11. FOREIGN EXPERIENCES WITH INCENTIVE SYSTEMS

Numerous economic incentives have been used in environmental management in foreign countries, including several mechanisms little known in the United States. Although a detailed description and assessment of each of these incentives is beyond the scope of this report, this Section does contain an overview of charges, deposit-refund systems, subsidies, product labeling schemes, and market-based permit systems used as environmental policy instruments in foreign countries to provide perspective on the U.S. experience. While this Section in general does not include incentive mechanisms that have been proposed but not implemented, it does describe a few proposals whose acceptance appears imminent. The incentives are described under the same general headings as in earlier sections.

Table 11-1 highlights a few noteworthy incentive mechanisms used in foreign countries. This report does not endorse any of these mechanisms. They are included in the table because they appear to either differ significantly from incentives used in the United States or have significant impacts on behavior. More information on these and other incentives used outside the United States can be found in the rest of this Section.

Table 11-1: NOTEWORTHY INCENTIVE MECHANISMS OUTSIDE THE UNITED STATES

Mechanism	Where applied	Observations
Environmental labeling	Virtually all industrialized and numerous less industrialized countries	Govt. programs to promote environmentally friendly products. Credited with decreasing VOC and other emissions in Germany and increasing recycled paper use in Korea.
Noise pollution charges	Belgium, France, Germany, Japan, the Netherlands, Norway, and Switzerland	Not used in U.S.
Effluent charges	Several countries	Evidence of incentive effects in Germany, the Netherlands, and Malaysia.
Water extraction charges	Several countries	Incentive effects noted in several Asian countries and projected in the Netherlands.

Mechanism	Where applied	Observations
Carbon / energy taxes	Denmark, Finland, the Netherlands, Norway, and Sweden	Not used in the U.S. Incentive effects noted in Sweden and Finland and projected effects in the Netherlands.
Deposit systems	Numerous countries, including Austria, Greece, Korea, Norway, and Sweden	Differ from U.S.: Korea requires deposits from producers, links refunds to proper post-consumer disposal, includes motor oil, other products. Austria includes light bulbs. Greece, Norway, and Sweden include car hulks, note incentive effects.
Fertilizer and pesticide charges	Austria, Belgium, Scandinavian countries	Higher than fees in U.S. states. Incentive effects noted in Austria and Sweden
Other product charges	Various countries (e.g., Belgium's disposables tax, Italy's plastic bag tax, Korea's taxes on various products, Germany's industry-imposed packaging fees.)	More products than in U.S. incentive effects noted or projected for some of these charges.
Livestock and manure charges	Belgium and the Netherlands	Little if any use in the U.S.
Motor vehicle quota system	Singapore	Not used in U.S. incentive effects noted.
Congestion pricing	France, Norway, and Singapore	Use just beginning in U.S. Incentive effects noted in all three countries.
Motor fuel taxation	Various countries	Higher than U.S. taxes. Unleaded tax preference differs from U.S. credit approach. Sweden taxes diesel according to emissions. Incentive effects noted in differential taxation.

Mechanism	Where applied	Observations
NO_x emissions charges	France and Sweden	Little used in the U.S. (except California). Incentive effects noted in Sweden.
SO_2 emissions charges	France, Japan, other countries	Differs from U.S. approach of tradable allowances under acid rain program.

11.1. FEES, CHARGES, AND TAXES

The different types of fees, charges, and taxes were described in Section 4. As in that Section, the terms "fee," "charge," and "tax" are used interchangeably throughout this Section.

As in the United States, many of the environmental charges found in foreign countries exist in addition to command-and-control pollution regulations and are used to raise revenue as well as encourage environmentally friendly behavior. The revenue-raising effect is often stronger than the incentive effect.

11.1.1. Waste

A 1994 OECD study of economic instruments reports that municipal waste user charges are levied in 18 of the 21 industrialized countries (all but New Zealand, Portugal, and the United Kingdom) that it surveyed.[1] The charges are usually (but not always) flat rates for households and unit rates for commercial generators. Unit rates are more likely to have an incentive effect than flat rates that are independent of quantities of waste generated. The charges usually fund waste collection and/or disposal.

