4

The Use and Application of Economic Instruments to Promote Environmentally Sustainable Development

This Chapter addresses why environmental degradation occurs, and discusses the policy instruments available to reduce it at the lowest cost to society. It is argued that environmental degradation is the result of people being faced with the wrong prices for goods, or poorly defined property rights. Prices can be wrong either due to the failure of the market mechanism to incorporate the external effects of economic activities, or due to government policies which give wrong incentives. The former is termed 'market failure' and the latter 'policy failure'.

4.1 Market Failure

Markets work best when allocating private goods which are characterised by exclusivity, i.e. anyone who is unwilling to pay the market price for the private good in question is excluded from its use, and by rivalry in consumption (or divisibility). This latter characteristic ensures that a resource can be subdivided such that each individual who is willing to pay for it can exclude all others (rivals) from its benefits. Although there are some imperfections in private goods markets such as government interventions, monopolies and lack of information, on the whole, private goods fetch a price in the market. On the other hand, environmental goods tend to be non-exclusive and divisible (e.g. migratory fish shoals and groundwater reserves); exclusive and indivisible (e.g. closed access to nature reserves and private beaches up to a maximum use level); or non-exclusive and indivisible (e.g. scenic views and clean air and water). Due to these characteristics, markets fail to place a price on environmental goods.

While the market system appears to be highly efficient in the case of priced resources, it fails to correctly guide firms towards the efficient use of unpriced environmental resources. This market failure arises because firms only take account of the market price of a resource when deciding how much of that resource to use. When a firm uses and degrades an unpriced environmental resource or service (such as the waste assimilation function of water), this incurs no internal (or financial) cost to the firm but it does create an external cost for society. An external cost is the cost which accrues to third parties from the actions of a buyer and a seller and which is ignored by the market. There can also be external benefits, though these are rarer than external costs.

Market failure can be broken down by the size of the market: local market failure refers to the failure within a domestic economy (e.g. no market for good quality water), whereas global market failure refers to the failure arising from a lack of global markets (e.g. no market for biodiversity). Figure 6 shows how market and policy failures lead to the loss of biodiversity due to land conversion (on the horizontal axis), but it is equally applicable to other forms of environmental degradation.

Mprofit is the marginal private benefit (profit) curve showing that profits decline as more land is converted (marginal means extra: the extra profit from converting one additional unit of land to, say, agriculture). *Lprofit* land (the point where M(marginal)profit reaches zero) would be converted if the free market was left to itself. Two factors give rise to more land conversion:

- infrastructure development – road building lowers conversion costs and hence raises profit margins, and
- population growth – demand for food rises and hence profit from land conversion increases.

Land conversion imposes local external costs such as greater soil erosion and loss of locally important biodiversity. This is shown in Figure 6 as MECdom (domestic marginal external cost – i.e. the external cost imposed at the domestic level by an extra unit of land conversion). When MECdom is taken into account, the optimal level of conversion becomes *Ldom* (where Mprofit = MECdom). But land conversion also involves other external costs that accrue to people outside the country in question, e.g. scientific knowledge and carbon sinks are lost. We refer to these as global marginal external costs (*MECglob*). The local external cost, MECdom, must be added to the rest of the world externality, or MECglob. Taking the global externalities into account, the optimal level of land conversion becomes *Lglob* (where Mprofit = MECdom + MECglob). Figure 6 shows how market failure occurs when the domestic and global marginal external (or environmental) costs are ignored:

the difference between Lglob and Lprofit represents *market* failure:

the difference between Ldom and Lprofit is *local market* failure

the difference between Lglob and Ldom is *global market* failure

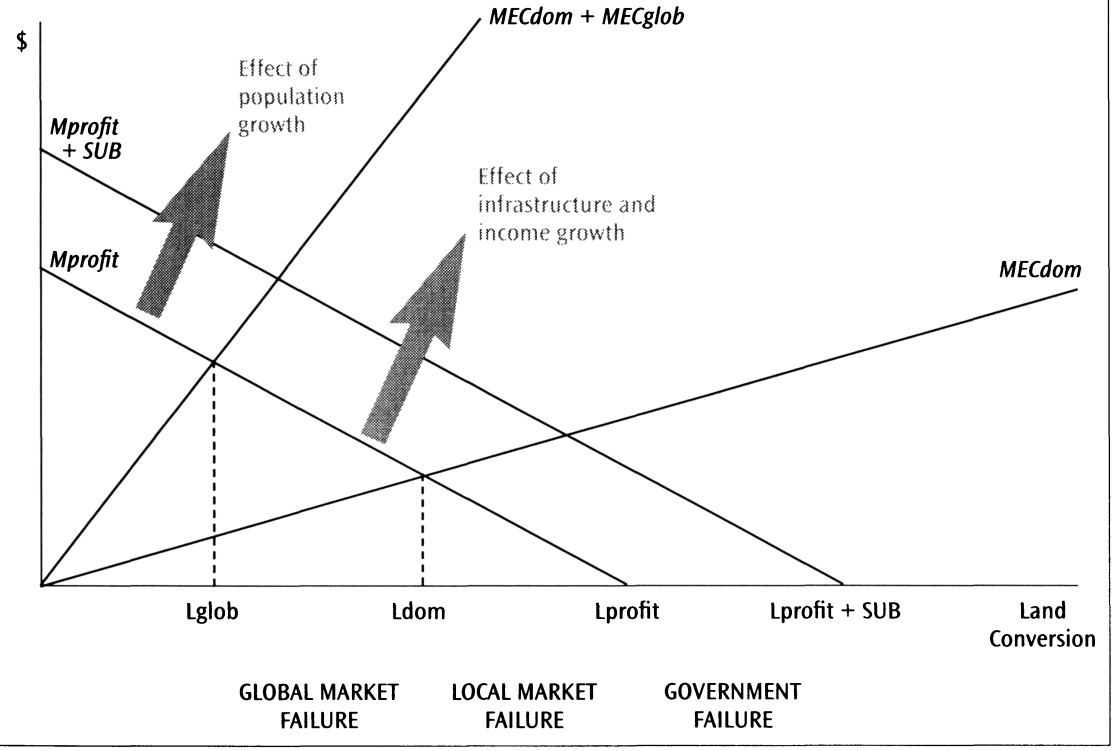
4.2 Policy Failure

Leaving aside environmental issues, in some markets the price charged for goods and services is even less than the marginal (private) cost of producing them. In some cases, this is due to policy (or government) failure. Policy failure occurs when the government creates incentives for prices to be less than the real cost of production:

P < MC for outputs or inputs (where P is the price and MC is the marginal cost of production)

Most of these distortions not only lead to lost revenues for the government but also create neg-

Figure 6: **Policy and Market Failures**



ative environmental impacts such as the overuse of natural resources. Policies that lead to failure include input subsidies, output price controls, physical output targets, foreign exchange controls, and tariffs. These policies have typically been applied in several different sectors of the economy: energy, agriculture and forestry are notable. As an example of policy failure, subsidies tend to be regarded as being, on balance, harmful for the environment. The reasons are easy to see if we look at Figure 6. For example, subsidies to land conversion cause private profits to increase to *Mprofit+sub* and land conversion to increase to *Lprofit+sub*. Therefore, it can be said that the cause of land conversion between Lprofit and Lprofit+sub is *government or policy* failure.

The effect of a **consumer subsidy** is to induce consumers to buy more of the subsidised commodity. If that commodity is environmentally damaging, either in itself, or because it embodies harmful inputs, then there will be more environmental damage as a result. The effect of a **producer subsidy** is also likely to be harmful because it can encourage over-production and, hence, the excessive use of environmentally harmful inputs. Producer subsidies might take the form of input subsidies, such as subsidies to fertilisers, energy, pesticides, irrigation water etc. They might also take the form of guaranteed prices so that the more someone produces the bigger the subsidy they get. Apart from being wasteful in itself, this process encourages 'extensive' production, e.g. in agriculture, rooting up trees and hedgerows to increase acreage to get more subsidies. Other subsidies include those offered to agriculturists to clear land of forest cover and subsidies to mechanised agriculture. It should be noted, however, that some subsidies can be regarded as being 'good' because they reward beneficial behaviour (these are discussed later on). Some forms of farming, for example, are consistent with the conservation of the 'rural way of life'. Subsidies to public transport may help take traffic off the roads, thus reducing congestion and pollution. The precise extent to which subsidies are good and bad is very uncertain and some would argue for a presumption that subsidies are bad unless proven otherwise.

Boxes 2 to 3 show a selection of evidence on the existence of policy failure. Agricultural price subsidies in Box 2 are measured by the 'producer subsidy equivalent', which is defined as the value of all transfers to the agricultural sector in the form of price support to farmers, any direct payments to farmers and any reductions in agricultural input costs through subsidies. These payments are shown here as a percentage of the total value of agricultural production valued at domestic prices. This implies, for example, that in Mexico in the mid-1980s, agricultural output prices could have been about half of their subsidised level. And in the OECD in 1992, prices could have been about three-fifths of their subsidised level. As P plus subsidy > MC, there is great incentive for land clearance for cultivation. The stumpage fee is the rate charged to logging companies for standing timber. The

Box 2: **Evidence on Policy Failure:** Economic Distortions to Land Conversion

Agricultural producer subsidy equivalents %		
Mexico	mid 1980s	54%
Brazil	mid 1980s	10%
South Korea	mid 1980s	55%
Sub-Saharan Africa	mid 1980s	9%
OECD	1992	44%
Timber stumpage fee as per cent of replacement costs		
Ethiopia	late 1980s	23%
Kenya	late 1980s	14%
Ivory Coast	late 1980s	13%
Sudan	late 1980s	4%
Senegal	late 1980s	2%
Niger	late 1980s	1%
Timber stumpage fee as per cent of total rents		
Indonesia	early 1980s	33%
Philippines	early 1980s	11%

Sources: OECD (1993); World Bank (1992); Repetto & Gillis (1988).

subsidy is expressed here as a percentage of the cost of reforesting (replacement cost) and as a percentage of total rents. In Niger, for example, the stumpage fee was only 1% of the cost of reforestation, thereby encouraging even greater logging. Moreover, since the government was left with 99% of the reforestation costs, this meant that, given limited budgets, reforestation did not take place.

Box 3 shows examples of input prices being lower than the marginal cost of producing them due to government subsidies. Although governments may justify such subsidies on the grounds of distributional considerations, they certainly encourage over-use of irrigation water and pesticides. Box 4 shows the extent of policy failure in the agriculture sector in OECD countries.

Box 5 summarises tentative estimates of subsidies worldwide. Although these are rough and come from various sources, significant conclusions emerge from them:

Box 3: **Evidence on Policy Failure:** Agricultural Input Subsidies in Developing Countries (late 1980s and early 1990s)

	Irrigation (Subsidy as a % of price)
Bangladesh	82
Indonesia	86
Rep. of Korea	82
Nepal	93
Philippines	78
Thailand	95

	Pesticides (Subsidy as a % of retail cost)
China	19
Colombia	44
Ecuador	41
Egypt	83
Ghana	67
Indonesia	82
Senegal	89

Source: Repetto, 1986, 1989.

