Pollution Charges: Lessons from Implementation

Pollution charges are becoming an increasingly popular instrument for environmental policy. Currently, they are widely applied in OECD countries, they play a key role among environmental policy instruments in most transition economies, and they are being introduced in developing countries, particularly in Latin America and East Asia. Many recent World Bank environmental projects propose using pollution charges. Economic instruments have a theoretical advantage over uniform command-and-control (CAC) regulations because of their greater flexibility and cost-effectiveness. However, the performance of poorly designed pollution charge programs may not demonstrate measurable economic and environmental benefits. This chapter provides some guidance on setting charges and designing an effective program.

Pollution charges exist in various forms, as described in Box 1. They can be imposed on emissions or products; they can be levied as a fee for service or as a fine for noncompliance; and they can be collected as separate payment or as part of a broader levy, such as a locally defined water use tariff or national energy tax.

Pollution charges can be levied on actual source emissions (*direct* emissions charge), estimated emissions (*presumptive* emissions charge), or products whose use or disposal is linked to pollution (*product* charge or tax). While the direct charge is most straightforward, the difficulty of systematically measuring discharges limits its possible application and may give a comparative advantage to indirect instruments, such as fuel taxes or water charges. Indirect pollution charges assume a certain connection between the tax base and the amount of pollution. The problem with these charges is that if the connection is not straight or strong enough, the incentive signals may be distorted or insufficient.

The design of pollution charge programs entails many compromises between the advantages and shortcomings of direct and indirect instruments. For example, indirect charges based on fuel use or water consumption can very closely approximate the direct pollution charge when supplemented with rebates according to actual source emissions.

Whereas the theoretical advantage of pollution charges is in their incentive impact, it is their revenue-raising function that often makes this instrument appealing to environmental policymakers. At the same time, it may require changes in legislation to allow additional taxes that may then give rise to political opposition. In this situation, user charges (payments for services rendered) or earmarking of charges for specific environmental expenditure often becomes more politically acceptable.

Summary of Implementation

User and product charges are most common in OECD countries. Most of the charges (apart from tax differentiation) are introduced to raise revenue. Where an incentive impact was intended, there is little evidence of actual incentive effects of emissions and product charges (except for Sweden). This is partly because of a lack of systematic evaluation and partly because when the charge is applied in conjunction with other policy instruments, the data on incentive impacts are inconclusive. A number of pollution charge programs were operated on a temporary basis and were subsequently modified or abolished. Overall, the OECD approach was to incorporate the costs of pollution into water charges and fuel taxes as a way of charging for emissions.

Box 1. Typology of Pollution Charges

Pollution charges fall into several major categories.

Emission, or effluent, charges are charges on emissions to the environment (air, water, or soil). In principle, they are based on the quantity and toxicity of discharged pollutants. In practice, emissions charges can be levied on:

- Actual source emissions that are directly metered, for example, Sweden's nitrogen oxide (NO_x) charge
- A proxy of source emissions that may be derived from prespecified technical characteristics or from input quantities that correlate with emissions. For instance, water consumption commonly serves as a proxy for wastewater emissions.
- Discharge sources in the form of a flat rate, commonly applied to households and small firms for municipal waste and wastewater charges.

User charges—payments for the costs of collective or public treatment of effluents—are one form of emissions charges. They may be based on the amount or quality of effluent treated, on water usage, or on uniform tariffs.

Product charges are charges or taxes on products that are polluting in the manufacturing, consumption, or disposal phase. These charges can be based on some characteristics of the product (e.g., a charge on sulfur content in mineral oil in Norway and Sweden) or on the product itself (mineral oil charge in a number of OECD countries).

In practice, product charges may take the form of *tax differentiation* that creates more favorable market conditions for "cleaner" products and less favorable conditions for polluting products. Because tax differentiation is meant primarily as an incentive, it usually operates in a fiscally neutral manner. Other product charges can be designed to be revenue raising as well.

Administrative charges, such as control and authorization fees and payments for administrative services (licensing, registering, etc.), are not considered here.