Denmark, for example, levies taxes of 195 DK ($34) per metric ton on waste delivered to landfills and 160 DK ($28) per metric ton on waste delivered to incineration facilities. These taxes raised 527.6 million DK ($92.6 million) in 1993.[2] Since the tax was introduced in 1987, the quantity of waste registered at disposal facilities has dropped and the reuse of building waste as filling material for road construction and other purposes has increased. There has also been a slight increase in illegal waste disposal. However, it is unclear to what extent these phenomena can be attributed to the waste tax.[3]

In the Netherlands, a tax on landfill disposal of waste came into effect January 1, 1995 as part of a broader environmental tax law. The tax was set at 29.2 Dfl ($17.8) per metric ton and is expected to generate annual revenues of approximately 275 million Dfl ($167 million). The main purpose of the tax is to raise revenue for the national budget, but a secondary purpose is to discourage waste generation. To promote incineration as a disposal method, incineration is exempt from the tax. The size of the tax relative to the

average waste treatment costs of 82 Dfl ($50) per metric ton suggests that the tax could have significant incentive impact.[4]

In the United Kingdom, a landfill tax is scheduled to come into effect on October 1, 1996. The tax rate will be 2 £ ($3) per metric ton for inactive waste such as bricks and 7 £ ($10.7) per metric ton for other waste. Landfill operators will pay the tax but will be able to increase their fees. The British Customs and Excise office said that the tax is "designed to use market forces to protect the environment by making the disposal of waste in landfill sites more expensive." Businesses' national insurance contributions will be cut to compensate for the effect of the tax on business.[5]

Outside the OECD, South Korea introduced a system in 1995 under which household waste can be disposed of only in standardized bags sold in officially designated places. As shown in table 11-2, bag prices in the metropolitan areas of the capital city of Seoul range from 60-80 won ($0.08-0.1) for five-liter bags to 1,090-1,450 won ($1.41-$1.88) for 100-liter bags. Prices are determined by local governments and vary slightly from area to area. The amount of waste sent to landfills was approximately 40% lower during the six months after implementation of the system. Unfortunately, a large quantity of the decrease was attributable not to recycling but rather to uncontrolled incineration or private disposal. (Perhaps six months is too short a period for viable recycling options to be created.) Other problems are that the plastic bags themselves are not biodegradable and thus pose disposal problems and that the bag fees are too low to cover waste disposal costs.[6]

In 1994, Turkey introduced an Environmental Cleanup Tax on waste to raise revenue and to discourage waste generation. The monthly rate was set at 25,000 TL ($0.37) to 100,000 TL ($1.47) for households and 25,000 TL ($0.37) to 5,000,000 TL ($295) for other generators. The Cleanup Tax was also imposed on waste water.[7]

Australia, Austria, Belgium, Finland, France, and several German states impose charges on hazardous waste disposal. Austria's tax of 200 S ($19) per metric ton is used to fund the cleanup of contaminated land.[8] France has imposed a tax on the disposal of "special industrial wastes," a category including asbestos, chrome, lead, solvents, and other specified substances. The tax is rising progressively from 20 F ($4) per metric ton in 1994 to 40 F ($8) per metric ton in 1998.[9] It is unclear whether these charges have a significant incentive effect.

The Netherlands and the Flanders region of Belgium impose charges on animal manure disposal to limit soil pollution. In the Netherlands, individuals are permitted to dump the manure equivalent of 125 kg of phosphate per hectare per year free of charge. Quantities between 125 and 200 kg are subject to a charge of 0.25 Dfl ($0.15) for every kg over 125 kg, and quantities over 200 kg to a charge of 0.5 Dfl ($0.3) per kg.[10]

Table 11-2: WASTE DISPOSAL BAG PRICES IN SEOUL METROPOLITAN AREA
(as of January 12, 1995)

Bag size	Price (in won)	Price (in $US)
For households		
5 liters	60-80	0.08-0.10
10 liters	110-150	0.14-0.19
20 liters	210-280	0.27-0.36
50 liters	510-720	0.66-0.93
For businesses		
20 liters	230-290	0.30-0.38
50 liters	550-730	0.71-0.95
75 liters	820-1,090	1.06-1.41
100 liters	1,090-1,450	1.41-1.88

Source: Rhee (1995), "Waste-Collection Fee and Sustainable Consumption."

