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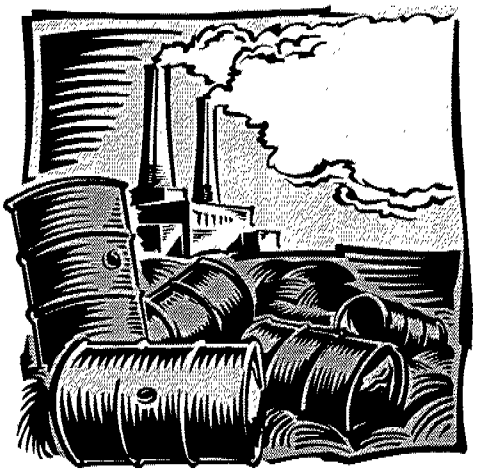
Environmental taxes and tradeable permits

How well do they work for nature conservation?



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Environmental taxes and tradeable permits: how well do they work for nature conservation?

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Executive summary

1. The purpose of this report is to review the potential of economic instruments (EIs) as a policy instrument for environmental protection, and in particular for nature conservation. It reviews recent research but can not claim to provide a complete overview of all literature in this area. It was initiated initially to help English Nature, in its statutory role in advising Government on policy for and affecting nature conservation, evaluate the numerous proposals for economic instruments that have been developed in recent years. As such it provides an in depth analysis of one policy option. However, economic instruments need to be evaluated by comparison with a range of policy options for environmental protection, including regulation, information and persuasion, and formal voluntary agreements.

2. English Nature is becoming increasingly involved in providing advice to Government Departments on proposals for economic instruments in environmental policy. We see our role primarily as being to advise on whether the proposed policy instrument is likely to deliver benefits for nature conservation and on whether the proposal seems the most appropriate given alternative ways of delivering wildlife gain. A summary of potential economic impacts on Biodiversity Action Plan habitats is at annex 1; economic instruments may be relevant in addressing some of these impacts.

3. The use of environmental economic instruments has developed gradually in many countries since the 1970s. The rationale for their use can be found in the analysis by environmental economists of the causes of environmental problems. According to this school of thought, the environmental damage caused by economic activity can be traced back to failures in the market mechanism (known in the jargon as 'market failure'). Amongst several possible causes of 'market failure' is the presence of 'externality' costs. Thus, for example, the market for food products is based on the interaction between the production costs to farmers and the demand for the food product. However, while this market mechanism takes account of the costs of production inputs such as nutrients and pesticides, it does not take account of the cost of any environmental damage caused by the use of these inputs.

4. 'Market failure' is evident because the environmental costs are pushed on to other markets (eg costs to the water industry) or to society as a whole (eg loss in well-being through reduced environmental quality). Consequently, the food product market may not reflect the full costs of the production process. Such market failures can lead to higher than appropriate levels of output and consumption, causing environmental damage, and lack of incentives to innovate in production methods or in behaviour that avoids damage. Note that a 'polluter' may be a firm or a household. This analysis leads to the conclusion that environmental damage would be reduced if markets can be made to face the full costs of their production processes, including the externalities. This requires 2 processes: first, a way of valuing the externalities that are not taken account of by the market; and secondly, a policy mechanism which 'internalises' these costs within market processes.

5. 'Economic instruments' is the term used to describe these policy mechanisms. Amongst many types, the main ones are:

- Environmental taxes, which place a compulsory charge on each unit of production or

consumption to reflect environmental damage costs. These could be emission charges or product charges;

- Tradeable permits. This involves the issuing of 'damage permits' to polluters. Potential polluters can then decide whether to avoid damaging activities, or to buy additional permits off others. In this way an overall cap on the level of environmental damage can be achieved.

6. A related mechanism, which works in a slightly different way, is a policy which simply implements more accurate charging systems than currently exist. Water metering is an example of such a mechanism.

