

**SURVEY RESULTS ON THE USE
OF ECONOMIC INSTRUMENTS
IN APEC ECONOMIES**



ASIA-PACIFIC ECONOMIC COOPERATION

APEC ECONOMIC COMMITTEE
1998

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EXECUTIVE SUMMARY

The survey was conducted to help member economies exchange information and experiences in the use of economic instruments for environmental protection. By building on the practical experiences with these instruments, the survey indicates what works and what doesn't, and may help member economies design and implement measures that are suitable for their particular circumstances.

The specific instruments included in the survey were:

- environmental/user charges
- deposit/refund systems
- tradeable permits/quotas
- financial incentives/environmental liability

These options were chosen since they represent the primary types of economic instruments presently in use. Survey respondents were also requested to include any other measures they felt would qualify as an economic instrument and that would be interesting to other APEC economies.

Environmental/User Charges

Since most of the charge schemes reported in the survey were of the user charge variety, it is not surprising that the primary reason given for their use was to raise revenue. Whether it was to cover the capital costs of new landfills, to provide water services or to raise funds to compensate patients suffering from environmental-related illnesses, these charges were found to be an effective source of funds for governments. In many cases, they were not designed to cover all the costs of providing these services (e.g. Australia; Hong Kong, China). In these cases, funds from general revenue would be required to cover the costs of these services. In China, charges were introduced as environmental charges with the intention of changing behaviour. However, in practice, they function as user charges. In Japan, a charge was introduced in order to compensate patients. However, as a result, it played the role of an environmental charge by changing behaviour.

In addition to providing a source of revenue, most of the reported user charges also had an incentive element to them. Australia; Canada; Hong Kong, China and Mexico all reported that, at the very least, these measures had the potential to change behaviour. However, in most cases, the primary objective of raising revenue led to charge structures that were considered less effective from an incentive perspective. This highlights the need to carefully consider both the goal of the measure and the level at which it is to be set. An example of this is the environmental charge on water, waste, noise and air pollution in China. The primary purpose of the charge is to provide an incentive for firms to reduce their pollution. However, as reported by China, the charge is set at a level that is less than the average treatment cost so polluters pay the charge rather than change their behaviour.

Besides the related goals of revenue and behaviour modification, charges were considered preferential to other measures for the following reasons:

- many of the alternative measures were administratively complex and difficult to enforce;
- charges were considered to be fair and equitable;
- the charge could target specific industries; and
- charges can provide a signal that heightens awareness of an environmental problem.

If properly designed, charges were seen as effective ways of addressing a variety of issues. However, in order to fully realize their potential, economies noted that particular implementation issues should be addressed. These included:

- charges should be based on the Polluter Pays Principle;
- where appropriate, metering consumption is essential;
- for waste disposal, illegal dumping should be addressed;
- well-functioning markets are required for charges to properly work; and
- where pollution reduction requirements are not met, exemptions should not be granted.

Deposit/Refund Systems

All economies reporting the use of deposit/refund systems did so for addressing beverage containers. Some were introduced voluntarily by manufacturers while others were introduced through legislation. All indications from the survey are that deposit/refund systems can create a strong economic incentive to return beverage containers. This is highlighted by the high return rates reported in the survey, especially for beer containers. While recycling is not guaranteed, these systems can provide favourable conditions for the reuse of containers or the material from which they are made. Besides helping to reduce the volume of waste collected, economies also reported that they can help prevent littering and serve to raise environmental consciousness. There are indications that industry can become less supportive if return rates fall below acceptable levels.

Details that should be considered when developing deposit/refund systems include:

- the system should not pose an unacceptably high load on retailers;
- ensuring retailers accept returns and pay refunds;
- promoting the return of empty containers by offering convenient drop-off locations;
- encouraging standardized packaging to facilitate recycling efforts; and
- in federal-style economies, the possibility of unequal cost conditions in different states should be considered.

Tradeable Permits/Quotas

There are a wide range of reported issues that have been addressed using tradeable permits or quotas (TPQs). These include controlling access to fisheries, allocating water and timber resources as well as reducing air pollution. In many cases, TPQs were introduced because it was felt a previous system was inadequate. For example, Australia had earlier tried to regulate the South East Fishery based on a boat replacement policy, restrictions on the size of vessels, limitations on entry to the industry and various kinds of input controls. This system did not succeed because it failed to prevent economic deterioration of the industry and the stock of some species. On the other hand, Chile introduced a system of individual transferable quotas to both overexploited fisheries and new fisheries. In China, the traditional method of controlling emissions did not allow existing firms to expand by taking advantage of scale economies and old firms could not afford the cost of new pollution control equipment.

In other cases, TPQs were used to control new substances. As a signatory to the Montreal Protocol on Substances that Deplete the Ozone Layer, Canada introduced a system of Transferable Consumption Allowances for HCFCs. This system was selected because it could provide a level of flexibility in adapting to the changing patterns of HCFC consumption while ensuring that HCFC reductions would be achieved on schedule. For the systems reported in the survey, TPQs were found to be an effective manner of achieving environmental objectives at a lower cost than alternatives. Their ability to take advantage of differing control costs was noted as an important factor. By encouraging trade between firms, reductions were achieved at a lower cost. The incentive to lower costs in a regulated industry can lead to support and even leadership to introduce such a system (eg. Canadian Pilot Emission Reduction Trading Program).

However, because TPQs are new and relatively untried, there are many issues to be addressed if they are to be successful. These include:

- monitoring and enforcement;
- the method of initial allocation;
- the number of participants;
- determining what pollutants and sources should be included in the program;
- determining the cap and a reduction schedule;
- what limitations should be imposed on banking and sales of TPQs;
- identifying a base year for total allowances and a method of allocating allowances; and
- the need to consider transboundary or global effects.

Financial Incentives/Environmental Liability

This category of instrument, more than any other, is composed of measures that are individually distinct from each other. Many of their features are specific to a particular measure or issue. Consequently, it is difficult to analyze these measures as a group because they are so distinct. Nevertheless, the following sums up those issues that are common to this set of economic instruments.

These instruments have been generally introduced to provide funding for various environmental goals. While each case should be judged on its own merits, it is probably fair to say that these types of instruments are supported by industry because they offer a high degree of flexibility and in some cases are implemented on a voluntary or self-regulated basis. In addition, they can be designed to be enforced through contractual law rather than made legally binding.

From the perspective of regulators, such measures are attractive because they can be tailored to individual sectors and issues and, through the use of consultations, can be used to increase community awareness of environmental problems.

Financial incentives are often used to meet the requirements of industry while encouraging acceptable environmental behaviour. However, in order to be successful, all factors related to their implementation should be considered. For example, administration details as well as environmental and economic factors all play a role in contributing to a measure's success or failure.

While many of these measures have the explicit objective of encouraging appropriate environmental behaviour, some funds are used solely to raise revenue. For example, Mexico's gasoline tax is intended to raise revenue to support environmental projects. It is not intended to modify gasoline consumption or provide any incentive to increase energy efficiency. Likewise, the Mala Fund in Australia was introduced to support research and not to directly affect behaviour. In this way, financial incentives are similar to charges in that they can be designed to provide revenue or to change environmental behaviour. It is important to have a clear objective in mind when developing financial incentives.

1. INTRODUCTION

Why the Survey is being conducted

The genesis for this survey took place in Seattle in 1993 where a vision statement was issued that added the environment to the areas for cooperation within APEC. At that meeting, the Canadian Prime Minister made a commitment to “green APEC” when he invited Environment Ministers from APEC economies to meet in Vancouver.

At the Vancouver meeting in 1994, an APEC Environmental Vision Statement and a Framework of Principles for Integrating Economy and Environment in APEC were issued and officials from member economies were directed to develop recommendations. One of the principles agreed to in the Vision Statement was that sustainable development depends upon successful implementation of policies and programs that integrate economic, environmental and social objectives. Following up on this, environment experts met in Chinese Taipei. A paper examining the potential of economic instruments was presented by New Zealand. In this paper, the various advantages and shortcomings associated with economic instruments were discussed. As a result of these discussions, environmental experts recommended that the Economic Committee give full consideration to the wider use of economic instruments for environmental management.

In the same year (1994), APEC Leaders meeting in Bogor recognized the importance of going beyond trade issues and examining a broader set of development issues, including efforts directed at environmental issues, with the aim of contributing to sustainable development. In February 1995, APEC Senior Officials directed working groups and committees to integrate environmental considerations in their ongoing activities and provided direction to the Economic Committee to address environment/economy issues, specifically economic instruments for environmental protection.

In July 1995 in Sapporo, Canada distributed an Issues Paper on Economic Instruments for Environmental Protection. The purpose of the paper was to stimulate discussion of options for approaching this issue, and as a result APEC members supported a tiered approach. After discussions, it was agreed that this approach would begin with a survey on the use of economic instruments for environmental protection in APEC economies.

Rationale for the Use of Economic Instruments

The use of economic instruments has been examined around the world for many years. This has largely been due to the realization that the traditional measures for dealing with environmental protection, the so-called command and control approaches, were becoming increasingly expensive and did not provide much incentive for technological innovation. So, while command and control approaches remain a meaningful option for many environmental issues, decision-makers are now examining other complementary instruments.

One of the primary measures that has been explored is economic instruments. These instruments recognize that the basis for many environmental problems rests with the failure of markets to adequately reflect environmental factors. This failure can give rise to negative environmental externalities which transfer costs from the polluter to others (e.g. a pulp and paper mill polluting a water body which then reduces the productivity of a fishery). A major cause of market failure is the inability to define and enforce property rights. The air, water and other natural resources are not “owned” by economic agents in the same sense as human produced capital. Many of these resources

are essentially free, which results in too much being consumed. Economic instruments are intended to correct for market failure by either directly affecting prices facing producers or consumers or by creating markets (tradeable permits) and a price for access to environmental resources.

An advantage of using markets is that market-oriented instruments can increase flexibility in responding to environmental issues. This is because economic instruments do not dictate a particular technology but allow polluters to choose the method that is best in their particular circumstances for meeting a given environmental target. By doing so, economic instruments can help achieve pollution clean-up in a less-costly manner. And once a process or technology has been chosen, there is a continuing incentive to maintain or improve upon it because by doing so, the polluter can lower its costs. There is also the potential to raise funds to address region-wide environmental problems and sustainable development initiatives. Additionally, if it is possible to achieve a given level of environmental protection at a lower cost, it is also possible to achieve a greater level of protection at the same cost compared to a command and control approach, and to achieve it in a faster manner. However, the decision to achieve a high level of protection may depend on other policy priorities.

These and other reasons, such as the potential for reduced administration costs, have encouraged the examination and implementation of economic instruments for environmental protection by academics, economies and international organizations such as the OECD, IEA and now APEC.

One of the most comprehensive studies of economic instruments that has been carried out was by the OECD¹. It examined economic instruments in use by OECD members in 1987. That study found that command and control policies, with a few financial and economic add-ons, were the dominant method used to protect the environment. A follow-up survey was conducted² which found an increased tendency to use market-based instruments for environmental protection.

While this work was being conducted within the OECD sphere, additional research was conducted by the Asian Development Bank³ (ADB) that examined the use and potential of market-based instruments in the Asia-Pacific region. The ADB found extensive use of economic instruments, primarily user charges, in the region but concluded they were primarily based on fiscal rather than environmental considerations. Other work of relevance from an APEC perspective has been conducted for the World Bank⁴ and the Economy and Environment Program for Southeast Asia⁵. These latter two reports were conducted at a broad regional level. Other studies have examined the potential for economic instruments in individual member economies. These include studies for Canada⁶, Chile⁷, Indonesia⁸, the Philippines⁹ and the United States¹⁰.

¹ OECD, 1989, Economic Instruments for Environmental Protection, OECD, Paris.

² OECD, 1994, Managing the Environment: The Role of Economic Instruments, OECD, Paris.

³ Asian Development Bank, 1994, Financing Environmentally Sound Development, Manila.

⁴ World Bank, 1993, Toward an Environmental Strategy for Asia: A Summary of a World Bank Discussion Paper, Washington.

⁵ Economic and Environment Program for Southeast Asia, 1996, Applying Economic Instruments in Developing Countries: From Theory to Implementation, Singapore.