Box 4: **Evidence on Policy Failure: OECD Agricultural Subsidies**

(Producer subsidy equivalents %)	1981-84	1985-88	1989-92
Australia	11	12	12
Canada	30	47	45
EC	32	47	46
Japan	63	74	68
Sweden	38	55	57
United States	27	35	27
OECD	33	46	43

Source: OECD, 1993.

a they are huge in number, being perhaps 4% of the world's entire GNP (which is about $25 trillion);

b they are some 14 times more than the entire official aid flows in any one year;

c while they exist in developing countries and countries in transition, they are declining quite rapidly (mainly due to structural reforms); and

d the largest subsidies are in the OECD

Box 5: **Provisional Estimates of World Subsidies** ($billion)

Sector	**OECD**	**Non-OECD**
Water:		
irrigation	3+	20
sanitation	?	5
supply	?	28
Fossil Fuel	34-52	100+
Nuclear power	9-14	0?
Agriculture:		
pesticides	0?	2?
fertilisers	0?	4
outputs	336	0?
Transport	79-108	?
Total	461-513	159
Grand Total		**620-672**

countries, especially in the agriculture and transport sectors.

The size of these subsidies casts doubt on the widely discussed 'shortage of finance' for the implementation of Agenda 21, the global programme of action to promote environmentally sustainable development, agreed at the Earth Summit in Brazil in 1992. There appears to be plenty of finance – it is simply in the wrong place!

4.3 Full Cost Pricing

Given that neither markets nor government policies can account for the full costs of using environmental goods and services, the principle of 'full cost' pricing mentioned in Chapter 1 needs to be adopted. Before going into the tools with which full cost pricing can be achieved, let us clarify what we mean by this concept. It means that the price (P) of a good or service should be equal to:

$$MC + MEC + MUC$$

or

$$P = MSC$$

here

MC	Marginal (private or financial) cost of producing an extra unit
MEC	Marginal environmental (external) cost of producing an extra unit
MUC	Marginal user cost
MSC	Marginal social cost

MUC (marginal user cost) is most relevant when the resource in question is non-renewable and scarce relative to demand. It measures the cost of using a scarce resource today at the expense of its future availability and use. It can be calculated as follows:

$$\text{User cost} = \frac{[P - MC\,(B)]}{(1 + r)^T}$$

Where P is the price of the resource; B is the technology which will replace the current one once the resource is extinct or economically infeasible to use; MC (B) is the marginal cost of the alternative technology; r is the interest rate; and T is the time it takes for alternative technology to become feasible. User cost is regularly estimated for non-renewable resources.

An Illustration of Full Cost Pricing: The Energy Sector

The energy sector is one of the most important economic sectors as well as a major source of pollution. Therefore, decisions on conserving existing energy sources and creating new ones should be informed by both environmental and financial impacts of each option. Conventionally, such decisions have been based on the financial costs and measurement of emission to air, water and land. However, as discussed in Chapter 2, such a comparison has the shortcoming of having to deal with variables in different units. In other words, how do we know which alternative is better if one reduces the emissions of sulphur dioxide, while the other reduces the emissions of particulate matter? The answer is to measure the value of the relative damages of these pollutants in monetary terms. Since the result is in money terms, the analysis permits direct comparison between the energy generation alternatives in terms of their environmental impacts. The analysis also permits the comparison between private costs (MC) of an alternative with its environmental costs (MEC). This second comparison is especially relevant for the decisions concerning installation of pollution abatement technologies.

CSERGE *et al* (1994) use economic valuation analysis to compare the environmental impacts of renewable energy sources in Scotland, namely wind power, small scale hydro, energy crops, incineration of municipal solid waste and energy recovery from landfill. Three types of environmental impacts are analysed: (i) generic impacts, which do not vary with location, i.e. the emissions of greenhouse gases; (ii) semi-generic impacts, which vary with source and receptor, i.e. the emissions of acidifying pollutants and particulate matter, and (iii) site-specific impacts such as disamenity, noise, odours etc. The first two impacts are quantified in money terms. However, data for the third impact are

not sufficient for a quantified analysis, and hence the site-specific impacts of energy sources are qualified.

Each energy source is compared with a baseline of "no energy generation from that specific source, and hence no impact" and "alternative technologies of generating electricity", depending on the alternative source. It is assumed that the electricity generated by a renewable source will displace the electricity previously generated by a fossil fuel source, leading to savings in emissions. Such a displaced source is the power station which will be the first to be switched off in the event of an increase in the supply. In the UK and many other countries, this is a coal-fired plant with minimum environmental controls.

Table 5 shows the results of the economic valuation analysis for alternative renewable energy sources in Scotland. The figures are in fact the marginal environmental benefits of renewable energy sources compared to the displaced energy source. Since renewable energy has marginal environmental benefits (MEB) as opposed to marginal environmental costs (MEC), the full cost pricing rule would require MEB to be deducted from the private costs (MC) of renewable energy production. This would then reflect the environmental advantage of renewable energy sources over fossil-fuels in the electricity market.

A number of policy conclusions emerge from Table 5:

1 Each renewable energy technology yields net environmental benefits from generic and semi-generic impacts. This is because the value of the pollution displaced by the technologies greatly exceeds the value of pollution from the renewable technologies themselves.

2 The size of the benefit from renewable energy technology is significant.

3 A ranking of renewables emerges. While the differences between net benefits for various technologies may not seem large, they can be significant. They suggest that considering generic and semi-generic impacts only, wind and hydro are the most environmentally beneficial technologies in Scotland. The addition of site-specific externalities would reduce the net benefit figures but is unlikely to change the ranking.

Case Study:
Economic Valuation of User Costs – Natural Gas Scarcity in Bangladesh

The economic cost of natural gas is comprised of two parts: the marginal private costs of extraction and supply, and the marginal user cost, or depletion premium. Current consumption of gas is at the expense of future consumption regardless of when it takes place.

This marginal user cost has been estimated for the reserves at Dhaka. Making assumptions about the reserves of gas left, and the price of alterna-

Table 5: **The Net Environmental Benefit of Energy Technologies** (based on the damage analysis across Europe) (pence/kWh)

Energy Technology	Net Benefits/Costs
Coal Fired Power Plant	(-3.55)-(-5.4)
Wind	3.5-5.4
Small Scale Hydro	3.5-5.3
Landfill Gas Collection	2.8-4.6
Energy Crops	3.1-4.8
Incineration of Municipal Solid Waste	2.7-4.0

Source: CSERGE et al, *1994.*

Note: Negative entries refer to net environmental costs. Positive entries refer to net environmental benefits.

Table 6: **Market and Economic Prices of Natural Gas in Bangladesh**

	all costs 1986 $/'000 cubic feet		
	residential	commercial	small industrial
marginal user costs	0.06	0.06	0.06
marginal private costs	1.42	0.88	1.65
economic costs	1.48	0.94	1.71
price paid by utility	1.04	1.16	0.92

Source: Julius et al, *1990.*

tive fuel, the marginal user cost was calculated to be $0.06 per thousand cubic feet. Table 6 presents these estimates.

4.4 Correcting Economic Failures, the Polluter Pays Principle and Towards Full Cost Pricing

The polluters pay principle (PPP) is based on the premise that the price of a good or service should reflect fully its total cost of production, including the cost of all resources used. Thus, the use of air, water, or land for the emission, discharge or storage of wastes is as much a use of resources as are other labour and material inputs. The lack of proper pricing and the 'open access' characteristic of many environmental resources causes over-exploitation. Open access means the absence of any ownership right and use regulation, i.e. anyone can use the resource without constraint, increasing the possibility that this will result in complete destruction of the resource. The PPP seeks to rectify this market failure by making polluters 'internalise' the costs of using or degrading environmental resources. The aim is to integrate the use of the environment (as depicted in the 'materials balance' in Chapter 1) into the economic sphere through the use of price signals and the use of economic instruments such as pollution taxes, charges and permits. The use of regulation to internalise externalities is also, however, consistent with the PPP. Essentially an economic efficiency measure, PPP is intended to encourage industries to internalise environmental costs in the prices of their products.

To implement full cost pricing through the polluter pays principle, two steps must be taken:

Step 1: bring market prices to the level of marginal private costs, i.e.

$$P = MC$$

This can be achieved by identifying and removing the policies that lead to policy failure.

Step 2: internalise externalities in order to bring market prices to the level of marginal social costs, i.e.

$$P = MSC = MC + MUC + MEC$$

Prices should be equal to the marginal social cost of the good, which in turn equals the marginal private costs plus both the marginal user and environmental costs. This can be achieved by applying the appropriate market-based instruments and regulations. The steps should be taken in this order, since internalising externalities while the free market price is distorted by a government policy would be fruitless. Moreover, correcting local market failure can have double benefits ("win-win" policies), both in terms of increasing economic efficiency and reducing (even eliminating in some cases) the environmental impacts.

Correcting Policy Failure: Successful Subsidy Removal in Brazil

Box 2 showed that Brazil was paying substantial subsidies to land conversion. This predominantly was in the form of a generous tax credit available to investors who cleared the forest and undertook cattle ranching in the Amazon basin.

The tax credit has been removed by the Brazilian Government, saving it some $300 million per year, and reducing one of the pressures on the rain forest.

Source: World Bank, 1992.

Correcting Policy Failure: Removal of Pesticides Subsidies in Indonesia

In 1985, the Indonesian Government was subsidising pesticides at 85% of retail price at a total cost of US$128 million. These heavy subsidies were not only a burden on the government budget but also encouraged excessive use leading to damages to the environment. In November 1986, 57 brands of pesticides, 20 of which were heavily subsidised, were banned. This caused a 90% decline in pesticide use during planting seasons without a decline in yields. On the contrary, the yields increased from 6.1 tonnes per hectare to 7.4 tonnes. In October 1988, subsidies on the remaining pesticides were cut from 55% of retail price to 40%. In December of the same year, the subsidies were eliminated all together. In order to reduce the potential effect of these changes on the farmers' incomes, floor prices for unhusked rice, yellow corn, soybeans and mung beans were raised. This was fiscally possible since elimination of pesticides subsidies had saved the government around $128 million per year.

Source: Panayotou, 1990.

4.5 Policy Tools for Correcting Market Failure

Command-and-Control Approach (CAC) is the enforcement of environmental quality through the setting of standards which must then be adhered to. Examples of this type of environmental policy approach are widespread. **Market-Based Instruments (MBIs)** are policy instruments that achieve environmental objectives by means of economic incentives to producers to lower their level of pollution or the use of natural resources.

With command-and-control approaches to environmental management, governments either specify the technology that must be used for this purpose (a technology-based standard), or set an emissions or extraction limit that all sources or users must meet (a uniform performance standard). These approaches can be effective in achieving environmental goals, but tend to be expensive relative to market-based instruments. The government would need detailed information such as cost of compliance with the regulation which is already possessed by the polluters. The advantages of market-based over command-and-control approaches, on the other hand, can be summarised as follows (note that 'the polluter' is used to identify both the emitters of pollutants and users of natural resources):

1 Polluters vary in the ease with which they can abate pollution or reduce resource use. Polluters who can easily reduce emissions will have an incentive to do so. Conversely, polluters who find it very expensive to reduce pollution can carry on polluting but pay the financial penalty. However, under command and control regulation, each polluter has to achieve a given standard regardless of the individual cost of doing so. The total costs of reducing pollution by a set amount are usually higher under a command and control system. This has been confirmed by the available empirical evidence.