7. Positive externalities can also occur, such as the provision of good conditions for wildlife from sustainable agricultural practices. It may be appropriate to reward these via public subsidies. However, this paper concentrates on environmental taxes, charges and tradeable permits for dealing with damaging externalities.

The potential role of environmental taxes, charges and tradeable permits for nature conservation

8. These economic instruments have a number of theoretical advantages in environmental policy.

9. **First, they implement the Polluter Pays Principle (PPP) by ensuring that polluters face the full costs of damaging activities.** This should increase production costs, and thereby affect output levels, and will provide incentives for 'cleaner' production and consumption patterns. By ensuring all costs are taken account of, market distortions can be reduced. Failure to reduce such distortions is equivalent to providing a public subsidy to the industry or household causing the pollution. In effect, it means taxpayers as a whole are paying the costs of pollution.

10. The implementation of PPP was adopted as formal policy by OECD countries in 1991, and the principle is supported by English Nature's Position Statement on Sustainable Development.

11. **Secondly, economic instruments may implement environmental policy more cost effectively than regulatory alternatives.** This is possible because the imposition of a tax or other instrument provides a choice of response. Those that can cost effectively change their behaviour will do so; those that can not will pay the tax.

12. **Thirdly, economic instruments can provide a dynamic incentive for environmental improvement.** By imposing an additional cost on all levels of output, an economic instrument can provide a continuous incentive to innovate beyond the basic minimum.

13. **Fourthly, economic instruments can be more cost effective to implement than alternative measures in some circumstances.**

14. Tradeable permits can have an additional potential benefit in that by setting a cap on the total permitted level of pollution, the overall environmental target is more likely to be achieved. Against this, permit systems may not be as feasible as a tax in some circumstances.

Potential problems with environmental taxes, charges and tradeable permits

15. The hypothetical benefits outlined above need to be weighed against certain potential problems in practice.

16. **First, getting the appropriate tax design to deliver behavioural change can be very difficult in practice.** For various reasons, effective design can be especially difficult for nature conservation benefits. The problems include:

- Valuing the environmental damage, which is especially difficult for biodiversity;
- Defining a suitable tax base (the measure of damage on which the charge is based) can be difficult in a way that maintains simplicity and cost effectiveness yet provides the correct incentives for behavioural change. For nature conservation, this problem is often compounded by knowledge gaps and the difference in spatial impacts from pollution.

17. **Secondly, market conditions may affect the extent of behavioural change.** Market conditions relating to many environmental impacts are characterised by inelastic demand levels, presence of perverse subsidies, and uncompetitive or regulated markets. If revenue is not then devoted ('hypothecated') to environmental restoration, the implementation of PPP still makes economic sense but may deliver no environmental benefits.

18. Thirdly, economic instruments can ensure that an overall environmental target is achieved cost effectively. **They have less control, however, over <u>where</u> damage is avoided (through abatement) and where it continues (ie where the tax is paid instead).** This is unimportant for CO2, for example, where the overall level of emissions is more important than where they occur. For the majority of nature conservation impacts, however, the location of the potentially damaging activity is critical. This problem suggests that economic instruments can provide benefits for nature conservation by reducing overall levels of damaging activity, but can not guarantee protection at specific locations. **Consequently, they should generally be seen as part of a package of measures for nature conservation.** Tradeable permit schemes, differentiated by geographical zones, may be more appropriate in some cases.

19. Fourthly, the potential benefits from a tax or other instrument need to be weighed against possible loss of goodwill in the industry affected, and against other potential ways of achieving the objective.

20. Finally, badly designed environmental taxes can have unfair effects. These mainly involve adverse social distributional consequences, unfair treatment of similar polluters in different sectors of the economy, unfair treatment of one country's polluters compared with similar polluters from another country, or unfairness in the implementation timetable which needs to give firms some time to adjust.

21. All the above problems suggest the following conclusions:

- Particular design difficulties may be evident for nature conservation interests; and
- Potential cost effectiveness advantages need to be weighed against a possible lack of certainty in achieving the environmental target.