⁶ Government of Canada, 1992, Economic Instruments for Environmental Protection, Ottawa.

⁷ Centro de Investigacion y Planificacion del Medio Ambiente, Borregaard, N., et al, (forthcoming). Use of Economic Instruments at an Early Stage of Environmental Policy-making, Santiago. The information on Chile presented in this survey is based on an early copy provided by the author.

⁸ Environmental Management Development in Indonesia, 1994, Macroeconomic Policies and Economic Instruments for Environmental Management in Indonesia: Their Future Role in Economic Policy, Sectoral Planning and Regional Development, Dalhousie.

⁹ National Economic and Development Authority, 1996, Philippine Agenda 21: Frameworks Paper on Generating Financing Options for Sustainable Development Activities in the Philippines.

Implementation Issues

As with any policy instrument, if not properly designed the benefits inherent in economic instruments may not be fully realized. The design of economic instruments should be done on a case-by-case basis but some of the main factors that would need to be considered include:

- *environmental effectiveness* - economic instruments are not the most appropriate instrument in all circumstances. For example, if the environmental goal is to eliminate a toxic substance, regulations may be more effective. However, economic instruments could be used to phase out toxic substances.
- *realization of economic benefits* - it is important that the use of economic instruments be examined to determine whether the potential economic benefits are actually realized. Administration and monitoring costs may be exorbitant or, in the case of emission trading, trades may not take place, both of which may limit any potential savings.
- *political feasibility* - in order for economic instruments to be effectively implemented, there must exist adequate political will and support. In many cases, this does not exist and may constrain the introduction of economic instruments.
- *international competitiveness* - even though there are good reasons to believe that economic instruments would have a positive impact on competitiveness, some economic instruments may increase costs for domestic industries making them less competitive. Any proposed remedies should take into consideration the GATT/WTO trade rules and in the end may be best dealt with through international coordination of environmental policies.
- *equity* - the distributional impact on groups, sectors or regions within the economy should be considered. Important considerations in this regard include the importance of the impacted group, sector or region to the economy, the relative impact on different sectors within the economy and the impact on individual companies.
- *administrative and compliance costs* - while the regulatory approach can also involve substantial costs, it is possible for the administrative and compliance costs of economic instruments to be so high as to make alternative approaches preferable.

Types of Economic Instruments included in the Survey

The survey is being conducted to help member economies exchange information and experiences in the use of economic instruments for environmental protection. By building on practical experiences with these instruments, the survey should indicate what works and what doesn't and help member economies to design and implement measures that are suitable for their particular circumstances.

Economic instruments can be categorized in a number of ways but their primary purpose is to encourage the market to account for the full environmental impact of different forms of economic activity. Because of this, economic instruments may affect natural resource pricing, the prices of final goods or the price of pollution. They can do this by modifying the price to reflect environmental concerns (e.g. various charges) or by creating a market for environmentally beneficial behavior (e.g.

¹⁰ United States Environmental Protection Agency, 1992, The United States Experience With Economic Incentives To Control Environmental Pollution.

tradeable permits). Behaviour can also be influenced through the tax system using environmental charges, tax incentives and a combination of environmental charges. Specific examples of non-tax instruments are tradeable permits, user charges, certain subsidies and deposit-refund schemes.

The specific instruments included in the survey are:

- environmental/user charges
- deposit/refund systems
- tradeable permits/quotas
- financial incentives/environmental liability

These options were chosen since they represent the primary types of economic instruments presently in use. A brief description of these measures follows. Respondents were also requested to include any other measures they felt would qualify as economic instruments and that would be interesting to other APEC economies.

Environmental Charges

Charges have been heavily used in the past for fiscal policy reasons but are now being examined for their potential to change environmental behavior. An important distinction should be made between charges that serve a strictly revenue gathering purpose and charges that are implemented to change environmental behavior. The former are most widely used since they can contribute to a dependable source of revenue if applied to goods and services with a low price elasticity of demand. With regards to taxes that change behavior, the initial level of tax might be higher in relation to a “revenue raising” tax but as activities that contribute to pollution decline, revenues would also drop. This implies that such a tax might not be a good, consistent source of long-term revenue.

Charges can be applied at different levels in the production process. A charge can be introduced directly on the pollutant, such as an emission or effluent charge, or a charge on solid waste. Alternatively, a charge can be applied at an earlier stage in the production process. This may be desirable where it may be impracticable to apply a charge on emissions directly and where the use of an input has a direct influence on pollution. An example of this might be a charge on gasoline or a carbon tax. Charges can also be applied as a way of including environmental considerations in the pricing of natural resources. This is one way of taking sustainable development into account in the management of such natural resources as oil and gas, forestry, fisheries, water, etc. Finally, environmental charges can also be applied to final goods. This would be appropriate where consumption is closely related to environmental damage. This could include issues such as the reduction of solid waste.

User Charges

User charges are different from environmental charges in that they are intended to account for the full cost of particular services. However, in doing so, they may also influence a change in behavior. Examples of user charges include fees for water treatment facilities and solid waste collection and disposal. Traditionally, services such as these have been funded out of general revenues. Individual users had no indication of the cost incurred by their usage and there was no incentive to reduce their use. In addition, there was the potential for subsidization of one group by another if rates for particular groups were less than their real cost. User charges can provide incentives to reduce demand for

services such as water and waste disposal by reflecting the full cost of that service. Users have the flexibility to benefit by reducing their cost/usage and municipalities can benefit by reducing their requirements for further investment in waste or water treatment facilities.

Tradeable Permits/Quotas

Tradeable permits and quotas have been used in several APEC economies in areas such as air pollution and the management of fisheries. These instruments work by establishing a cap on emissions (or total catch) and then using some mechanism to allocate the cap among the participants. Once this initial allocation has been accomplished, participants are free to trade their permits. For example, a firm that has only high cost options for reducing emissions would likely buy permits (as long as the price was below the cost of its emission reduction option) from a low cost polluter. As a result, the high cost firm would be better off because it would be able to reach compliance at a lower cost while the lower cost emitter would be better off by the amount of revenue received due to selling permits. More importantly, since the number of permits was established according to environmental criteria, the environment also benefits.

Tradeable permits have been used primarily in the United States for air pollution (SO₂, smog) as well as for the phase-out of lead in gasoline. Transferable quotas have been introduced in Australia, Chile and New Zealand in the commercial fisheries to help reduce overfishing.

Deposit/Refund Systems

Another group of well-used instruments are deposit/refund systems. These systems, in general, work to encourage recycling or reuse of goods. A deposit is required upon the sale of the good and is refunded when it is returned. These systems are commonly used for items such as beverage containers, automobile batteries, tires, tin cans and used lubricating oil but have also been used to ensure the rehabilitation of mined areas. In order for deposit/refund systems to be effective, the deposit must be large enough to encourage consumers to return the goods. The infrastructure for such a system can be developed by governments or private firms but considerations such as the eligibility of imported goods should be made clear.

Financial Incentives/Environmental Liability

Financial incentives work through the tax system to encourage activities that are compatible with sustainable development. Examples include: accelerated tax write-offs, investment tax credits or deductions, as well as tax sheltering mechanisms. Financial incentives are often used to reduce any adverse impacts on international competitiveness by minimizing the costs to industry of stricter environmental regulations. Incentives can also be targeted at particular sectors or industries which are adversely impacted by environmental regulations or by the introduction of new regulations. However, some experience has shown that these instruments may not always be effective in achieving their goals. It has also been argued that this mechanism may actually encourage additional firms to enter the market and result in increased environmental damage. Other considerations include fairness, leakage of benefits away from the environmental objective and the difficulty of linking the incentive to a particular environmental activity.

Environmental liability is another effective mechanism for changing the behaviour of consumers, businesses, and others. Although liability is imposed through legislation, the specific, detailed decisions about how to achieve environmental objectives are left to the markets. The financial sector, for example, takes into account the potential liability arising from environmental practices of a business when assessing and renewing loan applications. The need for capital and the benefits of lower loan premiums provide strong incentives for borrowers to take the necessary steps to reduce environmental risks.

An environmental insurance regime with premiums commensurate with risk also provides individuals and businesses with the market incentive to reduce environmental risk. In this regard, insurers play a similar role to the financial sector, that is, enforcing good environmental management. The added benefit of insurance is that it would provide resources to clean-up should environmental accidents occur.

Application of Economic Instruments in APEC Economies

There are a number of factors that should be considered when examining the use of economic instruments in APEC economies. Within the APEC sphere, governments have different levels of capacity for addressing environmental issues. Some economies have highly developed regulatory and enforcement regimes with sophisticated advocacy groups. Others may not share this degree of development and may have trouble implementing existing regulations.

While the implementation of economic instruments is purported to require fewer administrative resources, there remains a need for monitoring and enforcement abilities as well as a sufficient level of comfort by practitioners. This implies the need for the development of administrative infrastructure as well as raising the general level of understanding regarding the implementation of economic instruments. Moves to assist in these areas would make a significant contribution towards the implementation of economic instruments.

In other cases, some of the traditional management systems may already be making use of variations of economic instruments. For example, in some South Pacific islands, fines have traditionally been used to penalize poaching of fish. In areas where there is a tradition of using market-based incentives, the implementation of additional economic instruments may prove to be easier.

Another important feature of many APEC economies is the reliance on traditional energy sources such as biomass (wood, charcoal, animal wastes), biogas and alcohol. Many environmental problems

involve changing the patterns of energy consumption and this may result in substitution towards the available traditional energy forms. In addition, there are often measures in place which encourage the overuse of fossil fuels. It is important that the full environmental impact of energy use be examined because incentives to reduce negative environmental impacts in one area may increase them in others. For example, increasing the cost of heating oil or coal may result in greater use of biomass which can lead to deforestation. Tradeoffs may have to be made between different environmental problems.

2. RESULTS

General Overview

Based on the responses to the survey, there is a wide range of economic instruments employed by many economies for diverse reasons. Charges were used by all responding economies for issues ranging from waste and water pollution to ozone depleting substances. Tradeable permits and quotas have been introduced to deal with overfishing as well as water pollution, acid rain, smog and ozone depleting substances. Examples of financial incentives range from taxes on gasoline to providing incentives for biodiversity and general support for environmental projects.

Perhaps the exception to this is the use of deposit/refund systems for beverage containers. All economies reporting the use of such systems used them for beverage containers. In one case (China), deposit/refund systems are used for pollution control projects.

By and large, most of the instruments reported, and which have been operating for some time, have been successful. For example, success for user charges would occur when revenues cover the cost of providing clean-up services. In general, most user charges did provide adequate revenues. Similarly, most economies reported a high return rate for most items collected through a deposit/refund system. However, it is too early to adequately judge the effectiveness of tradeable permits and quotas since most have only recently been introduced. For those systems that have been in place for some time, the results are mixed. The success rate for financial incentives is generally good, but they have not been introduced without some problems.

Specific Findings

Environmental/User Charges

User Charges

User charges, as compared to environmental charges, were widely reported to have been implemented by responding economies. China, Japan, Chinese Taipei and the United States reported the use of an environmental charge. The following pertains to user charges and the discussion of environmental charges will follow. Error! Reference source not found. lists those economies that reported user charges and their intended purpose.

In most cases, user charges have proven useful in raising revenue for environmental protection. The more common uses of user charges have been to provide funding for the operating and maintenance costs of sewage services as well as the collection and disposal of waste. This funding can be raised through explicitly linking the revenues raised to a particular expense (earmarking) or through funding from general revenue. However, in many cases it was recognized that the revenues raised would not cover all of the actual impacts and costs imposed on the community or administration costs associated with running pollution abatement equipment. Of the examples of user charges for which there was relevant information, eight were earmarked while the remaining seven were included in general revenue.

However, it was noted that user charges can have additional benefits beyond raising revenue. In the case of the Trade Waste Policy and Management Plan administered by the Sydney Water Corporation in Australia, a schedule of increasing charges has provided a strong economic incentive for industry to improve the quality and reduce the quantity of waste discharged to the sewage system. In Hong Kong, China the Sewage Charging Scheme has been successful in generating revenue to meet operating and maintenance costs and has also raised awareness of households and the private sector to the need to protect the environment as well as the cost of doing so. In the United States, the user charge on hazardous waste disposal (now imposed in more than 30 states) has been found to have a significant effect on the quantities of hazardous waste generated by industry. Other benefits associated with user charges include providing an economic incentive for improved technologies and management practices.