2 Regulations tend to set a floor as well as a ceiling to emission levels. In the command-and-control approach, there is no incentive for the individual polluter to do better than the uniform standard. However, under market-based instruments, where a polluter pays per tonne of emissions, a dynamic incentive is retained to keep reducing emissions.

3 If there are many polluters, under a command and control system, the administrative costs of monitoring and enforcing the system can be very high indeed. Regulations work best when they are applied to a few large polluters and users. As pollution increasingly comes from

many small sources, the monitoring costs increase and the effectiveness of the regulation decreases. Market-based instruments can reduce much of the government's administrative costs.

4 MBIs can also generate revenue for the government budget. This would be the case if polluters prefer to pay the tax rather than see it as an incentive to reduce their environmental impacts. The twin advantages of market-based instruments – revenue raising and altering incentives to change behaviour – may seem to be in conflict. However, this trade-off depends on how individuals respond to price changes as measured by the price elasticity of demand (i.e. the responsiveness of demand to changes in price). To increase revenue, it is best to raise prices for polluters who will not change their behaviour substantially (demand with low elasticity). But to change behaviour (incentive setting), it is best to raise prices for those who will respond significantly (demand with high elasticity).The revenues collected by MBIs can be invested in environmental protection or could be used to reduce some other taxation to encourage environmentally sound behaviour.

Most MBIs create "win-win" situations for polluters and resource users. This implies that applying these instruments increases the efficiency of economic activity as well as environmental performance. This is not the case with command and control measures. However, MBIs are not always necessarily the best policy response to environmental degradation. Baumol and Oates (1988) demonstrate that in situations where environmental damage can occur quickly and unexpectedly, fiscal instruments may not produce a sufficiently swift response. In these instances, direct government intervention in the form of regulatory controls is necessary. Similarly, if there is a small number of polluters, dialogue and negotiations between polluters and the State may produce satisfactory results, though the relative strength of bargaining parties is crucial in this case.

It is also the case that, for MBIs to work well, they require a supportive institutional and legal framework. If an economy has a large non-market section of trade, either because of bartering, or because the market trade is illegal, then pricing incentives may not be very useful. Likewise, the role of courts may be important both in legitimising the use of some types of MBI and enforcing sanctions against non-payment. Hence, if the institutional/legal framework is poor, economic instruments should form part of a package of policy measures which include more direct measures. Of course, if institutions are weak, conventional 'command and control' policies will not work efficiently either.

4.6 Types of Market-based Instruments (MBIs)

MBIs can take the following forms:

Direct alteration of price and cost levels:

- Product, emissions and feedstock charges
- Deposit refund systems

Indirect alteration of prices or costs via financial or fiscal means:

- Subsidies and soft loans
- Fiscal incentives such as accelerated depreciation
- Non-compliance fees
- Performance bonds

Market creation and market support:

- Emissions trading
- Quota auctioning
- Market stabilisation for secondary materials such as recycled paper

Direct alteration of price and cost levels occurs when, for example, charges are levied on products or on the processes that generate these products, or when deposit refund systems are put into operation. Indirect alteration takes place

when, for example, direct subsidies, soft loans or fiscal incentives are provided to induce the use of environmentally clean technologies. Enforcement incentives can also be put in this category Market creation is often achieved on the basis of changes to legislation or regulations. Market support occurs when public or semi-public agencies take responsibility for stabilising prices or certain markets. We now examine different types of MBI.

4.7 Charges

Emission charges are levied on the emissions of pollutants to air, water or land and on the generation of noise. They are related to the quantity and type of the pollutant and the damage costs inflicted on the environment. Box 6 shows the basic aims and advantages; best practice conditions; relevance to different environmental media; and limitations to the application of emissions charges.

User Charges have a revenue-raising function and are related to treatment cost, waste collection and disposal cost, or the recovery of administrative costs depending on the situation in which they are applied. They are not directly related to the costs of environmental damage.

Product/Input Charges are levied on products that are harmful to the environment when used in production processes, or when consumed or disposed of. The charge rate is related to the environmental damage costs linked to the target product (see Box 7 for details).

Marketable (Tradable) Permits are environmental quotas, allowances or ceilings on pollution levels. Initial allocation of the fixed number of permits is related to some ambient environmental target, but thereafter, permits may be traded subject to a set of prescribed rules. Thus, the most efficient polluter can abate more than the initial allocation of permits requires, and sell the extra quotas and gain from economies of scale. The less efficient polluter can buy these extra permits and avoid prohibitive costs of abatement (see Box 8 for details).

Individually transferable quotas (ITQs) are essentially tradeable permits in the fisheries sector. They are assigned to fishworkers according to their historic catch, or by auctioning, and then traded.

Deposit-refund Systems involve a deposit paid on potentially polluting products. If products are returned to some authorised collection point after use, thus avoiding pollution and enabling re-use/recycling, a refund is paid (see Box 9 for details).

Performance Bonds are similar to deposit-refund systems and require the payment of a performance bond or security deposit by a mining, logging or other development firm. If activities conducted by these firms do not comply with environmentally acceptable standards (land reclamation, wetland protection etc) then any clean-up or restoration costs are paid for out of the bond/deposit (see Box 9 for details).

4.8 Emission Charges

Case Study: Combined Effluent Fee-Standard System in Malaysia

In 1975, the production of crude palm oil had emerged as Malaysia's worst source of water pollution, equivalent to the waste generated by 10 million people: almost the entire population of the country. In 1978, the newly established Department of Environment set maximum pollution discharge standards in terms of BOD (biological oxygen demand), but compliance was not compulsory. This gave factories sufficient lead time to develop and commission waste treatment systems. However, to push the industries along in this direction, a small fee was levied for effluent discharges above the prescribed maximum level. This was M$100 per tone of BOD load above 5000 ppm. In addition, a licensing system was introduced for all factories discharging effluents. The licence fee was also M$100 per tonne of BOD load, even below the prescribed limit. This gave factories an incentive to reduce their waste discharges as much as possible.

Box 6: **Emission Charges**

Basic Aims and Advantages	Best Practice Conditions	Environmental Media Relevance	Limitations
savings in compliance costs dynamic incentive effect revenue raising potential flexible system	stationary point-pollution variable marginal abatement costs between polluters monitoring of emissions is practicable potential for polluters to reduce emissions and change behaviour potential for technical innovation	water – high air – medium waste – low noise – high	limit on number of pollutants that can be covered monitoring problems distributional effects when revenue raised is earmarked, a coherent allocation system is required

Source: Turner et al, *1994.*

Fees could be waived in return for the conduct of waste treatment research. This resulted in some break-throughs in palm-oil effluent treatment technology. During the second year of implementation (1979), the maximum pollution level was reduced to 2000 ppm and compliance was made mandatory. Licence fees continued to be calculated in relation to the volume of BOD discharged. By 1984, effluent discharges had been reduced to the target level of 100 mg/l. In addition to the use of the polluters pay principle, the following factors played an important role in the success of the Malaysian programme:

a regular dialogue and consultation with industry in formulating and implementing regulations,

b an uncompromisingly firm yet fair attitude in enforcing regulations; and

c fostering the development of waste treatment technology by co-operation between government, industry, universities and research institutions.

Following the success of the system with palm-oil industries, rubber industries were also covered by the same effluent charge system. The economic effect of the system on the palm oil industry has been minimal. According to Rahim (1991) the Malaysian palm oil export sector "lost only 5% of the value of output as a result of environmental regulations from 1982-86 that reduced allowable BOD discharges by 90%. The crude palm oil sector lost less – only about 1% of the value of production... despite the highly competitive world palm oil market". In contrast, Rahim found large losses among the primary input producers, the oil palm plantation sector, which bore over two-thirds of the total welfare losses of the industry. Although evidence for this has not been collected, imposition of the charge on BOD load rather than volume of discharge can potentially lead to problems. It can provide an incentive for some firms to dilute their effluent to avoid the charge, without actually reducing the total BOD load entering the river. Another problem with the system is the implicit incentive for inter-media substitution from water to land due to the lower level of charges for BOD discharge to the latter.

The system is still in effect but has apparently lost part of its original rationale (to promote waste treatment facilities) and its potency. With treatment facilities becoming a licensing requirement and standard feature of palm oil mills, the basic charge is no longer enforced. The excess fee for effluents above the standard is still enforced but it is so low that it no longer acts as a compliance incentive: some mills find it more advantageous

to pay the excess fee rather than treat their effluent sufficiently to meet the standard.

Source: ESCAP, 1990, Panayotou, 1995b and Vincent, 1993.

Case Study: Nitrogen Oxide Charge on Energy Production in Sweden

In response to widespread damage from acidification of soil and water in Sweden, a charge of SEK 40 per kilogramme of nitrogen oxide emitted was introduced in 1992 for combustion plants with a capacity of 10MW or more. This covered the energy supply industry, pulp and paper manufacturers, chemical and metal industries, and the waste sector. The revenue generated by this scheme was redistributed back to the plants in accordance with energy production, i.e. it was not related to nitrogen emissions. Hence the incentive remains for plants to reduce the tax base of emissions of nitrogen oxide by installing de-NOx equipment. However, the revenues could be redistributed in a manner which is unrelated to both emissions and energy production. This would provide an incentive to reduce pollution both by cutting back total demand for energy, and by installing equipment to reduce emissions from the energy required. The scheme could have established more efficient incentives, but did not because this would have decreased the political acceptability of the project.

Nevertheless, the scheme was very effective in reducing emissions. The parliamentary decision was made in 1990, at which point many firms invested in the relevant equipment, and by the time the tax was introduced in 1992, emissions had already been cut by 35%.

Source: Olivecrona, 1995.

Case Study: The Potential Benefits of An Effluent Charge to Control Industrial Pollution in Sri Lanka

A key environmental problem in Sri Lanka is the quality of water supply. Industrial concentration around Colombo, with the associated pollution discharges, coincides with the areas of highest population density. Large industries exploit groundwater supplies and government command and control regulations concerning waste water treatment are difficult to monitor and enforce. The Government could place a charge on effluent discharge from industrial sources. This requires information on both waste water flow and pollution concentration. It could monitor pollution levels in emissions, and could estimate approximate waste water flow based on likely industrial need. The burden of proof for the flow could be laid on the industry: either install a flow monitor or accept the government approximation. Depending on the level of charge, this scheme could create incentives for firms to reduce overall water use, and reduce pollution discharged per unit of water used. More recycling of water would occur. The charge will also generate large amounts of revenue: estimated to be $12 million per year based on current estimates of the charge and effluent discharges, although this does not account for the reduction in discharge that will occur as a result of the charge.

The revenue could be re-distributed in many ways:

- Reduced corporate tax rate for water use
- Interest free loans to corporate sector to invest in pollution abatement equipment
- Lower income tax rates
- Higher cut off point for tax exemption

No decision has yet been taken by the Government on the proposed scheme. It is thought to be politically unpopular.

Source: Steele et al, *1995.*

Issues:

1 Which income group benefits most from reducing water pollution? Which groups will pay the costs?

2 What difficulties is the Sri Lankan Government likely to face if it decides to go

ahead with this instrument? Which of the revenue redistribution options would best limit these difficulties? Could any of the options make the scheme a political success?