22. Tradeable permits may avoid some of the concerns about environmental certainty, because the overall permitted level of damage should not be exceeded. Zonally differentiated permits may help distinguish between the spatial effects of pollution, though the level of geographical specificity may not always be sufficient for nature conservation. Permit schemes may also be less practical for some areas of policy. For example, a large number of participants in the area is required to ensure that trading takes place.

Evaluating environmental taxes, charges and tradeable permits for nature conservation

23. The conclusion from this discussion is that proposals for economic instruments must be objectively evaluated on a case by case basis. Particular caution is suggested in the evaluation of benefits for nature conservation. Evidence from experience in Europe is beginning to suggest that these policy instruments can be environmentally effective. However, their role for nature conservation will be as part of a set of mechanisms, including a strong regulatory framework.

24. The following 5 questions are suggested to help such evaluation:

1. *Do environmental 'externalities' clearly exist?*
2. *Is a tax feasible?*
   - 2.1 *Can the tax be designed appropriately?*
   - 2.2 *Will market circumstances deliver behavioural change?*
   - 2.3 *Are the proposals fair?*
3. *Are tradeable permits or other types of economic instrument preferable to a tax?*
4. *Will there be benefits for nature conservation?*
5. *Is the proposal preferable to or complementary with other policy alternatives?*

25. Questions 4 and 5 above are the key questions for English Nature's advice role. However, questions 1 to 3 provide useful context analysis. Annex 3 attached provides a breakdown into more detailed sub-criteria, together with a summary evaluation against recent proposals.

1. Background and introduction

1.1 The purpose of this report is to review the potential of economic instruments (EIs) as a policy instrument for environmental protection, and in particular for nature conservation. It reviews recent research but can not claim to provide a complete overview of all literature in this area. It was initiated initially to help English Nature, in its statutory role in advising Government on policy for and affecting nature conservation, evaluate the numerous proposals for economic instruments that have been developed in recent years. As such it provides an in depth analysis of one policy option. However, economic instruments need to be evaluated by comparison with a range of policy options for environmental protection, including regulation, information and persuasion, and formal voluntary agreements. A summary of potential economic impacts on Biodiversity Action Plan habitats is at annex 1; economic instruments may be relevant in addressing some of these impacts.

1.2 EIs can be designed to encourage the avoidance of activities that have a negative effect on the environment, or to encourage beneficial activities. The scope of this report is limited to EIs which are designed to encourage the avoidance of damaging behaviour by implementing the **'polluter pays principle'** (eg taxes, tradeable permits). It does not, therefore, cover the design of 'public good' incentive measures such as the agri-environment schemes, which are also a key economic measure in nature conservation. However, as the paper discusses, the distinction between the 'polluter pays' and the 'provider gets' principles depends crucially on definitions of where property rights lie or should lie (Bowers (1997)). The paper also focuses mainly on the terrestrial and atmospheric environments, though the same principles are relevant to the marine environment.

1.3 The main types of EI for pollution control are:

- *Environmental taxes.* These implement the polluter pays principle by adding a charge to resources, activities or products to reflect the environmental costs associated with their extraction and use. These are discussed in detail in sections 3 and 4.
- *Charges.* This is a payment made for a specific environmental service. The key features is that the charge is voluntary and requited (ie there is some indication of the use to which revenues will be put).
- *Levies.* This is a compulsory charge and is therefore equivalent to a tax. However, it is a special form of tax in that it is requited ie the purpose of the revenue raised is made explicit at the outset (eg the Non Fossil Fuel Levy).
- *Deposit-refund schemes.* Here, a charge is made but is re-fundable if certain behaviour is observed.
- *Tradeable permits.* These are voucher-type schemes which can restrict the total level of pollution within a defined area.

A fuller typology is set out in annex 2. This paper concentrates on environmental taxes and tradeable permits, as these are the most frequently proposed policy options.

