend to have a very high "waste content", mainly in terms of their visual impact when discarded. Such a tax would seek to internalise the cost of this impact, encouraging the public to minimise their use of these bags or to switch to reusable packaging. Another example would be a tax on the phosphate content of detergents, to reflect the impact of the phosphates on receiving waters and waste water treatment plants

10 [10]Of course some extra bureaucracy would be needed to administer the energy tax, but the cost would not be as great, since much energy use is already subject to the tax system. Also, an energy tax would apply to a far wider section of the economy and hence the administration costs would be spread more widely

Apart from the economic objective of including waste costs in the purchase price, product taxes can be used with the specific purpose of encouraging industry to set up recycling schemes or deposit-refund schemes. For example, Norway taxes non-returnable beverage containers, thereby providing an incentive to operate a deposit-refund scheme. In order for the tax to be successful in achieving these sorts of objectives it must be sufficiently large to make the alternative worthwhile. In using product taxes for this reason, it needs firstly to be established that encouragement of re-use or recycling is an optimal objective. If the costs of re-use or recycling, both internal and external, are greater than the corresponding costs of landfilling, a product tax that creates a strong incentive towards recycling may not be appropriate. Alternatively, the revenue from the product tax could be used directly to set up recycling schemes (or similar schemes). Again, it needs to be established before a recycling scheme is set up that this is the environmentally optimal thing to do.

Another factor to keep in mind is the effect of such a tax on production costs. If the tax is levied only in Ireland, action would need to be taken to ensure that domestically produced goods are not put at a competitive disadvantage. Goods imported into Ireland would have to be taxed on a product basis so as to restore the competitive balance. Domestically produced goods sold abroad would require a tax refund. This would of course mean that the information requirements of the tax would become large. For this reason the imposition of such a tax may make more sense at a transnational level.

Finally, the design and coverage of a product tax depends on the trade-off made between administrative ease and effectiveness. For example, in order to internalise external costs correctly, a large number of tax rates must be used, reflecting the contributions of different products to the waste stream. Clearly though, a higher number of rates will create greater administrative difficulties.

*Raw material taxes*Raw material taxes come in two forms. First, virgin raw materials can be taxed while secondary (i.e. recycled) raw materials remain untaxed, thus creating an incentive for the use of secondary raw materials. The tax on virgin raw materials can be set so as cover the eventual disposal cost thereof. The logic then in leaving secondary materials untaxed is that their waste component has already been charged for. The second type of tax is where all raw materials are taxed but the rates differ according to the rate of recycling for the material in question. Thus, a raw material that is never recycled would face a higher tax rate than one which is recycled a number of times. In both cases, the incentive to use recycled materials is intended to lead to the diversion of waste from the waste stream. The provisos mentioned for the product tax would also apply here.

Another issue which arises in the context of foreign trade is the possibility that recycled materials could be imported into this country in an effort by firms to avoid a virgin material tax. If this recycled material makes its way into the waste stream following one use, the effect on the Irish waste stream is the same as if virgin materials were used, since no real diversion has occurred from the domestic perspective. It is true that waste is diverted from the country which exports the recycled material but it would seem unfair that Irish consumers and producers would bear the cost of waste diversion for another country. Again, for this reason, imposing the tax at a transnational level may make more sense.

*Deposit-refund schemes*Deposit-refund schemes operate through an additional charge being placed on an item when it is purchased, and this charge being subsequently refunded when the item or its container are returned. Such schemes have been widely used in the US. and Europe, although typically for a limited range of products such as beverage containers. Other applications have been for car hulks in Greece and Norway and vehicle batteries in the US. (OECD, 1994).

These schemes can be used to internalise the costs of disposal. By setting the charge equal to the marginal social cost of disposal, a consumer who purchases an item and discards as opposed to returning it incurs the cost of disposal. A consumer who returns the item and thus keeps it from the waste stream avoids the disposal cost. Typically, however, the objective of these schemes has not been internalising costs but rather to generate high rates of return of materials, with a view to encouraging re-use and recycling and to reduce waste going to landfills and litter. The deposit rate necessary to achieve this may or may not be equal to the rate that would internalise disposal costs.