Sources: OECD 1991; Opschoor et al. 1994.

In developing countries and transition economies, emissions and effluent charges are the most common economic instruments used in environmental policy. However, in most of the cases where charges have been implemented so far, they were set at very low levels and, although intended to provide an incentive, had little impact on the behavior of polluters. Furthermore, because these charges have often not been systematically enforced, their revenue-raising capabilities have been limited. One exception is Poland, where the revenues have been significant and where some incentive effects have been achieved.

Lessons Learned: What Works and When

Economic instruments can make environmental policies based on CAC regulations more cost-effective (Tietenberg 1992). Yet poorly designed pollution charge programs may not achieve tangible results. The evidence from cross-country experience emerging in recent years, although not yet sufficient for a complete analysis and comprehensive conclusions, allows for a number of recommendations on how to design an effective pollution charge program for various types of charges (see Box 2 for examples of successful programs).[1]

Emissions Charges in Practice: Key Observations

In theory, emissions charges, set at the level of marginal environmental damage or abatement costs, are the best way to internalize the social costs of pollution and change the behavior of economic agents (Baumol and Oates 1988). The realities of implementation, however, impose significant constraints on the effective use of this instrument.

Emissions charges are more effective when they are set at a high level for a limited number of pollutants and sources rather than at a low level for a great number of pollutants and sources. Charges can be increased gradually, with rate increases scheduled in advance, to allow industries to make timely adjustments. The ultimate level of charges should be sufficient to provide an incentive for a targeted level of pollution abatement in an area or watershed over a designated period of time.

Low emissions charges, which are introduced with the primary purpose of raising funds, have not proved to have a comparative advantage in relation to other charges or taxes, given the higher

Box 2. Examples of Application: What Works, and Why

Example 1: Water Pollution Charge in the Netherlands. The rate of the Dutch water pollution charge is determined by the revenue required for sewage treatment and for maintaining and improving water quality in general. The charge is implemented by the water boards—self-governing bodies of surface water users responsible for water management. The charge is based on biochemical oxygen demand (BOD) and (in most cases) heavy metal pollution. It is levied on all direct and indirect discharges. Households and small firms pay a fixed amount. According to the research done on this issue, there has been an incentive effect for large firms that are actually metered, including the agricultural sector, especially livestock production.

Why does it work?

- The level of the charge is rather high and is aimed at providing full cost recovery of sewage treatment.
- The charge base is directly linked to pollution load (for large firms).
- The charge program is decentralized and transparent for water users.

Example 2: Sulfur Tax in Sweden. The Swedish tax is levied on the sulfur content of diesel fuel and heating oil that exceeds a threshold of 0.1%. The tax, which is a product charge, approximates an emissions charge and is repayable if a taxpayer can demonstrate an actual reduction of emissions of sulfur oxides. An official evaluation indicates that the sulfur content of oil decreased nearly 30% between 1990 and 1992 as a result of the tax and that emissions from burning coal and peat also considerably decreased. The tax promoted cleaning flue gases to a larger degree than before, but emissions have also been reduced by substituting among fossil fuels. The carbon dioxide tax provides an additional incentive for substitution. Administrative costs are somewhat less than 1% of revenue.

Why does it work?

- The tax level is high.
- A transparent rebate scheme strengthens the incentive effect of the tax.
- The design of the program provides for easy implementation and low administrative costs. The burden of proving the actual emissions level is imposed on polluters.

Source: Opschoor et al. 1994.

administrative complexity and costs. This is especially relevant for air emissions.

Emissions charges can be effectively applied to a very limited number of standard pollutants that are (a) emitted by many various sources with different costs of abatement, (b) controlled by commonly available technologies, and (c) relatively easy to measure by conventional methods. The examples are, for water, biochemical oxygen demand (BOD) and phosphates and, for air, total suspended particulates (TSP), sulfur oxides (SO_x), and nitrogen oxides (NO_x). Carbon dioxide (CO_2), which is affected by a change in fuel rather than a change in burning technology, is more suitable for a product charge, i.e., a carbon tax on fuel.