1.4 Section 2 below describes the socio-political context relating to EIs in the UK. Section 3 discusses how environmental taxes implement the polluter pays principle in theory, and section 4 evaluates how they work in practice. Section 5 reviews recent experience in

Europe. Section 6 evaluates tradeable permits. Section 7 concludes with an analysis of the key issues for nature conservation and a checklist for evaluating particular EI proposals.

2. The socio-economic and political context in the UK

2.1 Environmental economic instruments are a key area of current debate both in terms of environmental policy and economic policy more generally. The 'polluter pays' concept was originally developed by a British economist, Arthur Pigou, in the 1920s. Hence, taxes on pollution are often called Pigovian taxes. However, it was perhaps the publication of 'Blueprint for a Green Economy' (Pearce *et al*, 1989) which installed the idea more generally in the public's mind. Since the publication of the 'blueprint', there has been a considerable shift in the perception of EIs amongst environmental activists. Pearce's explanation of the potential role of economic instruments was originally treated with suspicion by an environmental movement which emphasised the need for an ever-increasing regulatory framework. However, support for EIs as a useful tool for environmental protection has increased over the past decade, partly due to the perception of their more widespread use in some of the more environmentally aware European countries. This shift has been so great that the 1998 Pre-Budget Report was widely criticised for its lack of EI proposals. Indeed, there is now a danger that the design complexities of EIs can be overlooked in the clamour to make the polluter pay.

2.2 One interpretation of the governmental perspective is that 'green taxes' are being seen increasingly as part of a country's overall tax strategy. Transnational corporations have become much more difficult tax targets. As capital mobility has increased so the tax authorities have had to focus more on labour as the less mobile factor of production. But if expenditure levels are to be maintained and unemployment levels increased, new sources of tax revenue are required to reduce the burden on labour costs. The favoured candidates are indirect taxes such as VAT, capital and real property taxes, and environmental taxes (Turner *et al* 1998). Arguably it is this context that lies behind the rhetoric of "taxing 'bads' rather than 'goods'".

2.3 Turner et al (1998) identified a set of principles which form the political economy context into which green taxes have to fit: economic efficiency, environmental effectiveness, fairness, administrative cost-effectiveness, and revenue raising.

2.4 As at April 1999, the main 'polluter pays' EIs implemented in the UK are:

- The Landfill Tax and escalator in tax rates;
- Differentiated fuel duty (between leaded and unleaded petrol, and between other road fuels based on environmental effects);
- An escalating real price rise for road fuel;
- A differentiated Vehicle Excise Duty (to be implemented from June 1999);
- The Non-Fossil Fuel levy.

Other measures announced in principle:

- A tax on the business use of energy;
- Preferential tax treatment of companies' 'green transport' schemes

Other measures currently under consideration by government include:

- Water abstraction charges based on environmental effects;
- A pesticides tax;
- An aggregates tax;
- Congestion charges for road users;
- Workplace parking charges;
- A new charging system for domestic waste;

Note that the water metering and domestic waste proposals are slightly different in that their focus is on moving from the current 'per head' pricing system to one based on the amount of resource used. They are 'charging' mechanisms rather than 'tax' proposals, but have similar effects in changing incentives at the margin.

Other potential areas for economic instruments (which may or may not be appropriate), do not appear to be under active consideration by government, or have been rejected. These include:

- A tax on water pollution from point sources;
- A greater level of imposition of water metering;
- A tax on sales of peat;
- A tax (or change to VAT) on the domestic use of energy;
- A tax on nutrient pollution (fertilizers);
- A tax on non-workplace, non-residential parking;
- A tax on incineration;
- A tax on development land in certain areas.

Note that the above lists exclude the EIs relating to the agri-environment programme and the Common Fisheries Policy.

2.5 The role of EIs needs to be evaluated in comparison with other policy alternatives, including regulation and voluntary agreement. Regulation, for example, can be seen as a different type of incentive scheme from EIs, but an incentive scheme nevertheless: it will be most effective when policed and backed up by serious penalties for offenders. The necessary monitoring arrangements can be compared with a market based alternative.