Case Study:
1996 Landfill Tax on Waste in Britain

Waste disposed of in landfill sites can be environmentally damaging. As materials break down, they emit some pollutants, notably methane, and may also form leachate which pollutes groundwater supplies. The British Government has recently introduced a £7 tax per tonne of organic waste deposited to reflect this external cost, and a £2 tax on inert waste. The Government announced two mechanisms to allocate the tax revenues: (1) reducing National Insurance contributions paid by employers and (2) contributing to local environmental trusts set up by local communities to improve environmental quality. The effects of this system on the amount and type of waste disposed of in landfills, employment and local environmental quality remain to be seen.

Source: for initial discussions Turner et al, *1995. The above is taken from various press releases by the Department of the Environment.*

Issues:

1 An emissions tax is a charge on each unit of emission released into the environment and equates to the damage each unit of emission will inflict. In the landfill context this would involve charging per unit of leachate and methane released from the site. Why was the deposition of waste at the site chosen as the tax base, rather than emissions?

2 The Government choose to re-cycle the revenue to employers to generate jobs. Were wealth re-distribution its prime concern, how else could the money be used? As it stands, what is the likely net impact of the tax on poor people?

Case Study:
Threatened Tax for Emissions in the Mining Sector in Chile

Exxon expanded an open-pit copper mine, which required the stripping of a very large tonnage of material. Before the development, the Chilean Government threatened Exxon that it would be taxed for any water treatment costs resulting from the expected acid contamination from the low grade material dumped in a local water source. The pressure from this threat resulted in Exxon investing in a new bacterial leaching project. The low grade ore, it was treated and the copper removed. The process turned out to be profitable due to the recovery of copper which was previously lost. The example demonstrates the potential economic benefits of building environmental controls into a mining project and is often referred to as a 'win-win' benefit.

Source: Warhurst, 1993.

Issues:

1 It may cost the government very little to threaten polluters with a tax, whereas an actual tax can be administratively costly. However a real tax generates revenue. What determines whether a government can achieve the desired result by threat of a tax rather than actually imposing the charge?

4.9 Product Charges

Case Study:
Taxes on agrochemical inputs in Iowa, USA

The use of chemicals (fertilizers and pesticides) in agriculture pollutes groundwater supplies and soil and may leave residues in food. Charges based directly on chemical or pesticide emissions are too difficult to construct; hence, a tax on the purchase of fertiliser or pesticides can be used. This is a useful policy option and it works well if there is a strong link between the tax base (fertiliser/pesticides purchase) and the pollutant (chemicals). The tax provides an incentive to reduce fertiliser/pesticide use and it is hoped that

Box 7: **Product Charges**

Basic Aims and Advantages	Best Practice Conditions	Environmental Media Relevance	Limitations
reduce use of products and/or stimulate product substitution incentive effect revenue raising flexibility potentially applicable to diffuse (non-point) and mobile pollution sources	products used in large quantities or volumes identifiable products price elastic demand for selected product substitution possibilities adapt to existing administrative and fiscal systems	water – medium prospect air – high, especially for fuels waste -high noise – medium, no practical system as yet	not applicable to hazardous waste (ban is preferable) low elasticity and substitution possibilities seriously inhibit the effectiveness of the instrument trade and competitiveness implications potential administrative constraints

Source: Turner et al, *1994.*

this will lead to less chemical pollution.

In this example, the fertiliser purchase tax was set at a very low level: $0.75 per ton. This reflected concerns about the impact on farming competitiveness. Revenues collected were earmarked for educational funds to teach farming communities about nitrogen application. Nitrogen use per acre fell in Iowa by 14% between 1988 and 1991. It is interesting to speculate on the extent to which this was the result of the tax or the educational programme that tax revenues funded. Farmers, following agents' advice, may have been simply applying excessive quantities of fertiliser in the past, a situation easily rectified by the educational programme and not so much by the incentive provided by the input tax. This is a good example of the importance of utilising the revenues raised by a market-based instrument.

Source: Wexler, 1995.

Issues:

1 Product charges proxy emissions charges. What determines how effectively the proxy instrument works?

2 Iowa farmers were concerned that a sizeable fee would significantly affect their interstate and international competitiveness. Would the size or the distribution of these costs be different if, instead of an MBI, the state government adopted a command and control approach, e.g. limiting by law the chemical composition of all bags of fertiliser?

Case Study:
Traffic Control in Singapore

The financial disincentives adopted in Singapore to discourage car ownership include the following:

High import duty on cars: The import duty on imported cars has been 45% of the open market value, net of retailer's margin since 1972.

Additional Registration Fees (ARF): ARF is in addition to the import duty set as a percentage of the cost of the car. The tax was 100% in 1976 and 150% after 1993. In 1994, basic registration fees were S$1,000 for private cars and S$5,000 for company cars.

Preferential Additional Registration Fee (PARF): ARF is moderated by application of PARF since 1975. ARF is reduced if an old vehicle is scrapped when a new one is purchased. The intention is both to discourage older, more polluting vehicles and to restrict the second-hand car market.

Certificates of Entitlement (COE): under a quota system introduced in May 1990, certificates are required in order to purchase a car. The government announces how many new cars each month it will allow to be registered, and poten-

tial buyers make a bid. In order to avoid speculation, secondary trading in them is prohibited.

Annual Road Tax: This is linked to the engine size and ranges from S$0.7/cc for engine size less than 1000 cc to S$1.75/cc for engine size greater than 3000 cc.

Although effective, the above disincentives are targeted at the ownership of cars whereas the environmental problems related to road transport arise from the use of cars. The *Area Licensing Scheme (ALS)*, established in 1975, is a programme to reduce the use of private cars in the Central Business District (CBD) and its surrounding area. The car owners wishing to travel to the CBD during morning and afternoon peak times have to purchase a daily or a monthly licence. The scheme is enforced by visual inspection at 25 entry points to the restricted zone. At the beginning, car pooling was exempt from the ALS. However, due to difficulties with monitoring, this exemption was abandoned later on. The system is to be improved and extended by the adoption of electronic enforcement mechanisms.

The effect of all the above measures on car ownership and use has been measured in many ways. The number of persons per car actually increased in the years 1975-77, after the introduction of ARF, and in 1986, coinciding with the brief economic recession of 1985-86. The number of licensed cars in 1992 was 32% less than that forecasted without the restraints. The pattern of commuting changed from 46% in public transport, 43% in private cars and 11% in other vehicles in 1974, to 63% in public transport, 22% in private cars and 15% in other vehicles in 1988. Inbound traffic in the restricted zone declined by a daily average of 28% after the 1989 revisions. The average daily decline for outbound traffic was 21%.

Sources: Buchan, 1994 and Olszewski et al, *1993*

Case Study:
A Product Charge on Leaded Petrol in Britain

Lead emissions from petrol engine cars have been linked with adverse human health impacts. In 1989, the Government set an excise duty on unleaded petrol some 3 pence per litre lower than leaded petrol. By 1994, this differential had increased to nearly 5 pence per litre. Since value added tax (VAT) is calculated on price inclusive of excise duty, VAT on unleaded fuel also fell. The product charge was very effective in reducing lead emissions since consumption of leaded petrol is directly linked to emissions of lead. Also, leaded and unleaded petrol are 'close substitutes' – people could easily switch from one to the other. Hence, the small fiscal incentive had a big impact on leaded petrol sales and consequent lead emissions. In 1988, 95% of motorists bought leaded petrol. By the end of 1989 that figure had fallen to 72% and by 1993 it was 47% (most motorists still using leaded petrol had cars that could not be converted to run on unleaded fuel). Emissions of lead fell by a similar proportion during this period.

Source: Rajah and Smith, 1994.

Case Study:
A Product Charge on Leaded Petrol in Taiwan

The Chinese Petroleum Company of Taiwan has supplied unleaded gasoline since 1984. In 1988, due to a differentiated tax, unleaded gasoline was NT$0.6/litre cheaper than leaded gasoline. The price differential was widened to NT$1/litre in 1989. The goals for promoting wider use of unleaded gasoline are to reduce the lead content of leaded gasoline from 0.12g/l to 0.08 g/l by July 1993, and to 0.0026 g/l by July 1997; to increase market share of unleaded gasoline to 82% by 1997; and ensure that all vehicles run on unleaded gasoline by January 2000. Since 1992, all new cars must use unleaded gasoline and comply with new emission standards. The market share of unleaded gasoline has increased rapidly from 19% in 1990 to 52% in 1993. Monitoring reports by the Environment Protection Agency indicate that the average lead content in ambient air in Taipei decreased from 0.46g/m3 in 1989 to 0.18g/m3 in 1992.

Source: Pan, 1994.

Issues:

1 Lead emissions per litre of petrol sold is reasonably constant across different vehicles of different ages. The product charge proxies emissions closely. This is not the case with small particulate matter and nitrogen oxides. What other market-based instruments might be more effective at reducing these pollutants?

2 Why did Britain and Taiwan choose to reduce the tax on unleaded fuel rather than increase the tax on leaded fuel?

Case Study:
The Potential Benefit of A Diving Fee for Tourists in the Bonaire Marine Park in the Caribbean

The Bonaire Marine Park attracts scuba divers from all over the world. However, increasing ecological damage is being done to the coral reef. Economic instruments – namely a site entrance/diving fee – can be shown to both increase the effective carrying capacity of the site, by generating incentives to allow divers into the water but with less environmental damage, and generate income. This is simply a product charge, where the revenue generated pays for the park's management, and ensures that a larger share of the economic benefits remain within the Bonairean economy.

The current approach to development in the island is based on the assumption that since the benefits which accrue to the economy of Bonaire from each tourist are relatively small, increasing the volume of tourists would increase total benefits to the economy. However, it is increasingly feared that this policy is unsustainable.

A study team of ecologists and economists sought to find out how the benefits to the island could be maximised in the long term. The ecologists estimated that only 4500 dives should be allowed every year in order to conserve the reef. The economists, using a CVM technique, suggested that an undifferentiated fee of some $40 a dive would be sufficient to attract only 4500 dives a year. A current fee of $10 a dive was attracting some 18,700 dives per year.

The ecologists suggested that less damage would be done if the dives were spread out over the year rather than concentrated in one season. If all the 4500 dives took place in a short period of time, i.e. during the height of the summer, then the ecology of the reef would be damaged more than if dives were less concentrated.

The fee could therefore be differentiated by the season. A fee during the height of the tourist season would be significantly more than during the low tourist season. Depending on the level of fees chosen, the revenue generated by the differentiated scheme would be broadly similar to that collected under the undifferentiated scheme, but less environmental damage would be done.

Source: Dixon et al, *1993.*

Issues:

1 The damage to the coral reef per dive is not the same across all dives. How effective would an undifferentiated diving fee be?

2 Who gains and who losses from the fee?

Case Study:
Royalties in Forestry Sector in Malaysia

Although forestry is a major source of income for the Malaysian economy, the ability of State Governments to capture a sizeable part of the rents in the sector varies. Royalties assessed on extracted volume constitute between 17% and 90% of the total forest revenue collected in the various states. Royalties vary by species or species groups and by State; however, they remain uniform within each State.

It is generally believed that the State of Sabah captures one of the highest levels of rent, which ranged from 46% to 81% in the 1966-89 period. The range of variation reflects the uncertainty in the data base and the fact that records of buyer and seller countries provide different figures. By comparison, only 6-14% of total rent is captured by the State of Peninsular Malaysia.