The fee structures associated with user charges can be based on fixed or variable rates. Fixed or flat rates involve a single payment that does not depend on the quantity or potential environmental impact a particular emission might have. A variable rate can include a fee structure that does account for these factors. For example, user fees for discharges to the marine environment in the Australian state of South Australia include components of quantity, salinity, type of pollutant as well as a consideration of the impact area. However, in Chinese Taipei the Air Pollution Prevention Fee is charged on the volume of gasoline, diesel or fuel oil consumed.

It is generally considered that variable fees are more efficient in providing an incentive to reduce compared to fixed fees because fixed fees are the same regardless of quantity. However, fixed rates can be used to generate predictable revenue streams. Variable rates were used by Australia in addressing ozone depleting substances as well as emissions to the marine environment, in Mexico for water pollution and by Hong Kong, China for operating their sewage system and waste disposal system. In the United States, billing practices vary. Some utilities charge flat rates for household sewer fees while others use declining block rates¹¹. Under the National Pollutant Discharge Elimination System (NPDES), permits are based on either volume or a combination of volume and toxicity.

¹¹ Under a system of declining block rates, fees are reduced as usage increases which would tend to increase consumption.

Table 1

Examples of User Charges in APEC Economies

ECONOMY	ENVIRONMENTAL PROBLEMS
Australia	Ozone depleting substances
	Marine environment discharges
	Discharges to the environment
	Environmental management of the Great Barrier Reef and other national parks
Canada	waste disposal
	oil spills
	water pricing
Chile	maintenance of national parks
	water pricing
Hong Kong, China	sewage treatment
	collection and disposal of chemicals waste
Mexico	wastewater
Republic of the Philippines	pollution from forestry, oil and gas, mining
Chinese Taipei	municipal and industrial solid waste industrial wastewater, sewage services
	air pollution
United States	water pollution
	air pollution
	solid waste disposal
	hazardous waste disposal

The State Air Emission Fees, landfill taxes and hazardous waste disposal taxes are all based on variable rates. In Canada, a system of fixed or flat rates are used for waste disposal, oil pollution as well as water rates (variable rates are also used for water). Chile also reported a mixed system, using both fixed and variable rates for its system of marginal water pricing. In the Philippines, fixed rates are applied to oil and forest products, while in the mining sector rates depend on the kind of resources extracted.

User charges can be implemented at the household level and/or the firm level depending on the environmental issue. For example, in Canada both households and firms can pay for curbside disposal. While relatively new, one reported scheme is covering 80% of disposal costs. In other cases, the nature of the environmental issue leads to the implementation of user charge at the firm level only. In Australia, heavy metals, organochlorines, HCFCs, methyl bromide as well as other industrial emissions are targeted for control using user charges. This is also true in the Philippines where forest charges and mining taxes are applied to firms while the oil levy and excise taxes on oil products are applied to both firms and households.

The survey found that user charges are often backed up by various forms of penalties. These include: fines, loss of accreditation, posting of bonds/securities and removal of licenses. In addition, it should be noted that many user fees are complemented by regulations that also provide a high degree of assurance that environmental considerations will be taken seriously. For example, in Canada, the Canadian Ship-Source Oil Pollution Fund has penalties supported by the *Canada Shipping Act* while the Sewage Charging Scheme in Hong Kong, China is supported by the *Sewage Services Ordinance*. In Australia, non-compliance of the user charge for ozone depleting substances can involve regulatory measures such as licenses, substance quotas and end use ban on equipment.

A key concern related to any controls on environmental degradation is the impact on cost. In general, economies did not have much information on the imposed costs to firms from the use of user charges. In those limited cases where information was available, the cost to firms was quite small. In Hong Kong, China the Sewage Charging Scheme was estimated to increase costs to industry by 1.2%. In Canada, user fees as part of the municipal water pricing schemes only accounted for 9.5% of total charges for water acquisition, intake treatment, re-circulation, and discharge treatment of water. Overall, it is unlikely that this component would affect Canadian industry in any significant way. In the United States., the NPDES is reported to only account for one half of one percent of total facility expenditures. In the Philippines, it was noted that the charges applied are passed on to consumers allowing firms to continue to operate.

A number of economies identified practical implementation issues that should be considered when developing user charges. While it is difficult to generalize due to the diversity of approaches included in the survey, several issues were mentioned by more than one economy. The first was the need for metering, especially for water use. Both Canada and Australia identified a significant number of water users that are not metered. This makes it very difficult to provide incentives to reduce and makes it difficult to adopt the polluter pays principle.

In Chinese Taipei, there has been some criticism that revenue should be allocated in a more direct way to prevent air pollution instead of building parks and providing health check-ups. However this may be accomplished, it was agreed that the "Polluter Pays" principle should be adhered to.

In the case of the oil levy in the Philippines, there were fears that prices of commodities would rise. The oil levy was intended to generate funds for the government while addressing air pollution problems arising from the consumption of fuel. However, the level of the charges was determined arbitrarily and did not actually cover the real costs to society arising from the pollutants due to the

difficulty of measuring pollution. Therefore, some viewed it as nothing more than a burden to the consuming public while others viewed it as necessary to stabilize the fiscal situation.

Another set of issues that was raised in the context of introducing user fees was the method of setting fees. It is important that whatever fee is established can provide enough revenue to ensure the long-term viability of the plan. Related to this are the issues of differentiating between different classes of users (eg. residential vs. industrial), determining whether the rate structure should be based on fixed vs. variable rates as well as assigning appropriate pollution loading and discharge factors. In addition, fee structures should not be too complex as this could reduce participation.

Economies were also requested to provide advice that might be useful to other economies contemplating the use of user fees. Besides the suggestion for metering, the benefits of holding public consultations when developing user charges were also identified. Some of the benefits of holding public consultations were lower costs to government as well as greater public support. With regard to cost, Chinese Taipei advised that attention should be given to the concentration of polluting industries in order to minimize the average cost of waste water treatment. Mexico also suggested that exemptions should not be granted to polluters that do not observe environmental requirements, and that control mechanisms should be available to support the intervention of government authorities when there is no compliance.

Environmental Charges

China, Japan, Chinese Taipei and the United States reported the use of environmental charges in Error! Reference source not found.. As previously mentioned, in theory environmental charges differ from user fees in that environmental charges are intended to change behaviour whereas user fees are primarily intended to raise revenue to cover the cost of operating and maintaining facilities. However, there are examples in all three economies where environmental charges were primarily used to raise revenue. In China, environmental charges were introduced in 1979 for water, air, noise and waste pollution. While the original purpose of the charge was to change behaviour, the actual function is to raise revenue.

Table 2

Examples of Environmental Charges in APEC Economies

ECONOMY	ENVIRONMENTAL PROBLEM
China	air pollution
	water pollution
	noise pollution
	waste pollution
Japan	air pollution
Chinese Taipei	water pollution
	noise pollution
United States	funding of abandoned hazardous waste sites
	fuel economy in automobiles
	ozone depletion
	product disposal costs

In 1974, Japan introduced a charge on SO_x emissions. It is designed to facilitate settlement of damage compensation disputes between the polluter and the victims of pollution on the basis of civil liability. The revenues go toward compensating patients under the Pollution-related Health Damage Compensation Law. The Japanese SO_x charge was originally introduced in order to raise revenue, but SO_x emission and pollutant levels declined very rapidly. The rate of this charge was determined by the level of financial resources needed for the compensation of victims of pollution. The rate had to be raised over the years to very high levels. As a result, the charge might have given an incentive to reduce pollution, although this was not its original purpose. Since the charge was implemented together with traditional command and control measures, it is difficult to determine whether the charge system was responsible for the observed emission reductions.

In both the Chinese and Japanese cases, the charges are earmarked with 100% of the revenues going towards environmental activities. Both are applied to firms and the rates are variable rather than fixed. In addition, both systems require the monitoring of firms. For small polluters, the charge is based on estimated coefficients.

Both the Chinese and Japanese systems have been successful in raising revenue but it is less clear whether there have been any associated reductions in emissions. For example, in the Chinese system of charges, many firms prefer to pay the pollution charge because it is less than the marginal cost of cleaning-up pollution. And, as has already been mentioned, the Japanese system of environmental charges was introduced at the same time as a command and control measure so it is difficult to assess the overall impact of the charge.

Both of these systems suggest issues for consideration when developing environmental charges. Besides the previously mentioned low charges, the Chinese system also does not encourage firms to address all pollutants since the charge applies only to the worst-offending pollutant. In addition, state-run firms can pass on their costs through higher prices or tax rebates so there is little incentive to reduce pollution. Polluters can also negotiate the timing of their payments especially if they have connections in the collection office.

In Japan, even though firms have decreased their SO_x emissions, the financial burden on firms increased rather than decreased. This was because the number of certified patients increased every year which required the total payments to increase. This led to the higher level of the SO_x charge.

In Chinese Taipei, the Water Pollution Control Act addresses water pollution sources to rivers and consists of three elements: household wastewater, business wastewater and livestock wastewater. Though it has not been enforced, it authorizes the EPA of Chinese Taipei to impose effluent discharge fees.

The United States reported the use of three environmental or product charges at the national level and a collection of measures for addressing waste collection costs at the local or state level. At the national level, the Superfund Tax was introduced in 1980 with the primary purpose of raising revenue. The total revenue raised so far is roughly \$2 billion and is earmarked for the funding of abandoned hazardous waste sites. There have been complaints by industry as to the fairness of this tax, and as of December 1995 this tax has been suspended. In contrast to the Superfund, the Gas Guzzler Tax was introduced in 1978 to change behaviour by targeting automobile fuel efficiency. The charge, which ranges from \$1,000 to \$7,700 per automobile is based on fuel economy and raises roughly \$144 million per year for the Highway Trust Fund. It is believed that this charge has led some manufacturers to improve fleet fuel economy. In addition to these two charges, the United States also reported the use of an excise tax on CFC production. As will be discussed later, this was introduced together with a marketable allowance trading system. The rationale for the excise tax was that the

restrictions on the quantity of CFCs and halons offered on the market would lead to rapidly escalating prices. The excise tax was designed to capture “windfall profits”, whereas the allowance trading system was designed to assure that production and import of the substances was efficient.

Deposit/Refund Systems

Of the economies responding to the survey, six reported the use of deposit/refund systems. All of these examples included deposit/refund systems to address beverage containers¹². Error! Reference source not found. indicates the return rate for these systems as well as the deposit as a percentage of the market price. As Error! Reference source not found. indicates, deposit/refund systems can be very effective in encouraging the return of refillable glass containers and cans. Typical return rates exceed 50% and return rates for beer bottles is often close to 100%.

The incentive to return items is largely determined by the size of the deposit that would be refunded. For economies reporting deposit/refund systems for beverage containers, the deposit ranges from a low of 3% for Australia to 20-25% for Canada and China. Except for South Australia, where a deposit/refund system has been introduced through the South Australia Beverage Container Legislation, most of these systems were introduced voluntarily by the beverage companies¹³. Presumably, industry would have done so because it would benefit them. Although most respondents reported that there was little available cost data, they did indicate that the benefits of such a system outweighed the costs.

One of the main concerns expressed by respondents was the need to determine an efficient level of deposit. It was noted that industry participants were more likely to support deposit/refund systems when there were relatively small deposits. However, to be effective, deposits must provide an incentive to return the product. For example, in particular Chinese cities, the level of the deposit was too low in relation to the product’s cost resulting in lower return rates. In contrast, some local governments in Japan abandoned deposit/refund systems because the resulting price was too high, which reduced proceeds for retailers.

¹² China also reported the introduction in 1989 of local deposit/refund systems for pollution clean-up. A deposit is made to ensure the effective operation of pollution control installations, and as such it operates in the same manner as a performance bond. The deposit accounted for 10-20% of the cost of the projects and was judged effective to ensure the operation of pollution control installations. The United States also reported the use of deposit/refund systems for lead-acid batteries, pesticide containers, tires as well as other private initiatives.