3. How environmental taxes apply the polluter pays principle in theory

3.1 This section explains the basic principles and theoretical benefits of environmental taxation. Annex 2 attached explains the economic concepts in more detail.

3.2 The classic, Pigovian externality problem involves clearly identifiable sources and extents of damage, clearly identified sufferers, and easily identified damage costs. An example is shown in figure 1: a stretch of river has a paper mill which discharges pollutants into the water course, having a detrimental effect on fish, other wildlife, and water quality generally. This action causes economic costs to third parties, which are known as **externalities**. These costs may be explicit, in the form of lost revenue to the fishing permit business and clean up costs for the water supply industry, or implicit, in the form of loss of well-being to society as a result of the wildlife damage.

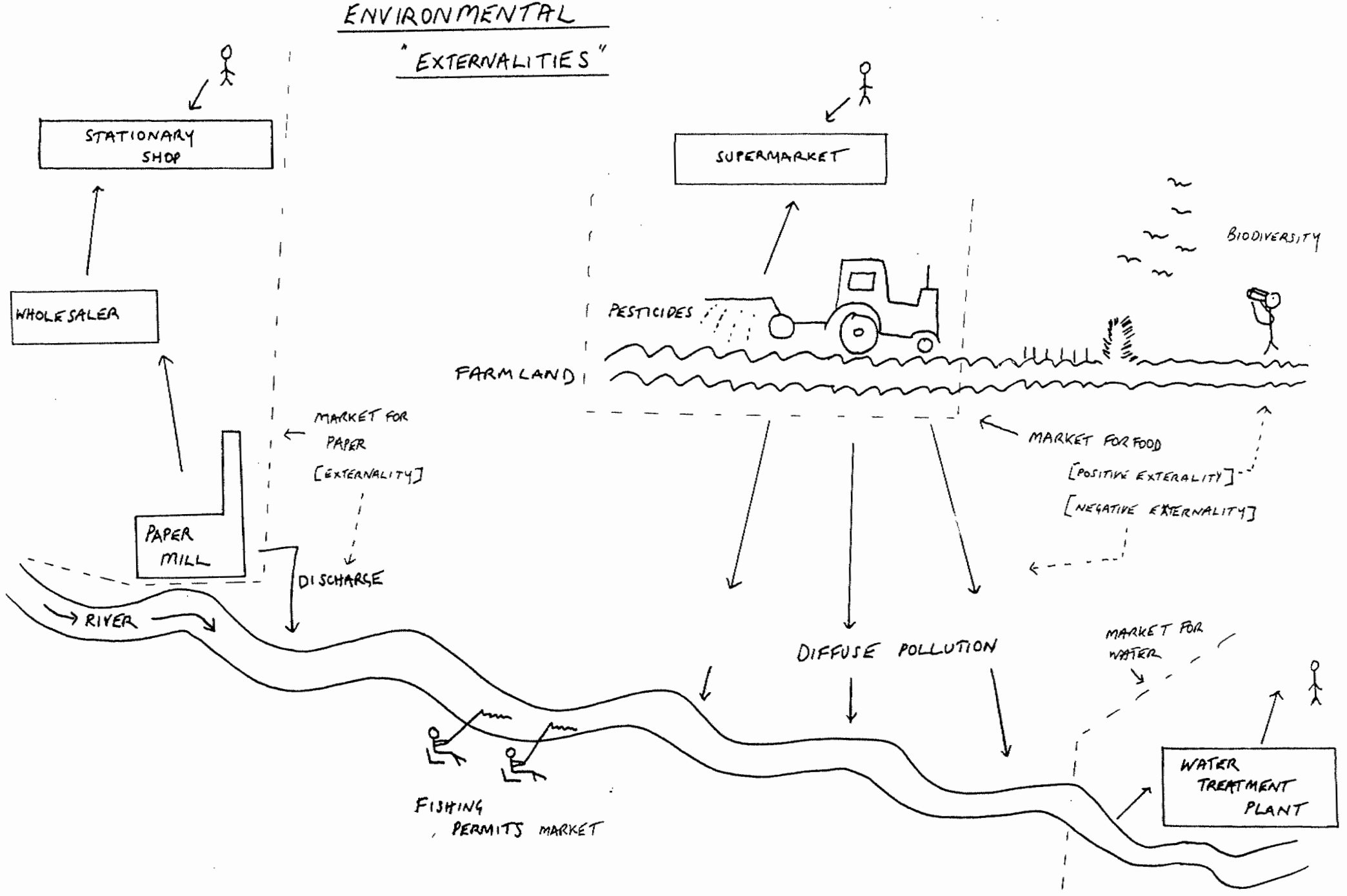
3.3 In the examples above, it is theoretically possible for the different agents to come to a negotiated arrangement whereby these costs are shared in some way, thereby removing the 'externality' effect. In practice, however, this is less likely because the agent suffering the pollution faces significant negotiation and monitoring costs (**'transaction costs'**) which provide a barrier to the establishment and enforcement of **property rights** (Coase, 1960). The problem is compounded in many circumstances relating to environmental pollution by other 'market failure' problems, such as the lack of well defined property rights (eg in the marine and atmospheric environment) and the 'public good' problem (see annex 2). These market failure problems act to prevent a privately agreed settlement. This suggests that 2 interventions are necessary to improve the functioning of the market:

- Estimates of the externality costs involved;
- A mechanism, such as an environmental tax or other instrument, to 'internalise' (ie to include) the costs of pollution in the economic decision making of the polluter.

3.4 By providing a price signal based on externality costs, environmental taxes (ETs) provide an incentive for firms to reduce output to more acceptable levels; the mechanism for this is explained in annex 1. In addition, the price signal provides a dynamic incentive for improved production processes which can reduce environmental damage further.

3.5 **Potential benefit: implementation of the 'Polluter Pays Principle' (PPP) and removal of market distortions**. Annex 1 describes the concept of 'economically optimal' levels of pollution. In theory, ETs can deliver an economically 'optimal' level of pollution based on an appropriate trade off between the benefits to society (from lower pollution) and the cost to firms and individuals (relating to their change in behaviour). In practice, this 'optimal' position is almost impossible to achieve, but environmental taxes can act to reduce market distortions to some extent by correcting market failures (ie the presence of externalities) and ensuring that prices fully reflect all resource costs (including environmental costs). This ensures a more efficient allocation of resources and thereby helps maximise society's well-being. The implementation of PPP was adopted as formal policy by OECD countries in 1991, and the principle is supported by English Nature's Position Statement on Sustainable Development.

Figure 1



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3.6 Arguments about the additional burdens of green taxes on businesses need to be seen in this context. The UK government sees it as market distorting and consequently abhorrent to prop up industries by the use of public subsidies (HM Treasury, 1998a). However, **failure to incorporate environmental externalities in the cost of goods and services is in practice subsidising industry just like any other subsidy (Ekins, 1998a).**

3.7 Two caveats are, however, relevant to the supposed market improving benefits of economic instruments:

- The efficiency gains from internalising the externality costs need to be set against 2 categories of costs resulting from the taxation process: these are the *transaction costs* (ie the administrative costs of measuring pollution and administrating an environmental tax system) and the *deadweight costs* (ie the loss of benefits to consumers (consumer surplus) caused by higher prices due to the tax);
- Setting the tax at an economically efficient rate requires the authority to know the shape of the industry benefit function (how profit changes with higher output), and the damage function (how damage costs change with higher output) since it is the intersection of these that defines the tax level (see annex 2). In practice this is very difficult.