Although the rate of rent capture is important, its effect is more profound when coupled with the period of concessions. If the period of a concession is relatively short, and rent capture is high and expected to be even higher in the future, the logger will have an incentive to harvest the forest as fast as possible. On the other hand, stable rents coupled with longer term concessions would provide an incentive for more stable and sustainable harvesting rates.

The National Forestry Council has recently acknowledged this and agreed to the proposal by the Federal Government that logging concessions should be on a long-term basis, as has been the case in Sabah and Sarawak. It has been agreed that concessions (of a minimum of 9000 hectares) should be granted for a minimum of 30 years with an option to extend them by another 30 years, subject to good performance of the concessionaire.

4.10 Marketable Permits

Case Study:
Using Marketable Permits in New Zealand's Fisheries

Until 1978, New Zealand's fishing industry was an 'open access' regime. This was coupled with a Government policy to encourage investment in the industry through a variety of fiscal measures. This resulted in over-fishing and major stock depletion.

In 1978, the Government introduced some controls to restrict entry for some types of fishing, but it unfortunately did not restrict the amount of fish that licensees could take. Stocks continued to decline.

In 1983, the government introduced an *individual transferable quota (ITQ)* scheme. This was designed to create property rights and, as long as the Government set a prudent total allowable catch, would create the incentive for an efficient and sustainable fishing industry. The authorities freely distributed quotas among fishworkers, based on historical catch, and each quota allowed a fixed tonnage of fish to be taken. All the quotas taken together equalled the total allowable catch judged by Government marine experts to be sustainable. A comprehensive administrative system was installed which allowed the Fisheries Board to monitor fishing from the catch through to sale to retailers. The amount of information on stocks and fish demand available to the marine experts improved dramatically.

Box 8: **Marketable (Tradable) Permits**

Basic Aims and Advantages	Best Practice Conditions	Environmental Media Relevance	Limitations
savings in compliance costs	differences in marginal compliance costs	water – low	limited applicability to more than one pollutant simultaneously
can encompass effect of economic growth	maximum ambient pollutant concentrations are fixed	air – high	pollution 'hotspots' may be exacerbated
flexibility	number of polluters large enough for market to form and operate	waste – low	initial allocation of permits requires careful consideration
international pollution abatement	better applied to fixed pollution sources	noise – low	administrative complexity
	potential for technical innovation		high transaction costs if there are many polluters
			low levels of trading of permits in the existing US systems

Source: Turner et al, *1994.*

But in early 1989, it was clear that certain key stocks were declining rapidly. Too many quotas had been distributed in 1983. The Government therefore decided to reduce the TAC and compensation had to be paid to fishworkers. The change proved to be politically difficult. The risks transferred from the government to the industry, but as a result of a lengthy and bitter dispute, the government was forced into paying the fishworkers significant amounts of compensation.

Some 80% of quotas have changed hands since 1983. About 10 major holders now own around 80% of total quotas. Laws prevent any one owner from having more than 35% of quotas.

Despite many other complicating factors, this scheme has enabled the Government to keep a tight control on fish stocks. Large amounts of information are now available which enable it to effectively control the total available stock. While the scheme has proven to be successful in New Zealand's domestic waters it does not apply to international waters. Since other countries are able to fish freely in these waters, New Zealand fishworkers have no incentive to lower their takes.

Source: Clark, 1991.

Case Study:
Using Marketable Permits for Fishing in Australia

In the mid-1980s, Australia and Japan entered into an agreement which divided the southern bluefin tuna fisher and introduced an individual transferable quota (ITQ) scheme. In the two years following the start of the ITQ system for that fishery, the number of boats in use dropped by 50%. Researchers estimated that the capital so employed in the boats was $10-12 million less than under other management schemes. The system also encouraged catches of larger, more valuable specimens; the value of the catches increased by three to four-fold. Highly esteemed by sushi diners, a premium bluefin can sell for between $6,500 and $11,000 at auctions in Tokyo.

A general question, which applies to other countries, is whether a monopoly would be likely to take over commercial fishing under an ITQ system? Thus far, this seems not to have occurred. When such concentrations appear likely, governments could make use of antitrust laws, impose taxes, place limits on quota transfers and levy user fees on windfall profits.

Source: Resources for the Future, 1996.

Case Study:
Using Marketable Fishing Permits in Bangladesh

Bangladesh has tried a number of different MBI approaches to manage open access inland fisheries known as *jalmahals*. The earlier policy was a leasing system based on yearly auctions to the highest bidder. This failed to reduce rent dissipation and open access since the licensees were non-fishing middlemen who then collected tolls from fishworkers that could be as much as one-third of the gross catch. These middlemen rigged the auction to keep prices down and the short period of licences, with no assured renewal, led them to maximise revenue by allowing as many fishworkers as possible to fish. In 1987, the New Fisheries Management Policy was introduced to redistribute the fishery rents to actual fishers by a licence system for fishworkers. The licence fee is set to cover administrative costs. This scheme has proved much more popular with fishworkers who now have incentives to self-regulate against entry by non-licence holders.

Source: Siddiqui, 1989 and Naqi, 1989.

Issues:

1 In New Zealand, the quota scheme has worked well in domestic waters. The Government has no incentive to extend the scheme to international waters because any self-restraint on New Zealand's behalf is profit to other countries. How should international fish stocks be protected?

2 The efficient solution offered by tradable permits assumes that the permits are freely traded in an open market. However, despite concerns about equity, economic theory

shows that were a monopoly present, MBIs are still useful as long as the gains to society from reducing fishing are larger than the costs to it from a monopoly preventing competition. Would a command and control type of regulation which limited the size of fishing vessels be any better?

Case Study:
Using Tradable Water Rights in Chile

Chile has both a system of tradable water rights and pricing at marginal cost. Individuals are granted perpetual, irreversible and freely tradable water use rights independent of land ownership and use. Water use rights are defined for a fixed quantity per unit of time and are awarded following application by a potential user. The General Director of Water grants the water right provided that (a) the new water right does not impair any existing rights and (b) an ecological threshold for the volume of water resources is not exceeded.

Water rights are freely tradable and the market is quite active. Seasonal water rentals are particularly frequent within the agricultural sector. Individual negotiations determine the price of each transaction.

The system allows demand management to accommodate growing water scarcity. Water users receive a price signal indicating the true opportunity cost of water and are thereby induced to adopt conservation measures. However, unregulated water markets may fail to internalise externalities such as minimum flow requirements, water quality changes, return flows and watershed protection which requires integrated watershed/river basin management. To deal with these externalities, a number of proposals are being considered including: (a) charges for new water rights; (b) a 5 year limitation or an annual charge for unused water rights (varying according to regional water scarcities); (c) guarantee of an ecological minimum water flow by the regulator and (d) the establishment of watershed management corporations to resolve intersectoral water use conflicts, and improve water quality management and watershed protection, all of which are expected to be self-financing.

Source: Panayotou, 1995b and Hartje et al, *1994.*

Issues:

1 What are the pros and cons of each of the four proposals suggested to internalise externalities such as watershed management?

2 How can water be priced more efficiently without hurting poorer income groups?

4.11 Deposit-Refund and Performance Bond Schemes

Case Study:
Deposit-Refund Scheme in the Republic of Korea

The purpose of the deposit refund scheme is to promote the use of returnable packaging and thus reduce the amount of waste. Prior to the introduction of a Government scheme, a market-based deposit refund scheme existed for glass bottles in Korea. It was designed to promote the re-use of glass bottles. Consumers deposited 6-25 US cents for each purchase of bottled beer and soft drinks. The deposits were refunded when the empty bottle was returned to retailers. The average recycling rate on beer and soft drinks bottles was approximately 90%.

The Government-initiated system was introduced in 1991. It is very different from the private scheme in that the responsibility for collecting and treating waste is assigned to producers. The producers of the product are required to deposit a certain amount of money for each unit sold. The size of the deposit is generally quite small. Once producers have safely treated the waste, their deposits are refunded. When items covered by the deposit refund scheme are not treated or recycled, the deposit stays with Government and can be used to finance recycling projects.

The deposit refund scheme covers five items which are either hazardous or generate large

Box 9: **Deposit-refund Systems and Performance Bonds**

Basic Aims and Advantages	Best Practice Conditions	Environmental Media Relevance	Limitations
Safe disposal, refuse or recycling of products and sustainable utilisation of natural resources **flexibility** **rewards appropriate behaviour**	hazardous or difficult components of the waste stream causing disposal problems markets for recyclable materials exist cooperative arrangements between producers, retailers and users development contracts allowing for performance bonds to be paid	water – low air – medium waste -high noise – not applicable	logging and mining – high set up costs, distribution and refilling costs for deposit refund systems possible trade implications difficulty in monitoring performance for performance bonds

Source: Turner et al, *1994.*

quantities of waste after being used by consumers. The policy objectives of the system are to promote recycling (e.g. bottles, cans etc) as well as ensure safe disposal of hazardous wastes (e.g. batteries, lubricating oils etc).

Table 7 shows the empirical data available on the government scheme. The second year of implementation produced a much larger refund rate. The scheme is generating significant revenue. In 1993, Won 28.4 billion (US$ 35.9 million) had been deposited, and only 8 per cent was refunded.

The refund rates on batteries and lubricating oils are relatively high, but those for insecticide and containers are still low. This discrepancy in rates results from a number of factors, including the relative difference between refund and producer cost, the ease with which final consumers can return waste, and familiarity with the scheme.

Source: Hoe-Seog Cheong, 1996

Issues:

1 How could the Government increase the environmental effectiveness of the scheme? Could it both increase government revenues and improve the effect on the environment?

2 Why did the market scheme resulted in a much higher return rate than the government scheme?

Table 7: **Deposit – Refund Systems in Korea**

	1992 – million Won			1993 – million Won		
	Deposits	*Refunds*	*Refund Rate (%)*	*Deposits*	*Refunds*	*Refund Rate (%)*
Food, cosmetics, soft drink containers	16,481	238	2	17,365	261	1.5
Batteries	1,069	23	2	1,100	587	53
Tyres	1,792	–	0	1,415	583	41
Lubricating oil	2,738	39	1	2,591	796	31
White goods (e.g. refrigerators)	3,592	–	0	3,496	1	0
Insecticide	1,732	–	0	2,458	2	0
Total	27,406	300	1	28,425	2,230	8

(Note: 1000 Won=US$1.25)

Case Study:
Deposit-Refund Schemes in Denmark

Denmark's scheme has been remarkably successful in promoting the use of returnable beverage packaging, thus reducing the amount of packaging waste. Approximately 99.5% of bottles are returned, with each bottle making an average of 33 trips.

Danish legislation allows only carbonated soft drinks and beers in returnable packaging to be sold in Denmark. Until recently, the deposit between bottler and retailer, and between retailer and consumer, has been the same. But some retailers, who returned more empty bottles than they received from the bottler, complained that they were not being compensated for the additional handling costs.

The scheme costs the Government very little, as it is almost entirely implemented by the private sector. However, the scheme does have negative aspects. It places a great burden on the retailer with respect to handling and storage. At least some of this burden is passed on to the consumer in the form of higher prices. The costs of running the scheme have never been estimated. The scheme only covers certain products: carbonated soft drinks and beer, but not milk. The rationale for this is not clear.