Waste charges have also been levied in a number of less industrialized countries, including the Czech Republic, China, Estonia, Hungary, Poland, Russia, and the Slovak Republic. Municipal waste charges for households and businesses in the Czech Republic, which have been in place since before World War II, were significantly increased in 1992. Municipalities determine prices: In Prague, for example, the rate was 14.53 ECU ($18.2) per metric ton in 1993, and other municipalities charge fees within 60% of Prague's rate. One problem with the increased charges is that they appear to have led to an increase in illegal dumping.[11]

Since 1992, the Czech Republic has also levied two types of charges on landfill operators. The first charge, imposed on all landfill operators, generates revenue for the municipality where the landfill is located to finance environmental protection activities. The second charge is imposed only on those landfills that do not adhere to specified waste disposal standards. One report indicates that the charge "very positively motivated the establishment of new dumps in accordance with the strict required criteria concerning the safe storing of waste." As shown in table #, the amounts of both charges vary significantly according to the type of waste, the highest being 5,000 Kc ($184) per metric ton for dangerous waste. The Slovak Republic has similar charges.[12]

Table 11-3: CHARGES ON LANDFILL OPERATORS IN THE CZECH REPUBLIC
(in Kc per metric ton in 1994, $=27.196 kc)

Waste category	Charge I	Charge II
Earth and organic matter	0	6
Other waste	10	140
Municipal waste	20	210
Special waste (not in categories 3 or 5)	40	640
Dangerous waste	250	5,000

Source: Regional Environmental Center for Central and Eastern Europe (1995), p. 11.

In much of Eastern Europe and the former Soviet Union, charges on waste as well as air and water pollution are higher for quantities in excess of permitted levels or for improperly handled quantities. These higher incremental rates for levels in excess of standards could be looked upon as non-compliance fees.[13]

11.1.2. Air

Canada, France, Japan, Norway, Portugal, Sweden, and several less industrialized countries have imposed emission charges on various air pollutants. France, for example, introduced a charge on emissions of hydrochloric acid, sulfur-containing compounds, nitrogen oxide-containing compounds, non-methane hydrocarbons, solvents, and other volatile organic compounds. The tax rates and base were expanded in 1990. The fee, 150 F ($30) per metric ton, has been imposed on combustion facilities with a maximum thermal power of at least 20 MW, waste incineration facilities with a capacity of three metric tons per hour, and facilities emitting more than 150 metric tons per year of taxable pollutants. Approximately 1,400 facilities have been subject to the tax, which generated revenues of 197 million F ($39 million) in 1993 and 169 million F ($33.5 million) in 1994. These charges are intended primarily to raise revenues to fund pollution abatement expenses at the charged facilities.

Japan has levied sulfur emissions charges to generate revenues to compensate victims of pollution-related diseases. (Since SO_2 was believed to be the main cause of such disease, it was chosen for the tax.) Both stationary and mobile sources are charged, the latter in the form of differential taxation dependent on vehicle weight. Since mobile sources are thought to generate about 20% of NO_x and SO_2 emissions, the tax ratio between stationary and mobile sources is 4:1. For stationary sources, tax rates vary from $0.625 to $56.25 per Nm^3, depending on whether the source is located in a designated area. Since many diseases date back to the 1980s, there is also a levy of $0.82 per Nm^3

based on SO_2 emissions between 1982 and 1986. Ambient SO_2 concentration levels have fallen significantly in Japan, but it is unclear to what extent this decrease is due to the tax.

Korea introduced air emissions charges in 1991. Facilities are charged based on the type and amount of fuel they use and on the region in which they are located. Revenues are deposited into an Environmental Pollution Control Fund (EPCF) to finance the development and installation of environmental technology.