¹³ It should be noted that, in Canada, the soft drink industry was less supportive of a mandatory program.

Table 3

Deposit/Refund Systems for Beverages Containers

ECONOMY	CHARGE BASE	DEPOSIT AS % OF MARKET PRICE	RETURN RATE
Australia	Per container	Varies from 3-16%	Ranges from 61.7% for PET container to 96% for refillable glass container
Canada	Sift drink, beer, wine, spirits, others	Less than 20% of price	Ranges from 40% to 86%, particular cases up to 98.5% for beer bottles
China	Cans, bottles	25% for beer	90% for beer bottles
Japan	Cans, bottles	Around 10%	Local rates range from 70-80%~100% for beer bottles
Chinese Taipei	PET bottles	Not available	75.3% in 1995
United States	Can, bottles, PET containers	Not available	Ranges from 50% for PET bottles to 95% for aluminum cans

In addition to the above six economies, several South Pacific Island economies also reported the use of deposit/refund systems for aluminum can recycling. In some cases they were quite effective (e.g. Nauru) while others (e.g. Marshall Islands, Nuie) reported problems with collection, shipping and management as well as limited markets for the recycled material.

Other issues that economies contemplating deposit/refund systems should consider include:

- convenient drop-off locations and automatic collecting machines;
- encouraging standardized packaging to facilitate recycling efforts;
- a common policy for federal-type economies; and
- sanitary issues associated with odour from void bottles.

Tradeable Permits/Quotas

Tradeable permits or quotas (TPQs) have long been advocated by economists as an efficient manner of allocating pollution permits. Although they are a relatively new option, six economies reported their

use. **Table** indicates those economies that report the use of TPQs and the environmental issue they are being applied to.

As **Table** indicates, there are a wide variety of environmental issues that are dealt with using TPQs. Australia and New Zealand use them to address overfishing while Chile uses them for both overfishing and new fisheries. They are used in Australia, Canada and China for air pollution as well as for water pollution in Australia and China. In Canada and New Zealand, they are used for ozone depleting substances.

Fisheries

Australia reported the use of TPQs in three of its fisheries. In all cases, the fisheries were suffering from overfishing and reduced profits. Traditional methods of control were based on fishing effort rather than the size of the catch. This approach was due largely to the difficulty in estimating the size of the stock and the difficulty in enforcing compliance with quotas.

Two of the reported examples (Southern Bluefin Tuna, South East Fishery) were individual transferable catch quotas (ITQs) which work by giving individuals secure, marketable, property rights to a specific share in total quotas. The third example (Northern Prawn Fishery) would fit the broader definition of TPQ since there is no catch quota.

In the Southern Bluefin Fishery, the total quota has declined continuously since the introduction of ITQs in 1984. As a result, it is reported that the fleet has been restructured by using more efficient equipment and harvesting methods and has earned higher estimated profits.

However, in the South East Fishery, profits have not increased and there has been little rationalization of the fleet. The ITQ system in the South East Fishery is complex and there are overlaps with non-trawl fishing for the same fish in the same waters and with state fisheries.

In the Northern Prawn Fishery, the permits system did not adequately allow for increased vessel size or fishing power. As a result, the system was changed by adding additional controls based on engine power and hull size which increased costs. The primary method of achieving reductions was accomplished through a buy-back arrangement of both Class A and Class B units¹⁴. In addition, the Australian Fisheries Management Authority decided to cancel up to 30 per cent of class A units and reduce the number to around 50,000 units.

New Zealand also uses Individual Transferable Quotas (ITQs) to manage their fisheries. During the period from the mid-1960s to the mid-1980s, the fisheries were managed as an open access asset which led to overfishing. The introduced system of ITQs provided a framework for constraining the commercial fishing effort within sustainable limits. ITQs are an access right to the fishery and can be traded, leased or “fished against” and are a proportion of the total allowable catch.

Under this scheme the initial allocation was based on historical catch. The government then bought out 15,800 tonnes of catch worth NZ\$45 million to bring the total down to a level equivalent to the total allowable commercial catch (TACC). The expected savings from using ITQ management will be shared by the government and industry and result from transferring fisheries management from government to industry, providing security of access as well as providing fishers with an incentive to ensure the future health and sustainability of the resource.

¹⁴ Class A licenses are based on a measure of fishing effort (engine power, hull size) while Class B licenses are required for every boat in the fishery but are not based on fishing effort.

Since 1986, 3.4 million tonnes of ITQs has been leased between participants, an estimated 6 times the total amount of ITQs in the New Zealand fishery. A further 1.3 million tonnes of ITQs has changed ownership since 1986. Prices for ITQs have risen over time, reflecting a growing confidence in the ITQs as an access right and the establishment of an ITQ market. For example, in the abalone market, prices in 1988-89 were \$49,500 per tonne while in 1994-95, prices were in the range of \$210,000 per tonne.

Table 4

Tradeable Permits/Quotas

ECONOMY	ENVIRONMENTAL ISSUE
Australia	<ul style="list-style-type: none"> • overfishing of certain species • inappropriate fishing methods • declining catches • habitat destruction • high salt loads • high nutrient loads • SO₂ and air quality • preservation of river flow • protection of wetlands • logging of native forests.
Chile	<ul style="list-style-type: none"> • over-exploitation of fishery • fishery management • water use
Canada	<ul style="list-style-type: none"> • emissions of NO_x and VOCs • emissions to ODSs
China	<ul style="list-style-type: none"> • water pollution • SO₂
New Zealand	<ul style="list-style-type: none"> • overfishing in the inshore fisheries • emissions of ODSs • water quality • resource management
United States	<ul style="list-style-type: none"> • protecting sensitive land areas • acid rain • lead in gasoline • air emissions (pollutant varies by program and state) • oxygen content in gasoline • emissions of ODSs • vehicle fuel economy • water pollution • loss of wetlands

Generally speaking, the status of fish stocks has improved and over-capacity has been removed as a result of ITQs and TACC. Even though the fleet size was reduced (22% between 1986-87 and a further 53% between 1986-87 and 1994-95), total employment has grown from 7,900 people in 1986 to 10,000 people in 1995. In real terms, the value of output has also grown by 50% between 1986 and 1995 and there is no longer any subsidization of the industry. In addition, according to Statistics New Zealand, the index of competitiveness in the fishing industry has increased by 12% over the last 10 years resulting in a more competitive industry.

One of the practical implementation issues that New Zealand suggests for consideration is for a fair but firmly managed process for making the initial allocation. In addition, there is a need for clearly defined fisher groups, agreement as to the need for change, good fisheries management infrastructure and effective enforcement.

Chile has also been using a system of ITQs in the Squat Lobster fishery, the Black Hake fishery and the Yellow Prawn fishery with varying levels of success. In the Squat Lobster fishery, total biomass has increased from 15,500 tons in 1989 to over 80,000 tons in 1995 as well as spanning a larger geographical area. However, in the Black Hake (or Deep Cod) fishery, a tradeable quota system was introduced to help manage an “underdeveloped” fishery. This fishery is located in a large area in which it is geographically difficult to conduct aerial surveillance. As a result, Chile reported that the presumed illegal catch in this fishery has been estimated to equal the total allowable catch.

In general the ITQ system in Chile has resulted in increased stocks of a highly valued resource that had been over-exploited when managed as open access fisheries or with traditional command and control measures. In addition, the most appreciated feature by operators and managers is the orderly system of administration that emerged. Operators have found that they have been able to significantly improve the quality of their final products, and by better planning the operations, to re-build markets and diminish social conflict with their workers.

A key factor that was highlighted by Chile was the need for a trusted methodology for independent assessment. The targeted industries were somewhat hesitant initially but have since become advocates of the system. The reason for this is that they feel they are now self-regulating. They prefer this to having to deal with government bureaucrats for bargaining global quotas every year.

Water Pollution

Australia, China and the United States reported TPQs for water pollution. More specifically, the Australian systems address salinity (salt credits) and high nutrient content (permits, entitlements) while the Chinese example deals with high nutrient demand (quotas). In the United States, various states have introduced tradeable permits to address biochemical oxygen demand (BOD) as well as phosphorus and nitrogen demand. A common feature of these schemes is that they apply to relatively few polluters. The Murray-Darling Scheme is based on trade between the Australian states of New South Wales, Victoria and South Australia. Similarly, the recently introduced bubble system for the Hawkesbury-Nepean river system involves 3 sewage treatment plants, while the Hunter River Scheme has 8-10 participants although this number may increase. In China, the system to reduce high nutrient levels involves less than ten participants. Of the three systems that are operating in the United States, the largest, in terms of participants, is the system on the Wisconsin and Fox Rivers where there are 26 and 20 potential participants, respectively. However, in all three United States systems, there have been relatively few trades and as alternative technologies were introduced, trading has declined.

In Australia and China, there was general consensus that these systems achieved their objectives in a cost effective manner. Some of the reported benefits associated with these systems include

minimizing the impacts of salinity on river systems and for irrigators and water users, as well as the provision of better environmental quality in a cost-effective manner. However, in the United States trading has had very little impact on environmental improvements. New technology has largely made trading unnecessary and therefore there have been few, if any, cost savings realized. For example, despite potential savings of \$7 million annually, there has only been one trade between a municipal wastewater plant and a paper mill on the Fox River. This may change as the population increases and more of a market develops.

One of the issues that regulators need to address in introducing TPQs is the initial allocation of permits or quotas. Possible options for allocating these potentially valuable assets include average historical usage and auctions. For example, in the Chinese case, the initial allocation was accomplished on the basis of actual emissions, the size and location of the firm. However, in the case of the Hunter River Salinity Trading Scheme, the initial allocation was accomplished based on a “merit formula”. This involved taking account of sound environmental management by firms previously, a proxy for a firm’s economic contribution, contribution to local employment as well as specific site difficulties that might face particular operators.

One of the key issues raised by respondents was the need for adequate monitoring and enforcement as well as the identification of parties to carry it out. In the Hunter River Salinity Trading system, monitoring is the responsibility of the permit holder and is required at discharge points during discharge for volume and conductivity (measurement of salinity). In addition, quarterly reports to the government and an auditing system are in place. However, there have been some initial problems with data collection and monitoring but these are expected to be overcome shortly. There have also been reported problems with monitoring activities of non-point sources in the Tar Pamlico and the Dillon Reservoir in the United States.

Another factor in the successful introduction of these systems was effective consultation. Consultation was considered to have contributed to the overall goal of meeting the environmental target with a high degree of accountability.

Air Pollution

This section will discuss the system of tradeable licenses in the Kwinana Industrial Area (Australia), the Canadian systems for reducing smog in the province of Ontario and reducing national production and imports of HCFCs and methyl bromide, the Chinese SO₂ quota system and the New Zealand ozone depleting substances tradeable permits scheme. Also included in this section are several examples, out of the many provided by the United States, of tradeable allowance programs. Specifically, the United States Acid Rain Program, the Chlorofluorocarbon Production Allowance Program and the Lead Credit Trading Program will be discussed.

When TPQs are being considered for addressing environmental problems, there are many models upon which they can be based. The TPQs discussed in this section are a good example of this. For example, the Kwinana Industrial Area program of tradeable licenses for SO₂ and particulates, is based on the bubble concept. Under this system, point sources within the Kwinana industrial area are subject to meeting ambient concentration targets for SO₂ and particulates. They are assisted in these actions through the use of a dispersion model to estimate the contributions from each source to ambient concentrations. The system is flexible and allows for agreement between individual dischargers that are cost-effective and commercially practicable. Its requirements for monitoring and compliance (funding is based on cost sharing) indicate that it is also effective in meeting air quality standards.

While this is not what some might call a true TPQ, its creators believe that it could easily be extended to a system of tradeable permits for SO₂ emissions.

Similarly, the Canadian Pilot Emission Reduction Trading (PERT) program, which is based on a similar program in the United States, does not fit the standard definition of a TPQ. With this system, which is a voluntary, industrial-led initiative, existing sources of NO_x and VOCs may undertake emissions reductions below what is required under legislation and receive credits (ERCs) for those reductions. ERCs can be sold to other companies or used at a later time (banked).