Finally, indications from Ireland and abroad are that while deposit-refund schemes may be appropriate at the commercial level or for the on-licence trade (pubs, hotels, restaurants), they are extremely expensive to operate at the domestic level (Barrett and Lawlor, 1995).

5.3.4.The impact of full cost recovery

Table 5.15 estimates the impact of full charging, as recommended here, on central and local government finances. Introducing full cost recovery (with compensating social welfare increases for low-income households) will reduce the revenue raising requirements of both central and local government by over £60 million at future cost levels, while the landfill levy will provide central government with a source of revenue over and above any financial costs. As an alternative, the private sector may become more involved in the provision of the service; this will have a similar effect on public finances as if the local authorities continue to provide the service, but use full cost recovery. We have not taken into account any reductions in waste quantities as a result of higher charges, though some reductions could be expected. However, without information as to elasticities of demand for landfill services, it is difficult to estimate the affect accurately[11].

11 [11]Barrett and Lawlor (1995) review some international research into elasticities of demand, but the findings are incomplete. Those elasticities that have been estimated have tended to be not very large, though they have in general been short term elasticities, and it may be that long term effects could be greater

Table 5.15: Impact of full cost recovery on public finances - solid waste

	£ million
Present shortfall in cost recovery (from Table 5.12)	40.00
Add:	
Expected increase in annual costs	28.00
Future shortfall in financing the service, if full cost recovery is not introduced = improvement in public finances if full cost recovery is introduced	68
Less:	
Increased social welfare expenditure for low-income households if full cost recovery is introduced (see note)	12
	56.00
Add:	
Landfill levy	15.00
Net improvement in public finances if full cost recovery, including a landfill levy, is introduced	71

Note: Expected future costs are £80 million per annum. 1.3 million tonnes out of a total 2.2 million tonnes landfilled per annum come from households, i.e. 60 per cent. Applying this percentage to the costs gives £48 million per annum chargeable to households. If 25 per cent of these cannot afford to pay, social welfare allowances would have to increase by £12 million to account for this.

5.4Conclusions and recommendations

This chapter has looked at the current fiscal structure as it applies to environmental services provided by local authorities and used by households, commerce and industry. We have seen that in general, these services are being under-priced, leading to over-usage and wastage, and consequent excess environmental damage. Present levels of cost recovery are 54 per cent for water supply, 8 per cent for waste water, and 23 per cent for solid waste. While the EU is at present paying a large share of the capital costs of these services (solid waste excepting), and will continue to do so until the end of this decade, beyond that date capital costs will have to be funded domestically. In view of this, our general recommendations are as follows:

1. Charges be adjusted to achieve full cost recovery and removal of subsidies, on a volume-related basis where possible. Over 95 per cent of Irish households say that they would prefer to pay for future improved environmental services by charges rather than through increases in central government taxes (according to the table in the General Background chapter) and there are sound reasons of efficiency for doing so.
2. This needs to be done *simultaneously* with reductions in central government taxes. If not operated as a package, the proposal might be strongly resisted.
4. Under full cost recovery, alleviation of hardship to low-income households will require an enhanced system of waivers which will put extra responsibilities on local authorities, or increases in social welfare payments. The latter is to be preferred, but whichever is adopted it should be paid for by central government.
5. The adjustments in charges, income taxes and social welfare should be phased in over perhaps 10 years, and be announced and initiated immediately.

In addition, there are a number of recommendations that relate to the individual services, and they are listed now. For water supply, we would recommend that:

1. In areas where capacity is tight, or may become so, the viability of universal metering should be estimated. The calculated marginal cost of expanding water supplies should include environmental effects such as impacts on amenity waters, water levels in fisheries, environmental impacts on lakes, ponds, wetlands, habitats et cetera, not to mention the opportunity costs of reducing water for hydroelectricity generation and for other potential commercial and industrial uses.
2. In areas where metered charging is not deemed viable, equitable methods of domestic charging include basing the charge on the number of residents in the household, on rateable valuation or on type of dwelling.
3. All new houses being built, or areas where service work is being undertaken, should have water meter boxes installed to give occupiers the option of metered charging. Careful users and consumers of small quantities will tend to opt for metering. Non-metered domestic customers could be charged *their* average costs, ie their total cost averaged only over them. They would find their charges rising as smaller users opt for metering. As prices rise therefore, an increasing number would opt for metering.
4. All customers consuming above a certain calculated level should be charged on a metered basis (possibly above 500 m^3 per year, or 1370 l per day).