11.1.2.1. Sweden's Nitrogen Oxide Charge

Sweden's nitrogen oxide emission charge of 40 SEK ($5.9) per kg ($5,400 per short ton) imposed in 1992 on energy producers with a capacity in excess of 10 MW and production of over 50 GwH is intended to have a significant incentive effect. Some 120 heating plants and industrial facilities, with about 180 boilers, are subject to the tax.

One interesting aspect of this tax is that revenues are rebated to taxpayers based on their energy generation. At the beginning of every year, facilities report their NO_x emissions and energy production for the previous year to the Swedish Environmental Protection Agency (SEPA). On the basis of these reports, SEPA calculates total revenues and refunds per generated MwH. Those facilities facing a net charge must pay by October, and those entitled to rebates receive them in December. The charge system in effect transfers income from high-emitting to low-emitting plants. In 1992, for example, approximately 15,300 metric tons on NO_x emissions were subject to the charge, generating about 610 million SEK ($90 million). As a result of the revenue and rebate calculations, over 100 million SEK ($15 million) was transferred from high-emitting to low-emitting facilities.

Most facilities subject to the taxes have installed measuring equipment so that the tax can be properly assessed. The annual cost of such equipment is estimated at 300,000 SEK ($44,000). For facilities that either have no measuring equipment or whose equipment is temporarily out of order, a standard of approximately 1.5 times the average emission level applies. This standard rate, 600 mg NO_x/MJ for gas turbines and 250 mg NO_x/MJ for other installations, gives polluters a strong incentive to install measuring equipment. Measuring equipment must be inspected once a year by an accredited laboratory. Measuring and reporting are monitored by SEPA.

Since other factors, including the planned introduction of tighter emissions standards in 1995, can influence NO_x emissions in Sweden, it is difficult to determine the effect of the NO_x charge. However, emission reductions appear to have been greater than they would have been without the charge. Incentive effects were evident as early as 1990 when many plants took measures to reduce emissions in anticipation of the charge. In 1992, the first year in which the charge was in effect, emissions from taxed plants were 15,300 metric tons, down 36% from their 1990 level of 24,000 metric tons. This decrease was not due to a decrease in energy consumption: emissions per mega-joule fell from 150 mg NO_x/MJ in

1990 to 99 mg NO_x/MJ in 1992. Some plants have even linked staff compensation with emissions reductions.

The charge was set at 40 SEK ($5.9) per kg because studies by the Swedish Environmental Protection Agency (SEPA) had indicated that control costs varied from 20 to 80 SEK ($2.9-11.8) per kg. SEPA has stated that the value of NO_x emission reductions is at least as high as the amount of the charge. The taxed plants were able to reduce emissions at an average cost per kg of approximately 10 SEK ($1.5) in 1992. Costs have ranged from 5 to 20 SEK ($0.7-2.9) per kg. Since these costs are significantly lower than the 40 SEK per kg charge, rational facilities will probably implement more abatement options in future years. Abatement measures used since the introduction of the charge include not only investments in new equipment but also measures to limit emissions by optimizing combustion.

Table 11-4 shows SEPA's estimates of the net benefit of the NO_x charge for the 1992 emissions reductions. It is not clear how the benefit of at least 40 SEK per kg ($5,400 per short ton) was estimated. Annual administrative costs of the charge are approximately 2 million SEK ($290,000) for SEPA and 300,000 SEK ($44,000) for each firm using measurement equipment. (SEPA appears not to have included its 2 million SEK administrative cost in its cost-benefit table, but this exclusion does not have a significant effect on the conclusions of its analysis.) Assuming 2 million SEK in administrative costs for SEPA and 18 million SEK ($2.6 million) in measurement costs for those taxed facilities that have installed measuring equipment, the annual monitoring and administrative costs amount to 20 million SEK ($3 million), or roughly 3% of charge revenue.

Table 11-4: SEPA ESTIMATES OF THE NET BENEFIT OF THE NO_x CHARGE
(for 1992 reductions of 9,000 metric tons)

Type of benefit or cost	SEK per kg reduced	Total (in SEK)
Environmental benefit	> 40	> 360 million
Abatement cost	- 10	- 90 million
Measurement cost	- 2	- 18 million
Net societal benefit	> 28	> 250 million

Source: Swedish Ministry of the Environment and Natural Resources (1995), p. 47.