It is assumed that the environmental tax will better represent the true costs of production than in the no-tax situation, and the market efficiency gains from this will outweigh the additional transaction and deadweight costs. However, this may not always be the case and a badly designed instrument could lead to a more market distorting scenario than in the pre-tax situation (Helm, 1998).

3.8 It is also important to recognise that regulatory approaches may also be market improving to some extent, as they impose the PPP by imposing costs on firms in meeting regulatory standards.

3.9 **Potential benefit: ETs can provide the most cost-effective way of meeting environmental standards ('static cost effectiveness').** Where lack of knowledge prevents the setting of an environmental tax at the economically optimal level, ETs can still be applied using a 'standards and charges approach'. This involves setting a tax at a level which the authorities believe will be sufficient to achieve a specific environmental target. An ET will in principle achieve the given standard more cost-effectively than regulation. This is because it uses the price mechanism to encourage the best mix of abatement (ie pollution avoidance) within and across firms who face different abatement costs. Consider the case of the factories discharging pollutants into the river. Under a regulatory regime, each factory must meet the standard, whatever the costs involved in changing behaviour. However, with a correctly set price signal, in the form of a tax, polluters can decide whether to pay the tax or to implement abatement measures. Those that can adjust their emissions cheaply will do so; those that can not will opt to pay the tax. The overall level of emissions reduction will depend on the tax rate, among other factors discussed below. If it is set at the right level, it will achieve the same environmental result as regulation, but more cost-effectively. This consideration is very important given the need to minimise cost burdens on industry.

3.10 There are 3 points to bear in mind about the cost-effectiveness advantage of ETs:

- Achieving the same environmental result as regulation requires the authorities to set the tax at the right level. This means they need to have a good knowledge of the damage function ie how the costs of environmental damage change with increased output; or, alternatively, there must be a flexible structure to regularly change the tax rate until the desired environmental target is reached;
- The cost effectiveness advantages of ETs will be most significant where there is variation in abatement costs amongst the polluters ;
- This advantage ignores possible 'rights' issues. For example, some may argue that all firms must meet minimum standards as a matter of principle, and that the ability to pay the tax and avoid pollution control, merely because abatement is expensive, is unacceptable.

3.11 **Potential benefit: ETs can provide a continuous incentive for environmental improvement, over and above the regulatory standard ('dynamic cost effectiveness').** Because an ET places a charge on every unit of emission, this provides a dynamic incentive to develop innovative processes which can, over time, reduce pollution to levels even further than the original environmental target. A regulatory approach, by contrast, provides no incentives over and above the regulatory minimum.

3.12 This dynamic cost effectiveness can act as a driver for the development of innovative practices in pollution abatement. With an environmental tax, a firm that can develop innovative technology or practices will be able to reduce costs by avoiding the tax, and thereby gain a competitive advantage in the market.

3.13 **Potential benefit: Revenue raising for wider efficiency benefits or hypothecated environmental expenditure.** The idea of environmental taxes providing a 'double dividend' derives from the basic principles of tax general taxation theory. Public policy economics addresses the problem of how general taxation needs (eg income tax) affect the efficiency of markets. The problem is that, with the exception of the ancient per head (poll) taxes, all taxation to meet government's social programmes are market distorting in that they affect price signals. Income tax, for example, distorts markets by increasing the cost of labour as a factor of production relative to capital. So, public policy theory suggests that if a 'first-best' (ie non-market distorting) tax strategy is not possible, then the aim should be for a 'second-best' outcome whereby all markets are distorted to an equal degree; the wide coverage of general taxation instruments (eg VAT, income tax) is designed both to raise sufficient revenue and achieve a second-best outcome (Begg et al, 1984).

3.14 The key to the double dividend idea is that environmental taxes are unusual in that they are not market distorting. Indeed, the first dividend from environmental taxes is that they are market correcting, ensuring the cost of environmental damage is taken into account and production is revised back to optimal levels. The potential second dividend derives from the fact that, even where they are highly effective in changing behaviour, they will incidentally raise some revenue. This revenue can substitute for more distorting forms of taxation. Substitution of environmental tax revenue for labour tax revenue, for example, can reduce the distortions in the cost of labour, and consequently create jobs. This is the second, or double, dividend effect.