Emissions charges can be effectively applied to a relatively limited number of the most significant sources (except for user charges, which are applicable to all sources). Criteria for selecting sources include (a) feasibility of systematic monitoring or inspection, (b) potential for technical innovation, and (c) financial viability (ability to respond by adopting new technologies or improving operation and maintenance).

A good example is *air emissions charges,* which are most suited for large stationary sources. For instance, the Swedish NO_x charge and the French air pollution charge are levied on a limited category of burning installations with capacity over 10 megawatts (MW) and 20 MW, respectively. In the case of significant air pollution from diffuse sources such as vehicles or households using coal for space heating, product charges (for example, taxes on gasoline or heating fuel) may be a good proxy.

Upper-bound presumptive charges that are adjusted for those polluters that demonstrate a lower level of actual emissions can moderate monitoring and enforcement problems. Under this scheme, polluters are motivated to monitor and report their emissions, while an implementing agency supervises self-reporting with random inspections and stiff penalties for false emissions reports.

Emissions charges achieved the best results when implemented as part of broader pollution control programs with clear ambient quality or emissions reduc-

tion targets. Examples include effluent charges in France, Germany, and the Netherlands, an oil palm charge in Malaysia, and an NO_x charge in Sweden. In most of these cases, charges were introduced to facilitate and speed up compliance with preannounced stricter emissions and effluent standards.

The qualities of emissions charges described above do not allow a strong case to be made for their unquestionable superiority over other possible environmental regulations of large sources. In principle, location- and source-specific emissions limits may be as cost-effective and provide similar flexibility to polluters. In this case, the choice between charges or limits (or their combination) for controlling large sources should mainly depend on the administrative feasibility of and political support for a particular program in each country.

The real advantage of pollution charges emerges when they can be used to control various sources, including a large number of small sources, where other policies and instruments are not applicable or are very expensive. Water charges and product taxes appear to have this advantage.

Pollution Control with Water and User Charges

A careful approach is required when designing effluent charges that would apply to small industries and households, especially in developing countries where environmental objectives compete with the needs of industrial growth and poverty alleviation. Air emissions charges are typically not applicable to these two groups, but water effluent charges are. Households generate a very significant input to water pollution in urban areas. A user charge for municipal or collective wastewater treatment with differentiated tariffs for industries and households is one instrument in these cases. Where water usage is metered, a water charge itself may provide an incentive to reduce water use and the corresponding pollution. In addition, a pollution surcharge may be added to the regular water charge for those polluters that discharge more than an average amount within a given group of users. However, the distribution effect on large-size, low-income households has to be assessed and mitigated.

User charges can be used to recover the costs of municipal or collective treatment plants and are appropriate in all cases where such treatment takes place. The basic principles of designing an effective economic instrument of this type are as follows:

- There should be a differentiated approach to setting tariffs for industry, other big consumers, and households.
- Charges are based on pollution load or water usage where possible. This is especially relevant for industry and other big consumers.
- Tariffs are set at the level (on average) that provides full recovery of investment and operating costs.
- Full cost recovery is warranted only if the size of the public or collective treatment plant and the level of treatment adopted are defined on the basis of an extended economic analysis as part of optimizing wastewater treatment strategy in a watershed.

Use of Product Charges and Fuel Taxes

Product charges are most widely imposed on fuels, as a proxy for an air pollution charge, and on products that can be recycled or that need to be safely disposed of. Unlike air emissions charges, fuel taxes can be used to control diffuse sources and are relatively easy to collect, given the possibility of using existing administrative and fiscal channels.

A product charge is the preferred instrument when:

- There is a strong connection between the use (or disposal) of the product and the amount of pollution, as in the case of fuel taxes.
- Pollution occurs at the consumption or disposal phase and is generated by a great number of small sources (e.g., gasoline engines and batteries).
- Pollution occurs at the manufacturing or power-generating phase and the discharge of the targeted pollutant depends on input characteristics rather than on abatement or process technology, as in the case of carbon taxes or, to some extent, sulfur taxes.