One limitation of the charge is that it reportedly covers only about 6.5% of total NO_x emissions, partly due to some energy producers' tendency to supply just under 50 GwH to avoid the tax. (Because of the 50 GwH threshold, the marginal taxation of quantities of energy just over 50 GwH is high.) The threshold will be lowered gradually to 25 GwH by January 1, 1997. Another potential problem is that the charge on NO_x may cause some

plants to increase emissions of other substances, but other control standards are in place to limit such emissions.[14]

11.1.2.2. Charges in Less Industrialized Countries

Several Eastern European and Central Asian countries have more air emission charges than industrialized countries. In many of these countries, higher units fees are charged for emissions in excess of permitted levels. In some countries, there are no fees for emissions within permitted levels. Charges assessed only on emissions in excess of permitted levels could be regarded as non-compliance fees.

In the Czech Republic, thermal units with an energy capacity of 0.2 MW or greater are scheduled to be subject to the charges shown in Table 11-5. (Class I includes asbestos, cadmium, mercury, and benzene; class II includes arsenic, chlorine, phenol, and tin; and class III includes ammonia, acetone, and toluene.) These rates are being gradually phased in from 30% of their full level in 1992-1993 to 100% in 1997. Facilities that exceed emissions standards are subject to higher unit rates. The polluters are responsible for monitoring, but random inspections are conducted by a state control body. Revenues go to the state environment fund to control air pollution. The incentive effects are unclear. The administrative costs of the charges have been estimated at 1% of revenues collected.

A separate charge system exists for thermal sources of less than 0.2 MW. These charges range from zero for coke, gas, and fire wood to as high as $365 for 100-200 Kw facilities using slurry. Implementation of these charges is optional and left to the discretion of municipalities. Revenues are used for municipal environmental activities.

Russia also levies air emissions charges for approximately 300 substances. Polluters' charges depend on the type and quantity of emissions and the socioeconomic and environmental situation in the areas where they are located. Regional authorities grant exemptions to some firms based on their pollution control investments.[15]

Charge revenues in most countries in Eastern Europe and the former Soviet Union go to environmental funds. In many of these countries, however, the incentive and revenue-raising effects of these charges have been diminished by lack of enforcement and/or erosion of real charge rates by inflation. One study points out that the charges in Russia are much more vulnerable to inflation than the value-added and profit taxes because they do not rise automatically with increases in the general price level.[16] Since non-compliance fines are significantly higher (ten times higher for Poland's SO_2 and NO_x charges), they are more likely to have incentive impact, but even these are sometimes too low to influence polluters.

In February 1996, China announced the introduction of a charge on SO_2 emissions by industry. Officials stated that a charge of 2¢/kilogram implemented on a trial basis in southern China resulted in a 30% decline in SO_2 emissions.[17]

Table 11-5: AIR POLLUTION CHARGES IN EASTERN EUROPE[18]

Country	Charge base and rate	Revenues
Czech Republic (larger industrial sources)	Roughly 80 pollutants included. Rates per metric ton: PM $109, SO_2 $37, NO_x $29, CO $22, hydrocarbons $73, Class I pollutants $730, Class II pollutants $365, Class III pollutants $37	1992: $27 million 1993: $29 million
Czech Republic (smaller sources, <0.2 MW)	Vary according to heat source and output. Maximum annual rate $365	Unknown (implementation optional for municipalities)
Slovak Republic	Similar to Czech charges for smaller and larger sources.	Larger source: $3.1 million in 1992 and $7.9 million in 1993. Smaller source revenue unknown.
Poland	SO_2 and NO_x: $66 / metric ton CO_2: $0.05 / metric ton Over 50 other pollutants charged up to $44,132 / metric ton.	1992: SO_2:$89.2 million NO_x:$28.6 million 1993: SO_2:$149 million NO_x:$28.6 million Revenue for other charges unknown.
Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia	Charges for emissions in excess of permitted amounts. Amounts vary.	Revenues vary.