The primary reasons for implementing this type of TPQ were the wide variety of stationary and mobile sources present, the fact that mobile sources accounted for the bulk of NO_x and VOC emissions, a potentially wide range of emissions control costs, the transboundary nature of NO_x and VOC emissions and the desire to encourage voluntary behaviour through cost-savings to industry. Another reason was the fact that companies in several states of the United States had access to a similar program and would have improved their competitiveness vis-à-vis their Canadian counterparts.

While relatively new (April 1996), the system has resulted in the cross-border sale of 400 tons of ERCs from a United States utility (Detroit Edison) to a Canadian utility (Ontario Hydro). The reported price was close to that of the cost of abatement for the selling utility. As an example of the flexibility of the PERT program, other emission reduction programs underway or planned include:

- plans for energy management programs in hospitals, universities and schools;
- reductions of NO_x by two coal-fired electricity generating facilities;
- a proposal to retire 140 high-emitting vehicles.

Several issues were encountered when the program was being developed and should be highlighted for other economies considering a PERT-type program. The determination of the pollutants and sources to be included in the program are important to its success. For example, can non-point sources be included? Another issue is measuring, verifying and tracking emissions reductions. In the PERT example, it is the responsibility of the firm to prove measurable reductions have taken place. Should there be any limitations imposed on banking and sales of ERCs? Banking is reported to improve the efficiency of TPQs but it could become a problem if many credits are used at one time and location in the future. Finally, how can proponents of such a system generate interest by industry and government? According to its architects, the primary lesson learned from this program is the importance of selecting such a program if the emissions problem involves many diverse sources and control costs are expected to be high. Another strength is its ability to generate support from industry, government and environment/industry associations.

The remaining TPQs used for addressing air pollution fit the more standard definition. One of the first successful trading systems is the United States lead trading program. Since the 1920s, lead was added to gasoline to increase engine performance. However, due to the introduction of catalytic converters and health concerns associated with its use, lead levels were reduced from 1.7 gm/gallon in 1975 to 0.1 gm/gallon in 1986 in the United States. To facilitate the phasedown, the United States EPA allowed two forms of trading, inter-refinery averaging during each quarter and banking for future use or sale.

Inter-refinery averaging allowed refineries to “constructively allocate” lead. As an example, suppose refiner A produced 200 million gallons of gasoline in the first quarter of 1983 (lead limit in 1983 was 1.1gm/gallon) with an average lead content of 1.4 gm/gallon. Refiner A could buy 60 million grams of

lead credits from refiner B, who produced an equal quantity of gasoline with a lead content of 0.8 gm/gallon.

Judged by market activity, the lead credit trading program was quite successful. Lead credit trading as a percentage of lead use rose above 40 percent by 1987. Some 20 percent of refineries participated in trading early in the program, rising to 60 percent by the end of the program. Early in the program 60 percent of refineries participated in banking and by the end this level had risen to 90 percent. The United States EPA estimated that the banking provisions alone would involve 9.1 billion grams of lead credits and would save refiners \$226 million. Subsequently, the amount of lead banked was placed at just over 10 billion grams. The lead trading program may be viewed in retrospect as a considerable success. The use of lead in leaded gasoline was sharply reduced over a short period of time without spikes in the price of gasoline that otherwise might have occurred.

The United States Acid Rain Program is another good example of a trading program. For this reason, it is useful to go into a little more detail in describing this program. The Acid Rain Program was introduced in the United States as part of the amendments to the Clean Air Act in 1990. These amendments were introduced to address concerns that SO₂ and nitrogen oxide emissions were harming lakes, forests, agricultural crops, materials and other valuable resources.

The program was designed to cut total national emissions by approximately one-half at an estimated cost of \$4 to \$5 billion per year. During Phase I, which began in 1995 and ends in 2000, the 110 highest emitting coal-fired power plants must reduce emissions to meet a tonnage cap computed as 2.5 lbs. of SO₂ per million Btu multiplied by each unit's average 1985-1987 Btu consumption. The tonnage cap is expressed in terms of "allowances", with each allowance good for one ton of SO₂. These allowances can be bought, sold or banked for later use. This will yield a total reduction of 3.5 million tons. Sources that fail to meet their caps will be subject to a penalty of \$2,000 per ton of excess emissions. Phase II, beginning in 2000, will include all power plants producing more than 25 megawatts and must meet a new cap calculated as 1.2 lbs. of SO₂ per million Btu times each unit's 1985-1987 consumption. Total reduction in Phase II will be an additional 5 million tons. In addition to private transactions, there are annual auctions, equivalent to about 2.8 percent of total allowances to assure that some allowances would be available for utilities that planned on complying with their emission limits by purchasing allowances.

In March 1995, the United States EPA expanded the Acid Rain Program to include industrial facilities that burn fossil fuels. The rule establishes an "opt-in" program that allows industrial and other sources to participate in the existing SO₂ program that previously included only utilities. Prior to the drafting of this program, a number of studies had identified potential cost savings of up to \$1 billion per year through emission trading due to significant differences among utility sources in the marginal cost of abatement. More recently, the United States EPA has estimated the cost to be \$1.2 billion and \$2.2 billion for Phase I and II respectively. An earlier report put the costs of acid rain control at \$4.5 to \$6 billion annually if a command and control approach were adopted. The same report estimated the mean value of annual health benefits at \$10.6 billion in Phase I and \$40 billion in Phase II. Benefits to the environment and to material previously had been placed at approximately \$2 billion annually. Interestingly, health benefits were not a major concern in the design of the Acid Rain Program, yet they now appear to be the dominant benefit component, dwarfing earlier estimates for the environmental effects.

By early 1995, utilities had exchanged over 2.3 million allowances and purchased an additional 300,000 allowances through the annual auction. While this activity is not negligible, it represents less than 5 percent of all Phase I allowances, indicating that most utilities were not relying on trading allowances to achieve compliance. In addition, the price of allowances has been far below what had

initially been forecast. When the amendments to the Clean Air Act were passed, abatement costs were estimated to be as high as \$1,500 per ton. However, in 1995 the price of allowances trading at the Chicago Board of Trade auctions were \$126 per ton, and in 1996 these prices fell to \$66 per ton.

Some of the reasons given for the relatively low level of activity are transaction costs that could have reduced realized gains from trading allowances, the behavior of public utility commissions, and state legislation that promotes the use of locally-produced coal. Another factor is that utilities have traded between facilities owned by the same company rather than between facilities owned by different parent companies. Only the latter trades are included in the numbers reported above.

Analysts have also tried to explain the low allowance prices. Prices for virtually every form of compliance have declined well below what had been anticipated before 1990. The price of low-sulphur coal delivered to midwest and eastern markets has declined due to productivity improvements in extraction and transport. In addition, engineers have found ways to blend low-sulphur coal with high-sulphur coal to reliably meet emission limits. Finally, innovations in the scrubber market have cut the cost of scrubbing by approximately one-half. This suggests that the decline in allowance prices over time is largely a consequence of improvements in productivity and technology. In addition to these reasons, economists have suggested that the mechanics of the auction may also contribute to lower prices. The Act requires what is termed a discriminating price auction, which ranks bids from highest to lowest. EPA has interpreted this as requiring that each seller receive the bid price of a specific buyer. The auction awards allowances offered by the seller with the lowest asking price to the bidder with the highest bid price first and moves up the supply list and down the bid list until no bidder is willing to offer what a seller demands. This unusual auction mechanism apparently causes sellers to misrepresent and under-reveal their true costs of emission control.

What, then, is the overall impact of the Acid Rain Program to date? A few utilities clearly are buying allowances as part of their compliance plan. For example, at the 29 March 1993 auction, Carolina Power and Light bought approximately two-thirds of the allowances offered. At the 27 March 1995 auction, Duke Power bought over one-half of the allowances offered. More broadly, allowance transactions and especially auctions provide a very visible price benchmark against which utilities and regulators can gauge performance. In addition, it is believed that Phase II of the Acid Rain Program will see much greater reliance on allowance trading. Phase II will involve 700 additional sources and more of these are expected to select scrubbing as their method of compliance. Since more scrubbing should result in greater variation in the marginal costs of control across sources, there should be greater incentives to trade allowances to achieve compliance in Phase II.

Another example of a tradeable permits system used for SO₂ control is operating in China. While there was relatively limited information on the Chinese SO₂ program, it is based on tradeable discharge quotas. The reasons for introducing this system were due to restrictions on expansion of production facilities. Additionally, older firms had higher abatement costs compared to newer factories. Based on the size, location and historical emissions, a trading scheme was introduced. There are relatively few participants in this program and there has been no summary done to date on its success. However, both the industry and firms supported this program so it is likely there have been some savings.

One of the issues the Chinese had to address in implementing this system was making price information on the permit market available for firms. There were also concerns over who would monitor and enforce the program.

Finally, the Canadian Transferable Consumption Allowances for HCFCs and methyl bromide, New Zealand's ozone depleting substances tradeable permits scheme and the United States

Chlorofluorocarbon Allowance Trading Program would also fit the standard definition of TPQ. These systems are fairly similar and are part of each respective economy's response to commitments made under the Montreal Protocol. The Canadian system of transferable allowances is based on historical consumption levels being allocated to producers or importers (HCFC) or applicators (methyl bromide). The number of allowances will be phased out by the year 2020. As yet, neither the program for HCFCs or methyl bromide has been binding on the participants and no trades have taken place. The two major findings from the design and introduction of this measure were the need for data to support the design of the program, and for regulatory provisions supporting the program be transparent and complete.

In New Zealand, the right to import a specified quantity of ODS is traded, and permits are issued based on actual imports in a prescribed "base year". There have been no studies yet carried out to determine the success of the tradeable permit scheme in New Zealand.

The United States system of tradeable allowances for CFCs also involves distributing allowances to companies that produced or imported CFCs and halons, and is based on 1986 market shares. One of the unique features of the United States system is that it is coupled with excise taxes on CFC production. The marketable permit system has resulted in a number of savings relative to a program that directly controlled end uses. For example, the EPA needed only 4 staffers compared to 33 staffers. Furthermore, industry estimated that a command and control approach to end uses would cost more than \$300 million for record keeping and reporting, versus only \$2.4 million for the allowance trading approach. Thus far, there have been about 700 trades involving about 500 million kgs of CFCs.

United States officials consider the system successful in that in that it accomplished its goals, but noted that the cost of producing substitutes fell faster than anticipated. As a result, regulated substances have nearly been eliminated from the market. Some of the practical implementation issues that arose with the United States system include spreading the required information to millions of end users and to thousands of repair facilities about the availability of substitutes, retrofitting existing engines to use substitutes, establishing rules for recycling CFCs and the fact that the black market in imports is difficult to police.

Others

There are several other examples of TPQs that should be noted among the responses to the survey. The first of these, transferable water rights or entitlements, were reported by Australia and Chile. The system of transferable water entitlements (TWE) in Victoria, Australia was introduced to help increase the efficiency of water allocation and to provide incentives for reuse. Irrigators pay for a water "right" based on the amount of land they hold which is suitable for gravity-fed irrigation and the Irrigation District in which they are located. The majority of trades have been for temporary transfers. Under this system, prices are negotiated between buyers and sellers and there are no restrictions on the volume which can be transferred, although owners must retain stock and domestic allocations of water.

Australia reports that the primary economic advantage is that water allocations are no longer linked with land rights, but are traded in a separate market for water as a commodity. Based on an increased number of water transfers, the system of TWEs has been judged effective. One of the features of this system is that costs have been minimized by achieving a high approval rate for requested transfers. This has been encouraged by a non-refundable application fee and through the availability of regional staff to advise on potential transfers.

In Chile, transferable water user rights are assigned for a specific quantity per period of time and are granted free of charge. The Chilean authorities have, in general, been satisfied with the operation of the system for transferable water rights. However, the fact that water user rights have been accumulated by institutions and individuals for speculative purposes and without productive use, combined with concern about increasing water scarcity due to sustained economic growth, led the authorities to modify the Water Code in 1996, establishing a compensation payment - which in fact is a fine - for not using the water rights. This payment is progressive, based on the time the water right is "idle". The non-payment of the fine eventually leads to the auctioning of the respective right.