Source: Brisson, 1993.

Issues:

1 Denmark has a long tradition of voluntary re-cycling schemes, and the Government introduced the measures without opposition. What in practice may limit the ability of a government to introduce such a scheme?

2 Compare this scheme with the Korean scheme. Why has this scheme been so much more successful?

Case Study:
Deposit Refund System in the Maldives

The littering of beaches with beverage containers can become a problem, especially in the outer islands of the Maldives as tourism expands. A private company producing beverage containers has been implementing a deposit-refund system voluntarily, which covers tourist resorts, retailers and households in Male, the capital. The system has not been as effective in outer islands since transport to the bottling plant has proved too costly for small retailers. Tourist resorts are less affected by the transport costs due to the large scale of their purchases and their need for regular travel to buy other supplies.

There are two other threats to the success of the deposit-refund system: imported aluminum cans and plastic bottles. An earlier attempt to collect the former and export it has failed due to the importer's withdrawal. Although the price of glass bottles net of the deposit is lower, difficulties with the return of glass bottles may lead to a switch towards cans and plastic bottles.

Issues:

1 What kinds of pricing measures can be used? What would be the likely effect of imposing an even higher deposit or a tax on cans and plastic bottles?

Case Study:
Performance Bonds in Australia

Successful rehabilitation from a mining scheme begins at the beginning of the project and not the end. This system requires the mining company to deposit a sum of money in the form of a bond with the mining ministry at the beginning of the project. The sum is returned if the company complies with regulations concerning rehabilitation on the basis of explicit environmental criteria during the operation phase.

The details of the schemes vary. Some are more tailored to site requirements than others, and also vary in the terms and conditions of penalty clauses. Without such a bond, Australian mining firms cannot get an operation or exploration licence. There appear to be little data on their effectiveness to date. But the level of compliance seems to be high.

Source: Brisson, 1993.

Issues:

1 In what other sectors of the economy could deposit-refund/performance bonds be introduced?

4.12 Subsidies for Environmental Improvement

Subsidies to induce environmental improvement are rarely justified but may be used when it is necessary for transition to a new regime of pricing. Whereas an environmental charge is placed on the good generating the pollution, a subsidy is given to a technique that does not generate as much pollution. For example, if a particular method of processing coffee generates a great deal of water pollution, while an alternative technique produces less pollution, but at higher cost, this more expensive technique can be subsidised so as to tempt producers away from the other more polluting technique. Whenever subsidies are needed, it is crucial to select the most cost-effective type of subsidy. This depends on the subsidy vehicle, size of the subsidy and length of the subsidy. Generally, price subsidies are least efficient, while subsidies for training and investment in technical efficiency are the most cost-effective. Whatever their type, subsidies should be a short-term measure as this creates incentives for private producers to become commercially viable. Subsidies should not cover the entire costs of the activity. Complete subsidies become an easy source of funds rather than incentives for a certain action. These types of subsidies can quickly become a source of government failure as discussed earlier. Subsidies should be targeted to the groups who are most in need of them and who can use the subsidy to achieve better environmental performance in the most effective manner.

4.13 Environmentally Friendly Subsidy: Some Examples

Small-scale tree planting for community forestry or village woodlots that supply local domestic demands for fuel are rarely profitable without government support. Any subsidy must be carefully targeted, as free distribution breeds indifference and over-use. The West Bengal forest department has successfully subsidised household seed banks that have combined environmental aims of raising 15,000 seedlings with providing landless farmers with Rs 3,000 per household. The government also set up a committee of local people who, in exchange for protecting forests from poachers, are collectively entitled in total to 25% of net sales of timber.

Source: Roy, 1994.

India has reduced excise tax on pollution abatement equipment from 25% to 15%. It has also increased depreciation allowance from 30% to 50%.

Source: World Bank, 1991.

In Taiwan, all pollution control equipment (including parts and components), upon proof of application, is exempt from import duties. Domestic manufacturers who have invested more than NT$600,000 in the installation of pollution control facilities or technology during a fiscal year are eligible for a 20% tax reduction on the overall installation costs incurred. Overseas manufacturers are eligible for tax reductions on the transfer of pollution control technology.

Source: Pan Tin-Bai, 1994.

Much of the environmental damage caused by small-sale mining is because of the primitive techniques used, such as the inefficient use of mercury in gold mining. This damage could be reduced by appropriate subsidisation of capital for new techniques. In Mexico, lower-interest rate credit facilities for small-scale miners are provided by the government with the support of multilateral lending institutions.

Source: Proops et al, *1993.*

In Costa Rica, loans have been made available for ecological projects such as the provision of new technology for coffee processing. These loans have an interest rate 2% below the rate for current agricultural lending.

Source: Segura, 1993.

Issues:

1 What precautions should be taken to avoid environmentally friendly subsidies turning into government (policy) failures?

4.14 Property Rights Reform

It can be argued that the lack of ownership of many environmental assets creates the precondition for market failure discussed above. Indeed, many economists would attribute 'market failure' to the absence of property rights. If ownership of an asset does not exist, this open access resource can be used by anyone, at any time, and for any purpose. So long as the uses and the technologies employed do not impinge adversely on each other or on the well being of future generations, economic scarcity does not arise and no issue of management per se arises (Convery, 1995). But the rationale for environmental management rests fundamentally on the point that for many assets economic scarcity now exists. The number of users and their value systems and technologies are such that, if these assets remain as open access resources, they will be destroyed (Convery, 1995). The following is a summary of ownership systems, each of which can lead to market failure:

Open access: There are no defined users or owners. Under an open access regime, there is no incentive for any one user to protect the resource unless all the users protect it.

Common property: A management group has the right to exclude non-members. Non-members have a duty to abide by the exclusion. Co-owners comprise the management group and have rights and duties with respect to the use of resources. Many argue that local communities best understand their own environment and are best capable of managing natural resources in a sustainable way. There is evidence which shows this to be the case. There is also evidence to show that community management can fail when: (1) there is high population growth which puts pressure on existing resources, and (2) technology induces overuse of resources.

State property: Individuals have a duty to observe the rules of resource use determined by the controlling agency. For state ownership to work efficiently, the state must be able to monitor the use of resources, establish rules acceptable to individuals and communities, and enforce those rules. Typically, this has not been the experience with state ownership.

Private property: Individuals have the right to undertake socially acceptable uses, and the duty to refrain from unacceptable uses. Others have the duty to respect individual rights. This is likely to conserve the resource since the owner would be able to receive the benefits of conservation. However, markets will still be unable to account for externalities as discussed above.

Once property rights are defined, ensuring that the land is used in a sustainable manner becomes the next priority. This is particularly important for biodiversity conservation. For ecological and economic reasons, it is more cost effective to conserve habitats rather than species. Hence, biodiversity conservation becomes a land-use issue. The idea of tradeable development rights is based on the practices adopted in the UK and the USA. In the UK, conservation agencies buy land or buy rights to use the land; specify the conditions of use of land by excluding environmentally damaging activities; and resell or rent the land with these restrictions attached. This is known as covenant or easement. The practice in the USA is similar.

Tradable development right schemes can be effective instruments in sensitive areas threatened by development. The owners of land in conservation areas are permitted to exercise their development rights ex-situ – in another area designated for development. Alternatively, they may sell these rights to the highest bidder. In this manner, society benefits by preserving environmentally sensitive areas without depriving their owners of their legitimate rights, and without paying astronomical sums in compensation.

Case Study:
Property Rights to Land and Productivity

Migot-Adholla *et al* (1991) provide the most comprehensive investigation of the impacts of property rights system on productivity in Africa (referred to in Convery, 1995). The study surveyed 940 households practising rainfed agriculture in Ghana, Kenya and Rwanda during 1987-88. Data on the socio-economic characteristics of households and the parcels farmed by them were gathered including how the land was acquired and what rights the household could exercise. The following taxonomy was used:

Limited transfer. No permanent transfer of alienation rights. May have temporary transfer privileges.

Preferential transfer. May be permanently transferred but only within the family or through gift or bequest.

Complete transfer. May have the right to sell, i.e. private property right.

The evidence from Ghana and Rwanda supports the hypothesis that increased population pressure and commercialisation increase the extent of privatisation of property rights. To test the relationship between land rights and land productivity using parcel level data, they estimated regression equations relating yield to a vector of household, parcel and land characteristics. The authors found no relationship between land rights and productivity in Ghana and Kenya. In the case of Rwanda, they found that short-term use rights (mainly rented land) were more productive than parcels in all other land rights categories. No significant relation was found between the use of formal credit and the proportion of land held with private property rights. In Rwanda and in one region of Ghana, a positive relation existed between investment in improvements and the extent of land rights.

These African findings are in sharp contrast to those recorded in studies of the effects of a World Bank-supported land titling programme in Thailand. Angus-Leppan (1989) carried out statistical analysis ex-post. Table 8 shows the categories of land analysed and changes in the annual yields as a result of titling.

Table 8: **Impact of Land Tenure on Production in Thailand**

Property right	Production (Baht/Rai)	Annual Increase Yielded by Titling (%)
encroached state land (state)	998	18.9
undocumented land (open access)	1,020	16
certificate of utilisation	1,122	5.4
Title deed (private property)	1,183	0

Source: Convery, 1995.

Issues:

1 How do you think the striking gains achieved in Thailand and their absence in the three African countries can be explained?

Case Study:
Failure to Assign Property Rights and Share Revenues Equitably in Ecotourism – the Galapagos Islands, Ecuador

The Galapagos Islands of Ecuador are an example of state management of an open access ecotourism site. The islands are situated about 1000 km off the South American coast and have been the concern of naturalists due to their species endemism since Darwin's first visit in 1835. The Ecuadorian government declared the Galapagos a National Park in 1959, which now covers 92% of the 8000 km2 land area. The rival economic activity to ecotourism is agriculture.

The Government bans substantial tourism infrastructure development on the Islands. Visitors have to eat and sleep on the cruise ships which transport them around the Islands. The park authorities charge large tour boats a concession fee and regulate prices, service quality, itineraries and boat capacity. In addition, the Government also charges a $40 park entrance fee for foreigners and $6 for Ecuadorians.

Despite these regulations, state management fails to establish sustainable tourism, because:

i There is no effective control on the total number of tourists visiting the Islands, which has increased dramatically with the opening of the second airport in 1986.

ii Only 25% of the park revenues are kept by the Galapagos park authorities to pay for the park guards and three patrol boats. Moreover, research showed that the entrance fee can be increased to over $500 without decreasing the number of tourists substantially.

iii Due to the ban on tourism development on the Islands, the local community earns very little income from tourists. Nor does it receive a share of the park revenues.

Particularly as a result of the last failure, the local population is switching to agriculture as an income earning activity. The problem is that agriculture poses an even greater threat to the endemic species than tourism. Research shows that 12 endemic species of plants will become extinct if agricultural activities expand at the rate they have until now.

The Government could take the following steps to make tourism more sustainable:

- Increase the park entrance fee in order to prevent the number of tourists from increasing any further, while at the same time increasing revenue.
- Enable the local community to participate in providing services for tourism by allowing it to operate local tours and/or small scale developments on land; and allocate a proportion of park revenues for the local community's development. This will help to ease the pressure to expand agricultural activities.
- Transfer a larger share of the revenue to the park authorities so that regulation and management duties can be undertaken more effectively.