Source: Regional Environmental Center for Central and Eastern Europe (1995), p. 10.

11.1.3. Water

As noted in Section IV, economic incentives in water policy include user fees for groundwater, surface water, or for drinking water supplied by waterworks and fees for direct or indirect effluent discharges. For many water consumers discharging into sewage, effluent charges are included in water user fees.

11.1.3.1. User fees

A number of countries levy water service fees. Eighteen of 21 industrialized countries surveyed by OECD (all but Austria, Iceland, and Japan) reported user fees for water, sewerage and sewage treatment. Rates in most OECD countries are higher than those in the United States.[19] In the case of industrial users, water fees are usually based on quantities of water consumed. Water charges for residential consumers are set at flat rates in some areas and based on amounts consumed in others. To the extent that municipal water charges include sewage service, they are also indirect effluent charges.

Consumption-based rates are more likely to influence water use than flat rates, but relatively large price increases might be needed to induce changes in consumer behavior. A number of studies have found water consumption to be negatively related to unit-based prices. In 1982, for example, the Hunter and District Water Board in Australia replaced its fixed-rate pricing system with a pay-for-use system. Water consumption subsequently declined by 20-30%, a decline that allowed the deferral of water supply construction projects.[20] Briassoulis (1994) found that increases in water prices in Athens in 1990 led to significant decreases in water use. Although some of the decreases have been attributed to public education campaigns, the price increases have also been credited with significant incentive effect. Hansen (1996) found price elasticity of water demand in Denmark to be -0.1 or smaller. In the Czech and Slovak Republics, increases in water charges since 1991 have led to significant falls in water consumption.[21] In Bogor, Indonesia, water rates were increased by 200-300% in 1988 and a conservation campaign was implemented in 1989. Domestic and commercial water use fell by 30% within nine months.[22] This implies a price elasticity of demand of -0.10 to -0.15.

Charges on surface and groundwater use differ from the water supply charges described above in that they can be regarded as taxes on the use of a natural resource rather than payments for services provided. Charges on surface and groundwater use have been imposed in several countries. On January 1, 1995, for example, the Netherlands introduced a ground water tax of 0.34 Dfl ($0.21) per cubic meter for drinking water companies and 0.17 Dfl ($0.10) per cubic meter for other companies. For surface water infiltrated and extracted as ground water, rebates are offered so that the net tax is 0.055 Dfl ($0.033) per cubic meter. Although the primary objective of the tax is to raise revenue, the Netherlands Ministry of Housing, Spatial Planning, and the Environment predicts, on the basis of current water prices and estimated elasticities of demand of -0.05 to -0.30, that water use will decline by 1.3% to 12.6% for drinking water consumers and by 5.7% to 51% for industrial and agricultural consumers who extract their own groundwater. The tax of 0.34 Dfl is equal to about 35% of current water prices for drinking water, and the tax of 0.17 Dfl is over twice as high as current prices for self-extraction. To promote recycling, groundwater used to rinse reusable packaging such as beverage containers is exempt from the tax.[23] An official with the Netherlands Waterworks Association opposed to the tax said that the higher rates for tap water and tax exemptions for the first 100,000 cubic meters of

self-extracted water would lead farmers to dig more wells, thereby increasing their use of groundwater.[24]

Most Eastern European countries charge fees for groundwater and surface water use, but the fees tend to be too small and to include too many exemptions to have significant incentive effect. Agricultural water use has been subjected to fees in many countries, but it has been asserted that these fees are generally too low to promote efficient water use. In Central Asia, extensive agricultural diversion of water has resulted in a significant decrease in water levels in the Aral Sea and severe salinization problems. Several countries in the region recently introduced charges on surface water use. Kazakhstan charges farmers about 0.2¢ per m^3, and Uzbekistan charges some (but not all) farmers about 0.1¢ per m^3. Elsewhere in Asia, the introduction of groundwater extraction fees in Jakarta, Bangkok, and Cebu (Philippines) reduced groundwater depletion.[25]

11.1.3.2. Effluent Charges

As noted above, indirect charges into sewage are imposed in a number of countries, often as part of water supply bills. Less common are charges on direct discharges of effluent into surface or ground water. Australia, Belgium, parts of Canada, China, France, Germany, the Netherlands, Poland, Portugal, and Spain are among the many countries in which direct effluent charges have been levied. In most countries, charges on indirect discharges differ from those on direct discharges. One notable exception is the Netherlands, whose effluent charges are explained below.