In the United States, a system of transferable development rights has been instituted by several communities in order to protect sensitive land areas. To achieve this goal, communities have tried to zone large tracts of agricultural land to preclude or severely limit development. Compensation to property owners in exchange for their accepting restrictive zoning in perpetuity typically takes one of two forms: transferable development rights (TDRs) and purchase of development rights (PDRs). PDR payments typically are established as the difference between appraisals of land value in agricultural use and for development.

No appraisals are needed with a TDR system. Rather, transferable development rights are allocated to property owners on the basis of acreage (e.g. one right per acre). TDRs are available for sale to urban areas designated by the community for further growth. Property owners in the designated growth areas are allowed to exceed normal building density limits provided they acquire sufficient TDRs. Thus the market mechanism provides a means of compensating rural property owners whose land holdings are restricted in terms of development; no government funding is needed. However, inasmuch as the price of TDRs is determined by the availability of TDRs and the demand for more intensive development in designated growth areas, there is no necessary connection between the payment and the decrease in value of rural land whose development is restricted.

While a comprehensive review of the 23 separate TDRs is beyond the scope of this paper, an example should illustrate how they function. Talbot County in Maryland introduced a program to protect undeveloped rural areas as farms and to concentrate future development in areas where land is most valuable. In the designated "Rural Agricultural Zone" the County distributed TDRs at the rate of one for each ten acres, the base development rate. The maximum allowed density was increased to one dwelling for every five acres; however, an extra TDR would have to accompany any proposal to subdivide a 10 acre parcel and build two dwellings. The result is that the least valuable lands are preserved in agricultural use while the most valuable areas are developed residentially.

In addition to these three, other economies are considering the use of tradeable water rights. Chinese Taipei is examining the use of such a system to deal with the drawdown of ground water and serious land subsidence problems.

A final example of TPQ is the system of quotas for logs from State forests in Australia. This measure was introduced to address logging in native forests and to encourage greater efficiency of log use and improve measurements of value-added in the industry. In the past, the system used to establish log prices led to perceptions of financial inefficiency and subsidization of forest products supplied from public lands. As yet, there have been very few trades so it is difficult to determine the overall success of the plan.

Financial Incentives/Environmental Liability

A wide range of financial incentives and environmental liability measures have been developed to address a number of environmental issues. **Table 5** displays the various instruments reported by APEC economies. As can be seen from **Table 5**, they can take the form of performance bonds, subsidies, liability insurance and various tax measures to name a few and have been used in such diverse areas as waste disposal, the agriculture sector and the tourist industry. All economies that responded to the survey reported the use of these instruments. Because the issues these instruments can address is so diverse, they will be grouped by the different types reported. These include:

- performance bonds;
- various tax measures;
- liability insurance;
- subsidy funds.

Performance bonds

There were two economies reporting the use of performance bonds and/or financial assurance measures. Australia requires a performance bond to be posted by mining companies in order to ensure rehabilitation of mined areas. Recognizing the importance of the mining industry to its economy, the Queensland Government wanted to encourage improved performance of rehabilitation and environmental protection.

In addition, the government wanted to guide the industry towards self-regulation, with government ultimately playing an advisory and monitoring role. The reported advantages associated with self-governing regulations are: incentives to improve environmental performance, lower costs for government and less intervention by government in the resource management of mining companies.

While the bond, which was introduced in 1990, provides a strong incentive for lease holders to improve their environmental performance, it is also self-regulated. An external body carries out monitoring functions to ensure compliance. This, and the fact that industry contributed in the development of the scheme, has led to its acceptance by industry. The measure is mandatory for mining companies and there is a \$90,000 fine for non-compliance.

In Canada, the Ontario government can require a financial guarantee from a regulated industry as a condition of an order or approval. The guarantee is required to ensure that pollution control objectives are complied with or to ensure that funds are available for future remediation of landfill sites. These requirements can be met using not only performance bonds but also cash, letters of credit, Government of Canada or provincial bonds, agreements or liability insurance. At present, there is little information on their success but it is likely that compliance for installing pollution abatement equipment has increased due to the potential costs of forfeiting the financial guarantee. It is important to set the amount for the financial assurance at a level that does not impose undue costs on industry. With this in mind, the value of the financial guarantee in Ontario is based on: the estimated capital and operating costs associated with compliance; the quantity of waste being generated, processed, stored, or discharged; the estimated costs of cleaning-up and disposing of residues of a potential spill; and the costs of decommissioning a site. Thus far, the highest financial assurance required was \$10,200,000.

Tax Measures

Environmental incentives can be provided through different elements in the tax system. Some can be implemented using fuel taxes (eg. Australia - tax differential between leaded and unleaded gasoline, Mexico - revenue from gasoline tax used for environmental projects), others can be achieved using tax exemptions (eg. Australia - exemption for recycled paper products) while others target corporate income tax (Canada - accelerated capital cost allowances for air and water pollution control equipment, Chinese Taipei - accelerated depreciation, deductions for pollution control equipment) and other tax measures (Chinese Taipei - low interest rates, import tariff reductions, tax exempt dividends).

Australia reported the use of two different tax incentive schemes, one to encourage recycling of paper products and another to encourage the use of unleaded gasoline. The tax exemption for recycled paper products was introduced in 1992 at a reduction from the general sales tax of 21%. Even though a review concluded that the scheme had resulted in significant environmental benefits, it was recommended that it be abandoned¹⁵.

Table 1
Financial Incentives/Environmental Liability

ECONOMY	TYPE	ENVIRONMENTAL ISSUE
Australia: minesite rehabilitation, Queensland	performance bond	inducement for mining companies to rehabilitate mined areas
Australia: Lender Liability - Victoria	liability insurance	liability for the clean-up of contaminated sites
Australia: on-ground works in the Murray-Darling Basin	subsidy fund	<ul style="list-style-type: none"> • reclaim salt-affected land • diminish erosion • lower watertable recharge • lower salt, particulate and nutrient discharge into water supplies • reduce soil acidity
Australia: incentives for biodiversity conservation	Mala Fund	research into the Mala, or Rufous Hare-Wallaby, an endangered marsupial found in the central Australian deserts
Australia: recycled paper	tax exemption on recycled paper products	disposal of waste paper
Australia: unleaded/leaded petrol	tax incentive	lead emissions from petrol
Canada: financial assurances	financial assurance	for pollution control objectives and for funds for clean-up and remediation of landfill sites
Canada: ACCA	Accelerated Capital Cost Allowances	encourages the purchase of air and water pollution control equipment
China:	subsidy, favourable tax for environmental protection, performance bond	pollution reduction, cleaner production
Hong Kong, China:	default payments, bonds, insurance	air, noise, water, waste discharges

Table 5 cont'd

¹⁵ See Analysis section for more detail.

Financial Incentives/Environmental Liability

ECONOMY	TYPE	ENVIRONMENTAL ISSUE
Japan:	construction and transfer (C&T) program and low interest loan	not specified
Mexico: gasoline tax	tax/charge earmarked to support environmental projects through a trust fund	energy-gasoline related pollutants
Chinese Taipei:	import tariff reduction accelerated depreciation low interest loans tax deductions tax deferred dividends	air pollution, solid waste, water pollution, noise, vibration
Chinese Taipei: unleaded/leaded gasoline	tax incentives	lead emissions from gasoline combustion

In 1993, the Australian Government introduced a differential excise tax favouring unleaded gasoline. The differential is currently at a level of 2 c/l. The success of the differential will only be evident over a period of time, as older vehicles are retired. This change-over will be complemented by direct regulations which have also been introduced to require new vehicles to use unleaded gasoline. During its development phase, a number of concerns were raised. The public was concerned that the tax differential would be regressive, since lower income earners were considered more likely to own older vehicles. As a result, the original differential of 5 c/l was reduced to 2 c/l. In addition, the petroleum companies and motor vehicle manufacturers were concerned they would face additional costs.

Another way of using the tax system to address environmental concerns is through the use of accelerated capital cost allowances (ACCA). In Canada, operational or capital assets for air and water pollution control equipment can be amortized (expensed) more quickly, which effectively lowers their immediate tax payable. Deferred taxes effectively provide a loan to profitable companies by delaying the payment of taxes. However, the money saved is equal to the amount deferred multiplied by the annual prevailing interest rate. To qualify, legitimate expenses must have been incurred prior to the end of 1998 and the operations, building or plant in which the equipment is being used must have been in operation or under construction before 1974. To date, there have been approximately 17,000 applications processed.

There is no information on the environmental benefits related to this measure but industry was very supportive of the ACCA. However, it should be noted that projects affected by the ACCA would likely cost less because of the positive tax implications, and therefore these projects would be more likely to be implemented.

One of the issues to consider with this sort of instrument is that it is difficult to target specific industries. In the case of ACCA, unprofitable companies would not be able to take advantage of the ACCA because they would have no payable taxes to be deferred. As for the actual application rates, they have fluctuated depending on the economic and regulatory climate in the particular sector. For example, there has been an increase in applications from the pulp and paper sector in recent years, due to the recent increasing profit levels in this sector.

Like Australia, Mexico also reported the use of a gasoline tax. However, in this case the revenues raised from the tax on gasoline are earmarked to support environmental projects through a trust fund.

Some of the advantages noted for this measure were its low transaction costs, its political attractiveness and lack of social opposition (surcharge is equivalent to 1/200 of the price) and the efficiency with which funds can be raised for the trust fund. On the other hand, its design means it is not intended to modify behaviour patterns towards gasoline consumption and there is no incentive for improving energy efficiency.

In Chinese Taipei, the *Customs Import Tariff* encourages the use of “cleaner” technology by exempting imported equipment to reduce air pollution, noise, vibration and solid waste. In addition, under the *Statute for Facilitating Industrial Upgrading*, investment in excess of 0.6 million NT dollars can be offset by a deduction from corporate income tax up to 20% of the expense. Other tax measures that Chinese Taipei applies include accelerated depreciation for water and air pollution equipment and tax deferred dividends for newly released stocks if the retained profit is used for purchasing pollution control equipment.

Liability Insurance

In many economies, liability for the cost of cleaning up contaminated land has become a concern for lending institutions. As a result of increased financial risk, lending institutions are becoming more cautious about lending to businesses that they perceive as being risky from an environmental viewpoint. This result has the potential for serious consequences, particularly for environmentally important sectors such as the waste management industry.

In Victoria, Australia, the Environment Protection Act was amended in 1994 to exclude “passive lenders” from the definition of occupier under the Act. This limits the liability of financial institutions that act as mortgagee in possession, controller or managing controller to making the site safe (abating any existing hazard) and ensuring that any further operations do not cause pollution.

Hong Kong, China also reported a mix of instruments including insurance (others are default payments¹⁶ and bonds¹⁷) that are included in long term contracts for the disposal of their municipal waste. Each contractor must take out sufficient insurance to cover costs which would arise from any accidental discharge from the site which might harm the environment. These measures apply to all discharges to the air, water as well as waste discharges originating from landfill sites. They are enforced through contractual law rather than being legally binding, although additional measures can be imposed legally through the courts.

This system of contracts has been supported by both the contractors and the general public. Importantly, environmental pollution has also been contained. Monitoring to ensure compliance is carried out by independent consultants and enforcement is the responsibility of the government. The contracts allow for mediation and arbitration to resolve conflict. In the case of environmental damage, the contractors are wholly liable. The average liability is in the order of US\$36 million.

One of the main issues that had to be addressed in developing this system was the requirement for the contractors to set up the necessary quality assurance and control systems to ensure compliance. However, as previously mentioned, the contractors support this system and compliance with environmental requirements is about 96%.

¹⁶ The contractor has sums deducted from his monthly payments for each occasion any environmental requirement of the contract is breached. Default payments are 25% of the operating costs of the landfill.

¹⁷ Each contractor has to provide the Government with an “on call” bond, which can be called by Government if the contractor does not comply with his environmental obligations.

Subsidies and Funds

The use of subsidies and funds is a popular way to provide financial resources for environmental protection. Australia, Chile, China, Chinese Taipei and Japan all reported measures of these types. Australia reported two funds used for environmental purposes: the Integrated Catchment Management Fund (ICMF) for on-ground works in the Murray-Darling Basin and the Mala Fund to support research on the Rufous Hare-Wallaby, an endangered marsupial. The purpose of the ICMF was to help reclaim salt-affected land, diminish erosion, lower watertable recharge, lower salt, particulate and nutrient discharge, reduce soil acidity and declining crop yields as well as to conserve ecosystems and biodiversity.