3.15 A study by Ekins (1998b) evaluated the effects of a set of ecological tax measures in the

road transport, waste, aggregates and energy sectors, using the Cambridge Econometrics macro-economic model. This estimated that in addition to the positive behavioural effects that could be expected, annual revenue of £28bn would be raised by 2010, creating an additional 390,000 jobs through the consequent reduction in labour taxes. Others, however, question the 'double dividend' effect and it is true to say that it is probably the most controversial theoretical issue in environmental taxation (O'Riordan, 1997). For example, it is argued that any labour market effects would only occur in the short run; unless they are accompanied by productivity improvements, then in the long run the benefits could be dissipated due to macro-economic effects of higher inflation.

3.16 An alternative is to earmark (hypothecate) the revenue, or some of it, for environmental restoration. This may be especially appropriate where the main effect of the tax is to raise revenue rather than prevent polluting behaviour. Section 5 below highlights how hypothecation of water pollution charges appears to have improved the environmental effectiveness of the policy. However, there are also arguments against this option. First, if the money is to fund additional expenditure, then the double dividend effect, described above, will be lost. This effect has to be set against the benefits from the extra expenditure. Secondly, a traditional argument of HM Treasury is that public expenditure in a particular area should be determined entirely by its relative priority, not the amount of expenditure that happens to derive from that source. Thirdly, such revenue could decrease over time as the tax increasingly bites. Nevertheless, given the practical difficulties that ETs have in delivering behavioural changes (see section 4), hypothecation of revenues may provide the only environmental benefit in certain cases.

3.17 **Potential benefit: 'transaction' costs for ETs may be lower than for other policy instruments.** Paragraph 3.7 above discussed the transaction costs for ETs which are likely to reduce the efficiency gains. These transaction costs include initial research, administration of the policy, monitoring and enforcement. However, all policy instruments have transaction costs; the issue is whether they are likely to be lower or higher for EIs. In certain cases, the transaction costs for EIs may be lower than for a regulatory alternative. For example, the alternative to the fuel escalator could be a regulation allowing households only to drive on certain days. However, the administrative and policing costs are likely to be much higher than a simple tax instrument which works through the price mechanism. A key feature in this example is the diffuse nature of the pollution. A regulatory instrument affecting the use of every car in the country is not easy to police. Conversely, a regulatory approach may be better for pollution from power stations, say, because of transaction costs (few sources to monitor) and other reasons. ETs are likely to have lower transaction costs than regulation in some circumstances. The relative transaction costs of ETs and regulation in comparison to those for voluntary agreements is an area for useful further research.

3.18 **Potential benefit: the price signal as a moral messenger.** According to some, ETs may be a more useful way of reinforcing positive environmental messages than regulation. The idea is that the regularity of tax payment by a firm or consumer acts to reinforce the message that environmental damage is occurring, on each transaction or at each production period, in a way that regulation is unable to. The suggestion is that the tax mechanism may in some circumstances reinforce messages in addition to the pure price signal effect. For example, tax mechanisms which make the reason for the payment explicit in a regular billing process may be helpful in this respect. This would suggest, for

example, that a clearly identified tax on peat may not only reduce peat consumption to an acceptable level, but may in the long term help change basic tastes and demand patterns. The extent to which this is the case needs further research and is likely to depend heavily on the precise design of the instrument. Some, for example, argue that the response to the price signal may be less important than the 'moral' response to the information provided (Green 1998a). Recent research by psychologists suggest that in some cases, the institutional framework of an environmental tax encourages a response greater than would be expected by the price signal; in other cases, the reverse is true (Van Vugt 1999). This suggests a role for behavioural science in environmental tax design.