Earmarking of Revenues

If revenues from charges are earmarked for environmental expenditures, it is important to have a coherent, transparent, and accountable allocation system with clear financing objectives and priorities. One example is user charges for wastewater treatment or, in a broader context, effluent and user charges implemented by a basin organization to support a well-defined water quality improvement program. A fiscally neutral charge-rebate scheme such as the Swedish NO_x charge is another example of a transparent earmarked program that facilitates the incentive effect of the charge. All revenues from the Swedish charge, imposed on actual NO_x emissions of large power and heat producers, are rebated back to these producers on the basis of their final energy output. The incentive effect has been very significant. The charge-rebate scheme can also be implemented through the general budget.

Recommended Steps in Designing a Pollution Charge Program

Analyze the scope and impact of pollution and identify targeted areas and watersheds. Cross-country experience shows that *emissions charges* are more widely applied to effluents than to air emissions, largely because of monitoring difficulties. Applying these charges to solid waste is least common, and user charges are most appropriate. The situation is reversed for product charges, which are most widely used to control air pollution and waste disposal. While effluent charges, especially user charges, tend to be a long-term instrument in environmental policy, air pollution charges are in many cases more appropriate as a temporary program to tackle a particular problem.

Identify medium-specific priority pollutants that are of major concern in terms of ambient quality and health and environmental damage. Sensitivity to abatement technologies, variation in abatement costs, availability of measuring and sampling techniques, correspondence between product use and discharge, and environmental impact of a certain pollutant are factors that determine the applicability and design of an economic instrument (see Table 1).

Identify the major sources of pollution. Different approaches are needed to deal with different categories of polluters, such as industries, utilities, vehicles, and households (see Table 1).

Pay attention to the scope of pollution. The spatial level of the pollution problem—local, subnational, national, regional, or global—affects approaches toward setting the charges and the related range of institutions and stakeholders involved. Pollution charges, and economic incentives in general, have an advantage where there is homogeneous pollution extending over a broad area. Decentralized pollution charge programs focusing on certain watersheds or saturated airsheds benefit from a simpler institutional arrangement, better accountability, and transparency for stakeholders. In these cases, establishing watershed agencies and air quality councils responsible for media-specific management in targeted areas, including pollution charge programs, is generally recommended. When the impacts of pollution are heavily localized or very harmful, pollution charges may be used only if combined with direct site-oriented regulations, such as requirements to install best controls, zoning, relocation, or a ban on highly toxic products.

Scrutinize administrative costs. Pollution charges, especially emissions charges, may reduce the costs of compliance for industries, but they increase administrative costs for the implementing agency, compared with command and control (CAC) regulations. When designing a specific pollution charge program, the costs associated with its implementation should be explicitly estimated and included in the comparative analysis of alternative policy instruments that can tackle the environmental problem. A special financial framework should be established that keeps the program accountable. Any measures to lower administrative costs by, for example, using existing fiscal channels to collect revenues or shifting the responsibility of systematic monitoring to polluters, should be taken to the greatest extent possible.

Examine the existing fiscal system in the targeted area with respect to targeted pollution sources and try to identify pollution charge programs that would best fit into this system, so that administrative and en-

Table 1. Pollution Charges Typically Recommended for Different Pollutants and Sources