The fund was introduced in 1996 and is expected to raise \$13.8 million per year from rural industries in the agriculture sector as well as from government programs. Since it has only been introduced recently, it is too early to estimate its success.

A cost-benefit framework was developed to help facilitate an action plan and the most appropriate mix of works under consideration. The entire process involved a multi-criteria analysis including:

- consultation with stakeholders;
- agreeing on cost-sharing principles;
- selecting an analysis method;
- identifying and valuing benefits and costs;
- identifying and quantifying levels of public and private benefits derived from on-ground works;
- selecting the mix of works
- assembling a cost-sharing framework for consideration in the next phase;
- assembling the cost-sharing framework showing the recommended cost shares as a basis for negotiation.

One of the unique aspects of the cost-sharing framework developed for the ICMF was that government would only contribute towards the cost of on-ground works if there was progress in satisfying the following conditions:

- community awareness of land and water degradation issues and remedial actions had been increased;
- community awareness had been increased about off-site impacts and other economic externalities associated with land and water degradation;
- policy and legislative impediments to addressing land and water degradation had been removed;
- point-source polluters were identified and measures imposed to ensure they pay the full cost of their actions; and
- governments have agreed to invest in implementation of action plans, on a beneficiary pays basis, on behalf of the broader community.

The other fund reported by Australia is the Mala Fund. Relatively little information is available on this instrument. It was established in 1991 by the Central Australian Tourism Industry Association and the

Pacific Asia Travel Association. Thus far, \$33,000 has been raised to support research into the Mala, or Rufous Hare-Wallaby, an endangered marsupial found in the central Australian deserts.

In Chile, a system of subsidies for reforestation has been in place since 1974. Originally the subsidies had a primarily economic objective, promoting tree planting and plantations. In the modification and extension of the subsidies, environmental arguments such as the prevention of soil erosion and reforestation with native species with higher economic value played an important role. The subsidies amount to 75% of the initial investment as well as the subsequent management costs. Any owner is eligible for the subsidies. During its existence, the system has funded about US\$120million for approximately 800,000 hectares of forest. Of concern, however, is the fact that the legislation does not distinguish between native and exotic species. This has led to a clear bias towards the introduction and plantation of exotic species for which the market is better defined and which provide investors with quicker returns. Also, the lack of discrimination between small and large owners has resulted in the subsidies accruing to the larger land owners. According to researchers only about 4% of the subsidies accrued to small owners (less than 50ha).

China reported the use of subsidies as well as favourable investment adjusting taxes and performance bonds¹⁸ for reducing pollution and providing an incentive for cleaner production. The key industries targeted for this mix of measures were the chemical, paper, iron and steel, building material and coal power sectors.

The measure was introduced in 1982 and has promoted the utilization of used materials and the development of an environmental industry. The subsidy measures, in particular, have been supported by the polluting industries. Revenues are raised through taxation measures and allocated by local authorities. The subsidy policy has, however, placed a burden on governments, and may not be compatible with the polluter pays principle. In addition, the system of subsidies is considered to be ineffective in generating an incentive for adopting advanced technologies for pollution control.

Another example of a financial incentive is the Construction and Transfer programme and system of low interest loans introduced in 1965 by Japan. Under this programme, various pollution control and environmental protection facilities are transferred to private companies and local governments after they are constructed by the Japan Environmental Corporation (JEC), which is a non-profit organization created in 1965.

Payments can be made to the JEC in long-term installments at interest rates lower than those of commercial banks. The JEC also provides loan services for companies which intend to establish pollution control facilities. The terms and conditions of these loans allow for preferential interest rates and repayment in long-term installments up to a maximum of 20 years. Although there have been no measurable impacts, on the whole, many efficient measures have been introduced through this system and have contributed to reducing and preventing environmental pollution.

Chinese Taipei reported the use of several funds for environmental purposes. In order to help with the administration costs of their mandatory recycling program, a fund was established by participating firms. This recycling fund has helped to reduce transaction costs and has helped to promote mandatory recycling. To implement waste recycling, eight regulations have been introduced which stipulate that twenty-one items, such as waste aluminum cans and used lubricant oil, are required to be recycled. To further strengthen the effectiveness of waste recycling, the "Four-in-One Resource Recycling Program" went into effect in March 1996. A Central Recycling Fund is expected to be established shortly. In addition, Chinese Taipei has enacted a "Feedback Fund" under which compensation for environment problems can be paid. It operates much as liability insurance does. For example, in 1990

¹⁸ A performance bond is required for cleanup projects from enterprises taking measures for pollution control. The maximum liability is based on the degree of pollution caused by polluters. If requirements are not met, the bond or deposit is not refunded.

protests were held over air pollution from the Chinese Petroleum Company. An agreement was finally reached under which the Company agreed to pay individual residents a total of 1.3 billion NT dollars. Officials feel that the "Feedback Fund" helps to encourage investment in pollution prevention by offering a lower cost alternative (it is cheaper to prevent pollution than to provide compensation) and better public relations. Another measure introduced by Chinese Taipei involves subsidies which are provided to encourage the private sector's involvement in constructing incineration plants. Two approaches have been adopted: build-operate-own and build-operate-transfer.

Others

In addition to some of the more conventional economic instruments, economies also identified others that they felt might provide additional insight into these types of measures.

Australia reported on a major initiative by the Victorian EPA over the past decade to promote the adoption of cleaner production technologies and management practices. Since the mid-1980's, it was clear to many sectors of industry that there were significant commercial opportunities as well as environmental advantages in minimizing wastes or avoiding them altogether by adopting cleaner production technologies and management practices. It was also recognized that cleaner production could overcome the operating and financial limitations of the more traditional end-of-pipe technologies that deal with waste after it has been generated. As a result, cleaner production has become a key feature in all EPA processes and activities in Victoria. Helping companies to identify opportunities for cleaner production is now an important part of the licensing and works approval process. Two examples of this process were identified.

Ford Australia was able to save approximately \$300,000 per year through its Waste Minimization Plan. High pressure water was used instead of caustic soda to clean paint off booth grates and skids. The initial capital outlay was \$120,000 and after including additional benefits of \$100,000 per year, realized a payback period of less than five months.

In another example, Cadbury Schweppes began a Cleaner Production Project to improve its waste minimization activities. For an initial outlay of \$1.25 million, the Project created savings of \$780,000. Environmental benefits achieved by the Project included reductions in solid and liquid wastes and dramatic reductions in water use and energy consumption.

Another innovative approach taken in Victoria is the Accredited Licensee Scheme. Under this scheme, businesses with demonstrated capabilities and commitment to environment protection are given greater scope to manage their own environmental performance within the framework provided by the Environment Protection Act 1970. These businesses can apply for accredited status with EPA, which offers a number of advantages, many of them financial. Some of these advantages include:

- a simplified license which outlines broad performance criteria for the site as a whole;
- no additional approval requirements for most new works;
- a 25% license fee reduction; and
- the ability to place environmental management in the mainstream of the company's decision making processes.

In addition, an Environmental Management System (EMS) is required for certification. This should result in increased environmental awareness and reduce the cost of pollution incidents and require less

time by senior management on crisis management. The scheme also frees up government resources which can then provide additional assistance to small companies experiencing environmental problems. The fact that the scheme is voluntary is important. The expected benefits will accrue only if the company is committed to best practice environmental management and consultations with interested parties. Checks and balances are built into the system with third party certification, an environmental audit program, annual environmental performance reports and involvement of the local community. Overall, the scheme promotes efficiency for both governments and businesses. It provides strong economic incentives for business to become good environmental performers and it allocates resources where they are most needed.

The United States also reported two provisions for addressing liability for natural resource and environmental damage. The first, natural resource damage assessment, was introduced in the Comprehensive Environmental Restoration, Compensation and Liability Act in 1980 and the Oil Pollution Act in 1990. This measure allows for restoration costs and lost use values to be applied to those who release hazardous substances and oil into the environment. Thus far, settlements have totaled nearly \$1 billion and available evidence shows that industry is being much more careful not to have accidental releases of oil and hazardous substances. In fact, the volume of oil spilled has fallen by about one half over the last decade. One of the key issues raised through the implementation of this measure was the treatment of so-called “passive uses” values that people held for resources even though they did not use the resource and had no plans to use the resource. Industry opposed any compensation for passive use and the rules that were adopted made it very difficult (but not impossible) to make claims for passive use losses.

The other provisions for liability are civil and criminal penalties. Most federal environmental statutes contain provisions making it a crime to knowingly pollute the environment or cause harm to natural resources. In addition, offenders may be “blacklisted” from receiving future federal contracts. In 1995, there were indictments against 443 corporations and 1,068 individuals and \$297 million in criminal penalties. Sentences for individuals totaled 561 person-years of prison for those convicted. These penalties, especially the threat of serving time in jail, seem to be effective. Some companies have changed their behaviour dramatically following enforcement actions against the company and its officers.

3. LESSONS LEARNED

In this section, the various reasons for implementing particular instruments will be discussed along with some of the difficult issues that were raised during their development and implementation. This will include some specific illustrative examples from the survey of measures which were considered a success or failure.

Environmental/User Charges

Since most of the charge schemes reported in the survey were of the user charge variety, it is not surprising that the primary reason given for their use was to raise revenue. Whether it was to cover the capital costs of new landfills, to provide water services or to raise funds to compensate patients suffering from environmental-related illnesses, these charges were found to be an effective source of funds for governments. In many cases, they were not designed to cover all the costs of providing these services (e.g. Australia; Hong Kong, China). In these cases, funds from general revenue would be required to cover the costs of these services. In China, charges were introduced as environmental charges with the intention of changing behaviour. However, in practice, they function as user charges. In Japan, a charge was introduced in order to compensate patients. However, as a result, it played the role of an environmental charge by changing behaviour.

In addition to providing a source of revenue, most of the reported user charges also had an incentive element to them. Australia; Canada; Hong Kong, China; and Mexico all reported that, at the very least, these measures had the potential to change behaviour. However, in most cases, the primary objective of raising revenue led to charge structures that were considered less effective from an incentive perspective. This highlights the need to carefully consider both the goal of the measure and the level at which it is to be set. An example of this is the environmental charge on water, waste, noise and air pollution in China. The primary purpose of the charge is to provide an incentive for firms to reduce their pollution. However, as reported by China, the charge is set at a level that is less than the average treatment cost so polluters pay the charge rather than change their behaviour.

Besides the related goals of revenue and behaviour modification, charges were considered preferential to other measures for the following reasons:

- many of the alternative measures were administratively complex and difficult to enforce;
- charges were considered to be fair and equitable;
- the charge could target specific industries; and
- charges can provide a signal that heightens awareness of an environmental problem.

Several economies mentioned that industry often supported the notion that charges should be based on the Polluter Pays Principle. Determining who would pay the charge as well as the level of charge that respects the Polluter Pays Principle was often accomplished through consultations with stakeholders. Consultations were considered to be essential in helping to set a charge at a level that is sufficient to provide incentives for ongoing improvement as well as gaining the support of the general public and industry who might have had little previous experience with charges based on pollution levels.

Another benefit of consultations and social marketing is that consumers may regard the introduction of new charges on items that were previously included in general taxes as double-dipping. In this case,

surveys, telephone hotlines, information kits, open houses and even television announcements may help to reduce or eliminate this perception.

In addition to the issue of setting the charge levels and identifying who would pay, a number of other implementation issues associated with the introduction of charges were reported by economies. Many of these were specific to the measures in question. As previously mentioned, both Canada and Australia identified a significant number of water users that are not metered. Without a way of charging users based on their day-to-day use, charges become less effective. Taken to the extreme, a system based on flat rates provides no incentive to reduce consumption that is in excess of the quantity associated with the flat rate. In addition, metering provides consumers with the information they need to effectively change their consumption habits. The benefits associated with the general principle of charging consumers based on actual use would also apply for charges in other areas besides water.