Source: Steele, 1995.

Issues:

1 The case study shows that the local community has little incentive to support ecotourism since it does not share in its benefits. Is the fact that the National Park is owned by the state rather than the community or private individuals a part of the problem? If so, what measures might be taken to solve the problem?

2 Increasing the entrance fee will have some impact towards preventing the numbers of tourists increasing any further. What other measures will enable the Galapagos Islands to practise sustainable tourism?

Case Study: Using Property Rights in Ecotourism Policy – CAMPFIRE Programme in Zimbabwe

Traditionally, national wildlife reserves have been owned, controlled and managed by the Government. The objective was, at least in part, to reap benefits from the tourist trade. Local communities, who had exploited the reserves for centuries, typically lost out. They were resettled, prohibited from hunting in the reserves and neighbouring areas, and often had to bear the brunt of the damage done to crops from marauding wildlife.

In the absence of any involvement in the management of the reserves, and the breakdown of community-based common property rights, illegal poaching and hunting became prevalent. Local people became disinterested in preventing this, and the Government gamekeepers were powerless to prevent all but a fraction of the activity.

A more direct approach to dealing with conservation, ecotourism and rural poverty may lie in community-based wildlife management. This restores a common-property basis to the reserve, and gives the local people the economic incentive to look after the reserve. This can take the form of:

- sharing tourism revenue with the local community and local employment generation;

- ❖ infrastructure investment; and
- ❖ direct utilisation of wildlife resources

The Government of Zimbabwe launched the CAMPFIRE (Communal Area Management Programme for Indigenous Resources) programme in 1984. The project arose from the regional land use plan drawn up for the Sebungwe region of north-west Zimbabwe. The programme was set up to involve the local communities directly in reserve management and enable them to receive benefits from it directly. It was hoped that preservation of the reserve would become the most profitable land use option for the community. Each area was to be run by a profit sharing co-operative with the help of a Government agency. Lack of funding delayed the introduction of the project, until 1989, when with the support of a local NGO, two projects were started.

The Nayaminyami district council formed a wildlife trust. The council was made up of the chairmen of local wards. The trust established hunting and culling quotas and instigated controls to deal with animals which posed particular threats to crops and human beings, and to reduce poaching activities. It also developed two impala culling operations, licensed two safari operators and paid out compensation for economic damages.

A total of Z$319,353 was earned in 1989, largely from concession fees for hunting. It was redistributed equally among the wards, and earmarked for small projects such as footbridge building, nurseries, and health clinics. Compensation was paid out to local inhabitants suffering damages from wildlife, and subsidised meat was provided for local markets.

The scheme fared well in its first year in terms of the economic objective of increasing benefits to local communities. It did not do so well at fostering community participation, as surveys showed that local people felt that the reserves belonged to the trust rather than themselves.

Source: Swanson et al, *1992.*

Issues:

1 How could a greater sense of community participation be fostered amongst local people? What are the benefits of greater community participation?

2 Government officials may perceive the scheme as resulting in less tourism revenue accruing to the Treasury. Is this a problem? If so, how can it be avoided?

Case study:
Community Forestry in India

Many tree planting schemes in India have encountered problems because: often the wrong land was used, inappropriate species were chosen and the benefits of the programme were distributed unfairly. The West Bengal government has developed Forestry Protection Committees made up of local villagers in order to mitigate these problems. In exchange for protecting forests and plantations from poachers, Forestry Protection Committee members are entitled to 25% of the net sales of timber and the rights to collect fallen twigs, grass, fruits, flowers and seeds. Following the success of the West Bengal programme, this shift to greater community involvement became an Indian federal government policy in 1990.

Source: Roy, 1992.

4.15 The Distributional Impact of Market-Based Instruments

The relative impact of MBIs, such as environmental taxes, on different groups within society has been a high profile policy concern. Surprisingly, few studies explicitly address the issue, especially outside the European context. However, a distributive analysis can clarify what is actually at stake for particular groups when economic instruments are used to deal with environmental problems and can point the way to possible mitigation or compensation strategies.

Some other areas of the debate have been misdirected. Both MBIs and command and control (CAC) regulations impose costs. These

costs tend to ultimately fall on the consumer, which is entirely consistent with the polluter pays principle. Therefore, it is not correct to single out MBIs alone for their distributional impacts. In fact, contrary to CAC, by using MBIs to effectively reduce environmental damage, revenues can be generated. These revenues can then be used to redress distributional imbalance if that is a political concern.

Moreover, there is strong evidence that the total costs of compliance with a CAC policy are greater than that of an MBI. Several empirical studies indicate that the ratio of costs under a CAC system to an MBI system range from 2 to around 14 (Tietenberg, 1991). In addition, many MBIs generate revenue for the government. Hence, even if the initial environmental tax disproportionately falls on the poor (regressive), the revenues can be 'recycled' in a way which neutralises this effect or even leaves the poor better off. The effect of any MBI that generates revenue cannot be evaluated without an assumption being made as to what is done with the revenue. Only then does it become apparent whether the instrument is regressive or not.

Clearly, what matters is the *net* effect of the two components of the distributional incidence – the effect of financing and the effect of benefits. The possibilities are therefore:

a costs and benefits are regressive, in which case the net benefits are regressive;

b costs and benefits are progressive, in which case the net benefits are progressive;

c costs are regressive and benefits are progressive, in which case it is a matter of which has the greatest incidence; and

d costs are progressive and benefits are regressive, in which case it is a matter of which has the greatest incidence.

As mentioned above, policy costs are likely to be higher under a CAC system than under a market-based instrument system. Hence, the distributional incidence of CAC is likely to be worse, if the effect is regressive, than that of an MBI system. Evidence from the US suggests that CAC environmental policy costs are regressive, i.e. the poor bear a higher burden of cost relative to their income than do the rich. Less is known about the incidence of MBI-based policies. Research in the US does tend to suggest that the way incidence is measured matters a great deal: income-based measures suggest regressivity whilst expenditure-based measures suggest neutrality. Given these shortcomings of the 'distributional impacts' argument against MBIs, the following is a checklist for distributive analysis (OECD, 1994):

1 *What is the benchmark for comparison of different policy tools?*

   There are two principle alternatives for the benchmark (or threshold): (i) the "no regulation" case in which the MBI is judged against the status quo; and (ii) the comparative case in which the MBI is compared to the impacts of an equivalent CAC alternative.

2 *Will the economic instrument lead to government revenues and to what use will these revenues be put?*

3 *What are the initial impacts of economic instruments?*

4 *What are the relevant groups for which impacts will be addressed (either quantitatively or qualitatively)?*

5 *What empirical steps are needed to determine the final impacts (taking into account the shifting of costs and benefits to other groups)?*

The following are steps for a typical distributional analysis to find out the final impacts of an MBI:

a determine change in compliance costs by industry;

b determine impacts of changes in compliance costs as well as the impacts of "opportunity costs" on product prices and output, by industry;

c determine how many workers might become unemployed in the short-term due to output changes;

d determine impacts of higher product prices on consumers in different income groups, based upon expenditure survey data;

e determine impacts of price and output changes on firm profits, by industry;

f allocate the shareholder and taxpayer changes to income groups based upon survey data on their shares of corporate profits and income taxes, respectively;

g if government revenues are collected,

Table 9: **Economic Instruments: Mitigation and Compensation Options to Reduce their Regressive Effects on Income Distribution**

Economic Instruments	Mitigation Options	Compensation Options
Emissions Taxes	**Cut-off:** thresholds can be introduced for individual sources. This would be very complex to implement and reduce the incentive to make the most efficient abatement decision. **Exemptions:** similar to the exemptions for the food and clothing part of excise tax programmes in some countries. Exemptions can be given to sectors or individuals in selected income groups. This would lead to a higher tax rate on other sectors/groups; distorts the economy toward pollution-intensive activities; seems likely to become a permanent measure of protection compromising both the objectives of a cost-effective pollution reduction policy and those of free trade.	revenue neutrality: i.e. to offset increased emissions taxes with corresponding reductions in other taxes. There are empirical estimates showing that greater reliance on environmental taxes reduces distortions and leads to efficiency gains. However, for example, reductions in income tax as a result may not completely compensate the effects of an environmental tax, if those who are affected by the environmental tax do not receive sufficient compensation through the reduction in income tax. In other words, revenue neutrality should be carefully targeted.
Emissions trading	**Allocation formula:** the permits can be allocated for free or in "zero-revenue auctions". These options do not lead to government revenue but reduces the cost to businesses. However, whatever the allocation formula, the impact on the distribution of costs between firms and consumers as well as between firms and workers should also be looked at. **Shut down credits:** In order to reduce the negative impacts on workers, firms are not allowed to use credits obtained from shutting down production facilities. However, this policy would be difficult to administer due to problems in determining which firms shut down because of the trading programme.	The ability to mitigate business losses through allocation formulas means that compensation issues relating to business or consumer losses are less relevant for emissions trading programmes.

Source: adapted from OECD, 1994.

allocate them to income categories based upon the same survey data showing the share of income taxes paid by each income group (modify this step if the revenues are targeted to reduce specific taxes or to pay for new programmes);

h sum the results of the price impacts, the shareholder impacts and the taxpayer impacts for each income group; and

i summarise the results of the analyses for income groups, workers and regions.

6 *What options are available to mitigate or compensate for any groups harmed by the use of economic instruments?*

Table 9 presents some mitigation and compensation options for economic instruments in order to reduce their distributional impacts. It should be emphasised that each option creates a trade-off between efficiency and equity. What level of trade-off is acceptable depends on the magnitudes of equity and efficiency which are at issue, as well as other criteria discussed below.

4.16 Other Selection Criteria for Market Based Instruments

After the foregoing review of different types of MBIs, and issues concerning their distributional impacts, it would be useful to identify other key criteria that should be applied when selecting them to tackle specific problems.

Economic efficiency: An economically efficient outcome is one in which marginal costs and marginal benefits are equal, for all inputs and outputs. In other words, the concern is whether the environmental objective will be achieved at the minimum possible cost to society, where financial and environmental costs are net of financial and environmental benefits (including any secondary benefits discussed below).

Environmental effectiveness or dependability: In a world of imperfect information, different instruments will be associated with different degrees of certainty regarding the eventual outcome. MBIs offer certainty on the marginal costs of abatement, but leave the quantity of abatement uncertain. In the case of CAC, on the other hand, there is some certainty about the quantity of abatement but the costs are uncertain. The significance of these facts will vary depending on the context of the policy. When the aim is to meet set targets, such as those set by an international agreement or for highly hazardous environmental impacts, certainty may be deemed highly important. In the context of reversible environmental damages, depletion of substitutable resources or generation of biodegradable waste, cost and efficiency of the instrument may be of more importance.

Administrative costs: All policy instruments (MBIs and CAC) incur some form of administration costs. There will be costs to government, or its appointed agency, which might be financed from general tax revenue, or which might be passed on directly to the regulated sector. There will probably be further costs to the private sector in complying with the administrative requirements of the instrument. Key components under this heading include the costs of setting the instrument (the fewer the information, administrative and legislative requirements are, the less costly the instrument will be), monitoring the performance of the regulated sector, verification of compliance and enforcement mechanisms as well as the costs of collecting charges or engaging in permit trading. Estimates of these costs are likely to carry some uncertainty, which can be reduced by revisions based on initial experiences.