	Air pollutant				*Water pollutant*		
Source	*Particulates*	*Sulfur oxides*	*Carbon dioxide*	*Lead*	*BOD*	*Phosphates*	*Metals*
Vehicles							
Gasoline			Fuel tax	Fuel tax			
Diesel	Fuel tax	Fuel tax	Fuel tax				
Households and small enterprises	Fuel tax	Fuel tax	Fuel tax		User charge based on water use or flat rate		
Power and heat utilities	Emissions charge or limit	Fuel tax or emissions charge	Fuel tax				
Industry							
General	(Presumptive) emissions charges or limits		Fuel tax	Emissions limits (plus charge)			
Connected to collective wastewater treatment plant					User charge (plus pollution surcharge) based on water use; user charge based on pollutant load		Emissions limits (plus charge)
Not connected to collective wastewater treatment plant					Effluent charge based on load or presumptive effluent charge based on water use		Emissions limits (plus charge)

forcement costs are minimized. If the fiscal system is undergoing or will undergo reform in the relevant sectors (e.g., introducing water charges, modifying energy taxes, etc.), "mainstream" the pollution charges into the broader reform process. That is, try to design pollution charges in such a way as to allow the sharing of institutional capacities and collection mechanisms with other new or modified fiscal instruments.

Implementation Sequence Generally Recommended for Developing Countries

Water pollution. Start with locally imposed user charges, paying special attention to the distribution effects on small consumers and the metering of large industries, which ought to be charged on the basis of water usage or pollution load. Examine and assess institutional and legal options for introducing presumptive effluent charges (preferably based on water usage) for other significant sources that are not connected to public treatment plants.

Air pollution. Examine the possibilities of using existing fiscal channels for product charges. Consider designing, for specific pollution problems, focused programs that could be fiscally neutral (tax differentiation or charge-rebate schemes) Assess the changes that would be required in legislation, and give preference to programs that do not require major changes.

Implementation: Other Important Lessons and Considerations

One of the key lessons is that pollution charges have little chance to be successful unless a certain macroeconomic and environmental policy framework is in place (see Box 3).

Necessary Macroeconomic Conditions

Competitive market. In noncompetitive markets, the effects of pollution charges are reduced, since polluters, which operate either under "soft budget constraints" or as monopoly providers, can

Box 3. Examples of Implementation Problems: Macroeconomic Aspects

Estonia. Emissions charges were introduced in the centrally planned economy in the 1980s. Incentive effects were difficult to achieve even after independence and the course toward a market economy in the early 1990s, due to soft budget constraints for many enterprises that carried over their monopolistic status from the old regime. In addition, charges were constantly eroded by high inflation that made their real level very low. This situation was typical for many transition economies that were applying emissions charges in the early stage of economic reform.

Poland. Emissions charges were introduced in the 1970s, with the intention of influencing the behavior of polluters. Although the charge rates were increased several times during the central planning era, the effects were counterbalanced by the lack of financial motivation of economic actors, mainly state-owned enterprises. After the transition to a market economy started, the incentive effect of the charges, whose level was considerably increased and linked to an official inflation index, became far more significant.

Sources: Opschoor et al. 1994; Lovei 1995.

pass on costs to consumers with no pressure to look for alternative solutions.

Well-developed market of environmental services offering alternative options. Various control or cleaner technologies (in the case of emissions charges) and product or fuel substitutes with "cleaner" characteristics (in the case of product charges) should be easily available to polluters—a condition that is often missing in the domestic markets of developing countries and transition economies.

General economic and political stability, contributing to the effectiveness of pollution charges. An unstable situation works against economic incentives in environmental policy. First, it focuses decisionmaking on short-term goals and implies a higher discount rate of future savings as a result of pollution abatement investments. Second, it is usually accompanied by inflation that erodes charges unless an automatic revaluation mechanism is built in.

Key Environmental Policy Issues

In a country where environmental regulations are not enforced and environmental agencies are weak, economic instruments are not of much help either. Introducing pollution charges should go along with improving the overall environmental policy framework and strengthening the institutional capacities of environmental agencies. The following issues should be carefully considered before a pollution charge program is implemented (see Boxes 4 and 5 for examples of problems in this area).

Legal basis. Legislation should be carefully examined and brought into harmony with the implementation of pollution charges.

Political commitment. The support of the entire government is important for any innovative policy program.