Another issue that arose in the context of charges for waste disposal was illegal dumping. In Canada, this was addressed by increasing public pressure, strengthening existing legislation and increasing monitoring activities. In addition, another innovative option being examined is to publish the names of illegal dumpers in local newspapers.

An issue that is sometimes overlooked is that economic instruments, including charges, require well-functioning markets to properly work. In China, a charge on water, air, waste and noise pollution is intended to discourage these activities. However, since the law allows state-run firms to pass on the cost of pollution charges in the form of higher prices, or to obtain an offsetting tax rebate, pollution is not being reduced at the lowest social cost. This type of problem can exist wherever there is a lack of competitive forces that fail to give consumers opportunities to purchase goods based on price.

Where polluters are not meeting the pollution reduction requirements, Mexico pointed out that exemptions should not be granted. Granting exemptions may be an attractive option, especially when the firm in question is important to the economy. In essence, the use of exemptions effectively rewards those who are not observing the law and punishes those who do.

Deposit/Refund Systems

All economies reporting the use of deposit/refund systems did so for addressing beverage containers. Some were introduced voluntarily by manufacturers while others were introduced through legislation. All indications from the survey are that deposit/refund systems can create a strong economic incentive to return beverage containers.

This is highlighted by the high return rates reported in the survey, especially for beer containers. While recycling is not guaranteed, these systems can provide favourable conditions for the reuse of containers or the material from which they are made. Besides helping to reduce the volume of waste collected, economies also reported that they can help prevent littering and serve to raise environmental consciousness. There are indications that industry can become less supportive if return rates fall below acceptable levels.

In some cases, however, deposit/refund systems were abandoned. Japan reported that some local municipalities found that the deposit/refund system posed an unacceptably high load on retailers as well as decreasing their revenues due to the general impression of high prices.

Other details that should be considered when developing deposit/refund systems include:

- ensuring retailers accept returns and pay refunds;

- promoting the return of empty containers by offering convenient drop-off locations;
- encouraging standardized packaging to facilitate recycling efforts; and
- in federal-style economies, the possibility of unequal cost conditions in different states should be considered.

Tradeable permits/quotas

There are a wide range of reported issues that have been addressed using tradeable permits or quotas (TPQs). These include controlling access to fisheries, allocating water and timber resources as well as reducing air pollution. In many cases, TPQs were introduced because it was felt a previous system was inadequate. For example, Australia had earlier tried to regulate the South East Fishery based on a boat replacement policy, restrictions on the size of vessels, limitations on entry to the industry and various kinds of input controls. This system did not succeed because it failed to prevent economic deterioration of the industry and the stock of some species. On the other hand, Chile introduced a system of individual transferable quotas to both overexploited fisheries and new fisheries. In China, the traditional method of controlling emissions did not allow existing firms to expand by taking advantage of scale economies and old firms could not afford the cost of new pollution control equipment. In other cases, TPQs were used to control new substances. As a signatory to the Montreal Protocol on Substances that Deplete the Ozone Layer, Canada introduced a system of Transferable Consumption Allowances for HCFCs. This system was selected because it could provide a level of flexibility in adapting to the changing patterns of HCFC consumption while ensuring that HCFC reductions would be achieved on schedule.

For the systems reported in the survey, TPQs were found to be an effective manner of achieving environmental objectives at a lower cost than alternatives. Their ability to take advantage of differing control costs was noted as an important factor. By encouraging trade between firms, reductions were achieved at a lower cost. The incentive to lower costs in a regulated industry can lead to support and even leadership to introduce such a system (eg. Canadian Pilot Emission Reduction Trading Program).

However, because TPQs are new and relatively untried, there are many issues to be addressed if they are to be successful. An important factor is monitoring and enforcement. Not all applications are open to easy monitoring. If there are many sources, monitoring can become quite difficult. In some cases, continuous monitoring may be necessary. This can prove costly and technically challenging. For example, the Hunter River Salinity Trading Scheme in Australia requires real time monitoring to be conducted upstream and downstream of the discharge point in the Hunter River. Because TPQ systems are relatively untried, it may make sense to begin with a pilot phase. The Canadian Pilot Emission Reduction Trading Program is a voluntary pilot program that was considered appropriate given the relative scarcity of experience with emissions reduction allowance programs.

One of the important factors to be considered in the development of a system of TPQs is the method of initial allocation. The primary method used in the schemes reported in the survey made use of historical catch or emission levels. Under this form of allocation, historical usage is rewarded by free or low-cost access to a resource. One of the concerns with such a method of allocation is that participants may act strategically to prevent free access to the market. This seems to be what happened in Chile. Under their system of transferable water user rights, water rights have been accumulated by institutions and individuals for speculative purposes. As a result, Chilean authorities modified the system and introduced a penalty for not using the water rights.

Another method of allocation is through an auction. The United States Acid Rain program auctions a small portion of the allowances, but this system has been criticized on the grounds that the auction contributes to lower prices than would otherwise occur. The auction process awards allowances offered by the seller with the lowest asking price to the bidder with the highest bid price first and moves up the supply list and down the bid list until no bidder is willing to offer what a seller demands. This unusual auction mechanism apparently causes sellers to misrepresent and under-reveal their true costs of emission control. The United States EPA may consider using a single price auction, which in theory should elicit higher bids.

Another consideration in developing a successful scheme is how many participants there might be. If there are too few participants then an efficient market may not be established due to strategic market behaviour. If there are too many small participants, trading becomes difficult because of the cost of gathering information as well as monitoring and enforcement problems. The majority of the reported systems using TPQs were in the various industrial sectors which have a relatively limited number of potential participants. In two cases, there are only three participants (Murray-Darling Basin Salinity Scheme, Bubble licenses for the Hawkesbury-Nepean River). With this few participants, there is the potential for strategic behaviour. However, in the case of the Murray-Darling Basin Salinity Scheme, trading only takes place between three States within a constrained strategic framework¹⁹. In the case of the bubble license system for the Hawkesbury-Nepean River, trading takes place between three sewage treatment plants. The bubble licensing system is underpinned by a strong regulatory framework. In both cases, strategic behaviour may be unlikely because of these additional constraints.

Other concerns that were raised by economies were:

- determining what pollutants and sources should be included in the program;
- determining the cap and a reduction schedule;
- what limitations should be imposed on banking and sales of TPQs;
- identifying a base year for total allowances and a method of allocating allowances.

Most of these concerns can apply to any TPQ system. It is also important to consider potential complexities on a case-by-case basis. This is where consultations can prove useful. Often firms and environmental groups can identify issues that may not have been considered by the proponents of the scheme. Such consideration will often improve the chances of success. For example, the capability to switch between oil and gas as a source of fuel by a major point source in the Kwinana Industrial Area required two different patterns of adjustment by other dischargers in the area. Negotiations between dischargers has led to reduced emissions in a cost effective manner.

Another area of agreement among survey respondents was the need to consider the transboundary or global effects. For example, one of the concerns of industry in developing the Canadian Transferable Consumption Allowances system for HCFCs and methyl bromide was the existence of complementary action in other economies to maintain a level playing field. Another example is the ITQ system in the Australian Southern Bluefin Tuna Fishery. The system of ITQs and the overall management plan for the fishery are complicated by the fact that the species migrates over long distances and is fished on the high seas as well as within New Zealand's 200-nautical mile limit. This same issue arises within the Black Hake fishery in Chile. Not all of the species distribution area is within Chilean water and surveillance covers a huge and geographically difficult area.

¹⁹ This system works by encouraging investment in capital works to manage salt entering the river system. "Salt credits" are created by generating reductions which can be exchanged between the governments of New South Wales, Victoria and South Australia.

Financial Incentives/Environmental Liability

This category of instrument, more than any other, is composed of measures that are individually distinct from each other. Many of their features are specific to a particular measure or issue. Consequently, it is difficult to analyze these measures as a group because they are so distinct. Nevertheless, the following sums up those issues that are common to this set of economic instruments.

These instruments have been generally introduced to provide funding for various environmental goals. For a more complete listing of their uses see **Table 5**. While each case should be judged on its own merits, it is probably fair to say that these types of instruments are supported by industry because they offer a high degree of flexibility and in some cases are implemented on a voluntary or self-regulated basis. In addition, they can be designed to be enforced through contractual law rather than made legally binding.

From the perspective of regulators, such measures are attractive because they can be tailored to individual sectors and issues and, through the use of consultations, can be used to increase community awareness of environmental problems.

Financial incentives are often used to meet the requirements of industry while encouraging acceptable environmental behaviour. However, in order to be successful, all factors related to their implementation should be considered. For example, it is useful to review the experience in Australia of providing a tax exemption on recycled paper products. This program was introduced in 1992 and provided a tax exemption of 21% to recycled paper products. However, despite a review that concluded it had resulted in significant environmental benefits, it was abolished because it had proven to be administratively inefficient.

This was due to a number of market distortions including:

- The exemptions did little to increase the utilisation of waste paper, since the exemptions favoured single use goods such as tissues.
- There was a disadvantage to partially recycled papers.
- The exemptions increased the demand for high quality waste paper to the extent that such waste paper began to be imported, and resulted in the diversion of high quality waste paper away from more efficient uses such as the production of industrial and packaging papers.
- The exemptions resulted in supply of imported recycled paper products and thus represented a subsidy to the reduction of waste paper in other countries.
- As those imported products could not be tested for 100% recycled content they may have had some virgin fibre content and thus competed unfairly with domestic products which sought the exemption.
- The exemptions provided no incentive to increase the demand for waste newsprint which accounts for a greater proportion of waste paper in landfills.
- The exemptions did little to conserve Australia's native forests because the types of paper products targeted for the exemption, such as toilet tissue, were produced from plantation timber rather than forest timber.

The review recommended that it be replaced by a broader strategic mechanism to support the recycling of post-consumer high grade waste paper. As this example shows, administration details as well as environmental and economic factors all play a role in contributing to a measure's success or failure.

While many of these measures have the explicit objective of encouraging appropriate environmental behaviour, some funds are used solely to raise revenue. For example, Mexico's gasoline tax is intended to raise revenue to support environmental projects. It is not intended to modify gasoline consumption or provide any incentive to increase energy efficiency. Likewise, the Mala Fund in Australia was introduced to support research and not to directly affect behaviour. In this way, financial incentives are similar to charges in that they can be designed to provide revenue or to change environmental behaviour. It is important to have a clear objective in mind when developing financial incentives.

4. CONCLUSIONS

As the previous sections have shown, economic instruments have been successfully developed in the APEC region to address a wide range of environmental issues. Overall, their flexibility and allowance for differing control costs make them suitable for consideration as part of a broader policy package in many areas that are presently regulated.

However, it should be noted that some instruments examined in this survey were not successful for various reasons. This indicates the need for a careful examination of such instruments on a case-by-case basis during their development stage. Furthermore, many of these measures have only been implemented recently and therefore are yet to be fully evaluated.

According to the findings of the survey, the majority of charge type systems have been developed primarily to address revenue requirements rather than explicitly targeting environmental behaviour. With the costs of supplying environmental remedies rising, these user charges fulfill a necessary function. However, they may not explicitly address the root cause of environmental degradation.

It should be noted that several economies believed that these charges could also provide an incentive to change behaviour even though that was not their primary purpose. This could take place when systems provided enough of an incentive for polluters to reduce their emissions in response to the charge. In addition, user charges are also information tools in that they identify some of the previously hidden costs associated with pollution. Simply making these costs explicit can provide an incentive to change.

Financial incentive and environmental liability were also similar to charges in that they either provided funding for environmental projects or provided an incentive to change.

On the other hand, both tradeable permits/quotas and deposit/refund systems provided an explicit incentive to change behaviour. This makes them attractive when an environmental issue requires assurance that a specific goal or target must be met. However, both charges and tradeable permits/quotas can theoretically be used to address similar issues. The question boils down to setting the charge at an appropriate level. For example, it is interesting to note that Australia uses a charge system to address some of its requirements under the Montreal Protocol whereas Canada uses transferable allowances to address the same issue.

Another conclusion that could be drawn from the survey is that the introduction of economic instruments is facilitated by the use of public consultations with affected stakeholders. This serves a dual purpose of building public confidence and support for these novel approaches as well as providing for additional input into the development process that can result in an improved measure.



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