Schoot Uiterkamp, J.F.J, Leek, and de Savornin Lohman (1995) studied indirect and direct effluent charges in 12 European Union countries.[26] Some of the findings of their survey are summarized in Table 11-6 and Figure 11-1.

Table 11-6 summarizes the characteristics of effluent charges imposed on industry in the European Union. Not included in this table are indirect effluent charges in effect in Germany and Spain but on which little data are available. The six countries with direct effluent charges on industry (Belgium, France, Germany, the Netherlands, Spain, and United Kingdom) have imposed similar charges on municipal treatment plants.

Table 11-6: INDUSTRIAL EFFLUENT CHARGES IN THE EUROPEAN UNION

Country or region	Pollution parameters	Pollution assess-ment	Direct or indi-rect	Polluters covered
Belgium: Flanders	SS, ORG, MET, P, N	COEF, (MES)	BOTH	>500m^3 cons. / year or pump rate >5 m^3 / day
Belgium: Wallonia	SS, ORG, MET, P, N, TEMP	COEF, (MES)	BOTH	>7 employees
Denmark	ORG, P, N	PERM	INDIR	High amount of SS, P, N
France	SS, ORG, MET, P, N, TOX, AOX, SOL	COEF, (MES)	BOTH	Discharges > 200 i.e.
Germany	ORG, MET, P, N, TOX, AOX	PERM, (MES)	DIR	Licensed polluters
Greece	NA	NA	INDIR	NA
Ireland	SS, ORG	PERM	INDIR	Licensed polluters
Italy	SS, ORG	PERM	INDIR	Licensed polluters
Luxem-bourg	None	CONS	INDIR	NA
Nether-lands (I)	ORG, MET, N	MES	BOTH	> 1000 p.u.
Nether-lands (II)	ORG, MET, N	COEF, (MES)	BOTH	5-1000 p.u.
Portugal	SS, ORG	NA	INDIR	NA
Spain	BAND	PERM	DIR	Licensed polluters
UK (I)	BAND	PERM	DIR	Consented discharges
UK (II)	SS, ORG	PERM	INDIR	Consented discharges

Pollution parameter symbols:

SS	suspended solids	TOX	toxicity indicator
ORG	organics (BOD and / or COD)	AOX	halogenated hydrocarbons
MET	heavy metals	SOL	soluble salts
P	phosphorus	TEMP	temperature
N	nitrogen	BAND	discharge classed into bands to which value is attached

Pollution assessment symbols:

MES based on actual measurement
COEF based on sector-specific coefficients
CONS based on water consumption
(MES) actual measurement as basis is optional
PERM based on values specified in permit

Source: Schoot Uiterkamp, Leek, and de Savornin Lohman (1995), Part 1, p. 33.