Consensus among stakeholders. There is an increasing recognition that consensus among

Box 4. Implementation Problems: Lack of Legal and Political Support

Argentina. In 1980, Argentina attempted to introduce a discharge fee for industrial effluents. The tariff included a fee for discharges within the maximum allowable level and a much higher penalty for discharges above the maximum allowable threshold. There were provisions for increasing the level of fees gradually over 10 years, up to the level of treatment costs, and for granting transitory waivers for up to 2 years where enterprises were in the process of implementing abatement measures. In practice, the fees were never applied on a wide basis, and the system was modified in 1989 to lower the level of fees and to revise the penalties. Environmental groups sued the government on the grounds that the fee system amounted to a license to pollute beyond legal limits. The court declared the decree that introduced the fees unconstitutional, and the issue remains confused in legal terms. It appears that the court regarded the fee as exceeding the powers of the national government to levy taxes and concluded that it could not be justified as payment for a service.

Source: von Amsberg 1995.

Box 5. Implementation Problems: Lack of Institutional and Enforcement Capacity

Russia. The national emissions charge system introduced in 1991 is a combination of emissions charges and noncompliance penalties allocated in a network of earmarked environmental funds. The system is similar to those in many other newly independent states. The charges, which are set at a very low level, are levied on over 300 air and water pollutants and a large number of stationary sources. Available capacities of reliable monitoring and inspection fall well short of what is needed. There is neither a special staff training program nor a special implementation program. Although the central body of the environment ministry formally governs the program, including guidelines to calculate fees and set the permitted levels of discharges, negotiated agreements between polluters and local authorities determine the collection of the charges. The common practice is to waive the fees on the amount enterprises invest in pollution control or to exempt from payment polluters experiencing financial problems, using contradictions in the legislation. Currently, collection rates are low, and no coherent approach to spending revenues exists.

Source: NAPA 1994.

major stakeholders, such as environmental agencies, industries on which pollution charges are imposed, and communities exposed to pollution, plays a decisive role in implementing environmental policies. Public awareness and participation, including pressure on governments through NGOs, can be a powerful enforcement tool.

Institutional capacity of the implementing agency. The failure to build an adequate institutional capacity is one of the main constraints on implementing pollution charges. The staffing and structure of the implementing agency have to differ significantly from those of agencies operating CAC instruments. Where environmental problems have been successfully managed by CAC regulations, it may be worthwhile first applying an economic instrument to new problems not yet tackled by traditional CAC methods. In a developing country without a strong tradition of CAC regulations and well-established environmental institutions, or in a country undergoing a radical change in government structure, it may be politically easier to incorporate pollution charges into the system of environmental management than in industrial countries.

Evidence from a number of countries suggests that a lack of previous experience with well-enforced and effective CAC regulations leads to a dangerous underestimation of the need for strong institutional support when designing pollution charge programs. An adequate capacity for monitoring or inspection, as well as extensive and systematic training of staff involved in implementing a new instrument, should be built into the design of the charges.

Enforcement. Enforcement ability is the Achilles' heel of many existing pollution charge programs. Various factors weaken this ability, including (a) contradictions in the legal system; (b) a lack of expertise in or motivation for collecting charges, often exacerbated by a general problem of underreporting and undercollecting of taxes; and (c) insufficient capacity to monitor discharges. In developing countries, ensuring adequate monitoring faces additional challenges not only because of a lack of testing equipment and trained personnel but also because of a lack of measurement and sampling standards that makes comparison of collected data difficult. Enforcement needs not only a clear legal basis and technical expertise but also broad political support. In this respect, commitment of the government, consensus among stakeholders, and public participation are important inputs to improving enforcement practices.

Systematic program evaluation. Currently, most economic instruments worldwide are administered without systematic measurement of their performance, either through self-examination or through external oversight. Evaluation that focuses on clear-cut objectives and final outcomes, i.e., measurable effects on the environmental impact of targeted economic activities, provides the feedback that is necessary for the long-term success of pollution charge programs.

Note

1. The description in this section draws on analysis in Eskeland and Jimenez (1991); OECD (1991); NAPA (1994); Opschoor et al. (1994); Lovei (1995); and von Amsberg (1995).

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