Adaptability: The instrument should maintain its effectiveness in the face of changing technology, prices and environmental conditions. Indexing to inflation or setting the instrument as a percentage of the price are two ways of maintaining its value. Similarly, the instrument's value must rise with increasing resource or environmental scarcity. It should also respond to changes in monitoring, abatement and production technology. For example, mandatory use of the best available technology, an extensively used

command and control instrument, does not meet this criterion unless it is deliberately and regularly revised, at great cost (Panayotou, 1995b).

Dynamic efficiency: The instrument should continue to encourage environmental improvement and technical innovation beyond policy

Box 10: **Performance of Policy Instruments Against Selected Criteria**

Policy Instrument	Evaluation Criteria			
	Economic Efficiency	**Administrative Costs**	**Equity**	**Dependability**
Command-and-Control Approaches				
emissions standards	likely to be poor, i.e. excessive abatement costs variable	depends on the number and size of polluters	no *direct* redistribution effect, but if the costs of meeting the standard are passed on to customers, there is an equity impact on consumers according to income group	high
standards for inputs	likely to be poor	lower than emission standards	as for emissions standards	same as emissions standards provided that the relationship between inputs and emissions is known
technological standards for new sources	poor	lower than others	as for emissions standards, may also act as a barrier to entry	high for new sources but little effect overall
technological standards for existing sources	poor	lower than others	as for non-transferable emissions quotas scheme; may favour new sources	more assurance than technological standards for new sources
Market-Based Instruments				
emissions tax	good	variable depending on the bureaucracy and co-operation	variable depending on the redistribution of tax revenue	variable depending on the tax level
input tax	good	less than emissions tax	same as emissions tax	same as emissions tax provided that the relationship between input and emissions is known
differentiated input tax	very similar to an input tax. The difference is that the emissions vary with the quality of the input, as well as with the quantity.			
tradeable emissions quotas	good	could be high	variable depending on the allocation of initial quota permits	same as CAC emission standards

targets, and even promote environmentally sound and economically efficient structural change, if feasible. Panayotou (1995b) gives the example of how low gasoline prices in the United States have resulted in a dispersed pattern of development and land use that make the development of most mass transit systems unprofitable and the economy dependent on private driving. In contrast, European cities' mass transit systems are profitable because of the high density land use induced by high gasoline prices.

Political and cultural acceptability: Taxes and charges are generally unpopular with consumers and producers alike. On the other hand, market creation or emissions trading is seen as giving polluters the right to pollute. Strengthening property rights may be acceptable if there is a long tradition of individual or communal rights. However, in the case of a departure from prevailing and likely future practices, there may be opposition from those who think they will be on the losing side. In order to increase political and cultural acceptability, the best way is to present the costs and benefits of each policy option (including that of no action). This is the same as Cost-Benefit Analysis discussed in Chapter 2, although here the issue is policy appraisal. Other mitigation measures include consultative processes, gradual implementation and revenue neutrality for taxes.

Secondary benefits: In many cases, action to address one environmental problem is likely to have additional effects on others. Although it is usual to talk of these effects as secondary benefits (as in the case of reduced emissions of sulphur due to an action to curb carbon dioxide emissions), there can be secondary costs as well (e.g. reducing local air pollution from cars by fitting catalytic converters leads to increased emissions of carbon dioxide). In principle, any secondary benefits (or costs) should be counted within the total and marginal benefit arising from an instrument.

Box 10 sets out the performance of different instruments against four of these criteria: economic efficiency, administrative costs, equity and dependability.

4.17 Global Market Failure: capturing global value

The discussion so far has concerned the ability of economic instruments, or MBIs, to reduce local market failure at the lowest cost to society. Where domestic prices do not reflect pollution damage, or where there is no market at all for environmental quality, MBIs can be very effective policy tools. MBIs can also address the problem of *global market failure*. Although the world may place a great value on the continued survival of certain species, the owners of the rain forest may get very little compensation from foregoing their right to develop the forest. The misfunctioning, or complete absence, of markets between countries has been described earlier in Figure 6. How can countries capitalise on the economic value of their environmental assets of global importance such as biodiversity, carbon sequestration etc? This is what we mean by 'capturing global value'. There are various mechanisms whereby global environmental value can be captured, including:

Intellectual property rights: countries which own rain forests can lay claim to the benefits arising from discovering, for instance, the medicinal qualities of plants which can be developed into pharmaceutical products. If the cure to Aids or certain types of cancer lies in the rain forest, one suspects that there is a very great global willingness to pay to preserve the rain forest. The problem, of course, is to translate this into revenues.

Debt-for-nature swaps: an agency interested in conservation buys the debt and then returns it to the country of origin in exchange for locally denominated debt which is used to provide income, often to a local NGO, to conserve a specified asset. In this manner, the willingness to pay of citizens in the developed world for biodiversity preservation has an opportunity to express itself.

Franchise agreements: a country accepts a restriction on the use of its assets (e.g. not burning forests) in return for an annual payment reflecting the value of the asset to the rest of the world. The willingness to pay of the rest of the world can express itself in local decision-making. If global WTP per hectare of the forest is higher than development values, then local owners of the land gain by preserving the forest, provided they are actually able to capture this global value as revenue.

The Global Environment Facility (GEF): GEF is a financial mechanism that provides grant and concessional funds to developing countries for projects and activities that aim to protect the global environment with respect to climate change, biological diversity, international waters and ozone layer depletion as well as land degradation as it relates to these four areas. The projects have to produce benefits to the global environment and incur costs which otherwise would not have been incurred by individual governments. If a project produces domestic benefits greater than domestic cost, it is in a country's interest to proceed with the project. If the country is financially constrained it can gain funding through development funding channels other than the GEF. The GEF uses its money to fund projects in which the global benefits outweigh the domestic costs, and domestic benefits are less than domestic costs, The GEF pays the difference between global and domestic benefits. Projects to reduce CO2 emissions fall into this category. The GEF's present budget is too limited to enable developing countries to capture global benefits on a much larger scale.

Case Study:
Activities Implemented Jointly Under the Climate Change Convention

Under the UN Framework Convention on Climate Change, industrialised countries have an obligation to reduce their CO2 emissions. After much controversy, it was agreed by the first Conference of Parties to the Convention that, until the year 2000, there will be a pilot phase during which projects will be permitted whereby country A can pay for the cost of reducing emissions in country B (as this is cheaper for country A compared with reducing its own emissions domestically). However, no credits can accrue to country A as a result of greenhouse gas emissions reduced in country B during the pilot phase. This is known as 'activities implemented jointly'.

An example of this kind of project is that agreed between Norway, Poland and Mexico, whereby Norway has agreed to provide funding through the GEF for carbon-reducing projects in Mexico (energy-efficient lighting) and Poland (conversion from coal burning to natural gas).

Source: Global Environment Facility, 1992.

Case Study:
Debt for Nature Swap in the Philippines

In 1989, the Worldwide Fund for Nature (WWF) purchased $390,000 of Philippine debt, which had a face value of $590,000. The Philippine Government now owed $390,000 to the WWF, rather than to commercial banks. WWF agreed that the Philippines should pay the debt in peso equivalent in support of designated conservation projects. A variety of projects have been implemented: e.g. enhanced management of national parks and training programmes for conservation professionals.

Source: Peuker, 1992.

4.18 The Role of Market-Based Instruments in Natural Resource Management

A range of market-based instruments have been reviewed, which provide a means of reducing *local* and *global market failure*. This section identifies which type of instruments are best suited to certain economic sectors: e.g. water, energy, waste, tourism, fisheries, mining, forestry and agriculture. The summary for each sector, presented in Box 11, starts from the assumption that environmentally damaging subsidies should be removed. If polluting activities are 'cheaper' than they would otherwise be, then subsidy removal is

Box 11: **The Broad Focus of Policy and Market Failures, and Market-Based Instruments in Specific Sectors**

Sector	Policy/Market Failure ⇒ Non-sustainable Outcome	Exemplary Actions Required
Agriculture	Government subsidies for irrigation water, pesticides and fertilizers, insecure property rights ⇒ deforestation for agriculture, land/water pollution, soil erosion, overgrazing	• removal of policy failure (both inputs and output) • secure property rights • tax on irrigation water, pesticides and fertilisers • subsidies for environmentally friendly technologies such as Integrated Pest Management • tradeable quotas for livestock production • ecolabelling
Energy	Government subsidies reducing the price of fuels and electricity Prices do not reflect social costs of air pollution from fuel and electricity production and use ⇒ inefficient energy production and consumption, lack of incentive for energy efficiency measures, water/air/land pollution	• removal of policy failure • tax/tradeable permit on air/water emissions • environmental subsidies for cleaner fuels and technologies
Fisheries	Open access, insecurity of existing property rights at local, regional and international levels ⇒ capital intensive fishing, overfishing	• removal of policy failure • tradeable quotas • clearly defined secure property rights (EEZ fishing licences) • fishing input pricing
Forests	Government incentives for deforestation and land clearance, insecure property rights, lack of incentives for sustainable management and non-timber products, inefficient taxation of revenues, lack of environmental controls ⇒ deforestation, and resultant loss of biodiversity. • removal of policy failure	• secure long-term property rights/concessions • forest product pricing • royalty/profit/concession taxes • performance bonds/deforestation charge • carbon offsets/joint implementation agreements
Mining	Government incentives for mining in short term, insecure property rights, inefficient taxation of revenues, lack of environmental controls ⇒ environmental impacts from mining, loss of revenue due to inefficient taxation	• removal of policy failure • performance bonds • emissions tax • royalty/profit tax – levy based on mine's output. • equity participation – local people owning shares in the mine can be beneficial
Tourism	Ownership/ management which excludes the local people, inefficient pricing of the sites ⇒ overuse of tourism sites, air/land/water pollution, poaching, loss of biodiversity and revenue	• removal of policy failure • entrance charge applied and revenues at least partially redistributed to local communities • property rights for local people • performance bonds

Continued opposite

Sector	Policy/Market Failure ⇒ Non-sustainable Outcome	Exemplary Actions Required
Transport	policy failure encouraging excessive use of vehicles and roads especially in urban environment ⇒ air pollution, congestion, noise • removal of policy failure	• road pricing • differential fuel and vehicle taxes • investment in/subsidy for public transport
Waste	lack of collection/disposal facilities, lack of effective user charges for waste management ⇒ generation of excessive waste; no incentive for recycling; health hazards from uncollected/inefficiently disposed wastes; air/water/land pollution; lost revenue from not recycling	• removal of policy failure (full cost pricing) • deposit refunds and performance bonds • product charges on packaging • landfill tax-proxy emissions tax • recycling incentives such as credits to parties other than local authorities to collect
Water	Government subsidies making domestic, industrial and irrigation water cheaper Industry allowed to discharge used water without treatment ⇒ excessive use, water shortages, waterlogging, and surface and groundwater pollution.	• removal of policy failure (marginal cost pricing) • communal/private water rights • user charges • differential land/water use taxes

the most cost-effective means of conserving the environment. It is also assumed that property rights are well defined and secure. Each country needs to fine-tune MBIs to get the maximum environmental benefit at the least cost.