For waste water services, we would recommend that a pollution tax be levied on discharges to bodies of water, whether or not treatment has already taken place on the discharges in question. This would apply equally to discharges from industry and municipal facilities, and might be administered by some central body.

For solid waste services, we would recommend that the following:

1. The calculation of costs would be by reference to the next "generation" of landfills, rather than existing landfills, since the new facilities will be very much more costly than those they replace.
2. There would be a landfill levy, equal to the external cost per tonne of disposal to landfill. We estimate that this would raise revenues of perhaps £15 million per annum.
3. There would be subsidies for recycling and re-use of materials, equal to the external benefits of these activities, vis à vis production from virgin materials. As an interim, these could be based on the external benefits of energy saved in the activity in question. The revenues from the landfill levy could help to finance these.
4. In the longer run, an economy-wide energy pollution tax would obviate the necessity to have a subsidy as described in (iv). This however, is an issue that affects much more than just solid waste management, and its implementation may require agreement at an EU or even wider level.
5. The option of increased privatisation could be explored, since this would automatically lead to full cost recovery, and it appears that private firms find it easier to collect waste disposal charges than do local authorities. The landfill levy would of course still be charged on waste disposal.

*Implications for public finances of Cost Recovery for Environmental Services*Table 5.16 summarises the financial implications of full cost recovery for public finances. It shows the current shortfall on financing the services, and also the future shortfall, if full cost recovery is not implemented - an amount of £271 million per annum at future cost levels. This is by definition the saving to public finances from full cost recovery, though increased social welfare allowances of roughly £57 million per annum would have to be deducted. A landfill levy might bring in an extra £15 million annually. Note that the figures here do not incorporate any saving to the economy; they simply show the financial effect of moving from a system of paying for services mostly through general taxes, to one of paying for them by user charges. Society is paying for the service either way, although evidence of the incentive effects of use-related charges on quantities of the services demanded suggest that economic and environmental benefits will accrue from using this approach. In practice the incentive effect of charging may be considerable in the long run, given the very large rise in charges that is envisaged.

Table 5.16: Present and future shortfalls in financing environmental services, in the absence of full co: recovery (expressed in present day prices)

Service	*Total cost per annum £ million*	*Charges presently levied £ million*	*Annual shortfall /subsidisation £ million*
Present cost levels			
Water supply	136.00	73.00	63.00
Waste water	101.00	8.00	93.00
Solid waste	52.00	12.00	40.00
Total	289.00	93.00	196.00
Future cost levels			
Water supply	155.00	73.00	82.00
Waste water	129.00	8.00	121.00
Solid waste	80.00	12.00	68.00
Total	364.00	93.00	271.00

Note: Data on future cost levels assume that quantites of the services used are unchanged from present level. i.e. the incentive effects of charging are ignored.

Appendix 5

The gross bill for water, for a consumption of 200 cubic metres, is as follows:

City	Gross bill*	VAT rate (%)	Av consn m^3/yr
Amsterdam	£121.48 unmetered	6%	117
Athens	£115.75	varies	n.av.
Barcelona	£118.44	6%	103
Birmingham	£144.66 £75.12 unmetered	0%	120
Brussels	£221.29	6%	n.av.
Copenhagen	£193.74	25%	n.av.
Dublin	none	n. applic	n.av.
Edinburgh	£69.06 unmetered	0%	n.av.
Frankfurt	£271.96	7%	109
Helsinki	£93.90	0%	n.av.
Lisbon	£79.25	5%	n.av.
Milan	£19.60	9%	n.av.
Normandy	£199.72	5.5%	n.av.
Oslo	£64.18 unmetered	22%	n.av.
Stockholm	£284.88	25%	128
Vienna	£231.00	10%	n.av.
Zurich	£208.45	0%	n.av.

Source: Sullivan, D., (1995). *European Water Charges: A Comparison of 17 Cities.* Centre for the Study of Regulated Industries (CRI), Public Finance Foundation, London.
Note: * Bases on metered consumption, unless otherwise stated.
It is estimated that in Ireland the average household consumes 164m^3 per year.

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