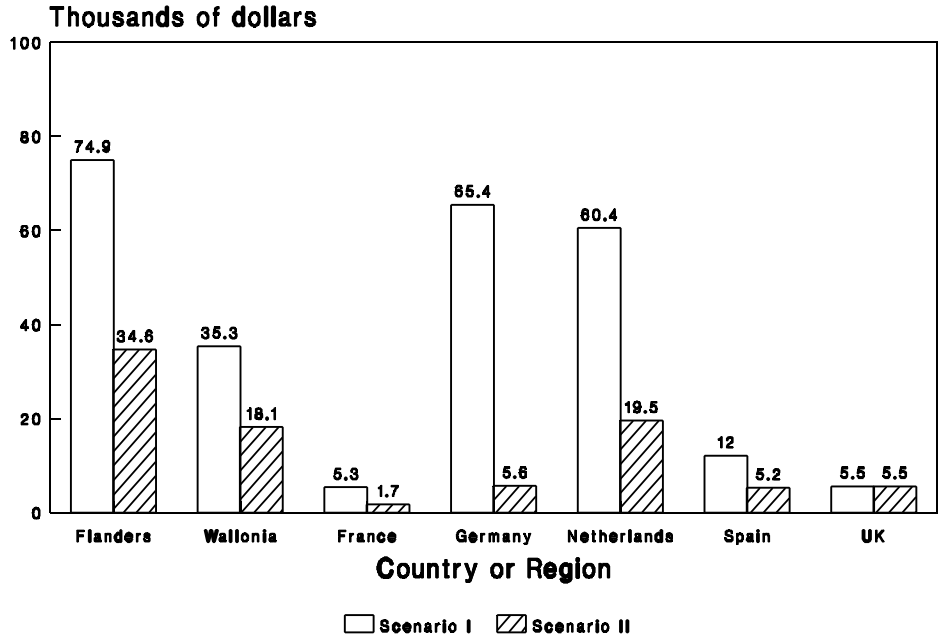
Because of differences in pollution parameters, assessment methods, and polluters covered, effluent charge levels are difficult to compare across countries. Figure 11-1 shows comparisons by Schoot Uiterkamp et al. of charge levels for two discharge scenarios for a chemical industry in the countries for which sufficient charge rate data are available. In scenario I, the industry subjects its waste water to only basic treatment, whereas in scenario II, it applies more advanced treatment techniques. In both scenarios, daily flow is 500 m^3. Table 11-7 shows the discharge levels for the two scenarios.

Table 11-7: DISCHARGE SCENARIOS FOR FIGURE 11-1
(mg/liter)

Parameter	I	II	Parameter	I	II
COD	400	100	AOX	1	0.1
BOD	100	20	Zinc	2	1
SS	40	20	Nickel	1	0.5
total N	20	10	Copper	1	0.5
reduced N	10	5	Lead	1	0.5
total P	1	0.5	Chromium	0.1	0.01

As shown in Figure 11-1, the absolute difference in charge levels between the two scenarios is largest in Belgium, Germany, and the Netherlands. The incentive effect appears to be strongest in these three countries. However, another set of scenarios considering the impact of differences in flow amounts on charge payments could yield different results. In the case of the United Kingdom, for example, a polluter could halve its payments by reducing its daily flow amount from 500 m^3 to under 100 m^3. Three illustrative charge systems are discussed in greater detail here. .

Figure 11-1: ANNUAL CHARGE PAYMENTS FOR HYPOTHETICAL INDUSTRIAL DISCHARGE

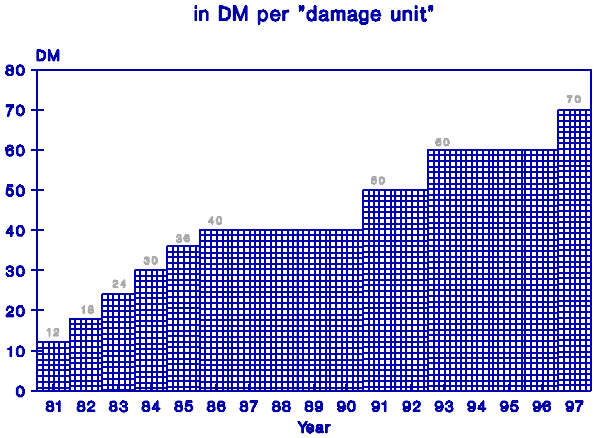


Source: Schoot Uiterkamp et al. (1995), Part 1, p. 51.

11.1.3.3. Effluent Charges in Germany

Based on the 1976 Federal Effluent Charge Law, effluent charges have been collected by German states (Länder) since 1981. Although collection is left to the states, the charge calculation rules, charge amounts, and damage unit parameters are determined at the federal level. German states do not have the autonomy to set effluent charges that U.S. states have in setting the NPDES permit fees discussed in Section 4.

Figure 11-2: POINT SOURCE EFFLUENT CHARGES IN GERMANY



Effluent charges for point sources are based on "damage units" dependent on quantities and types of pollutants. One damage unit is defined as 50 kg organic matter (COD), 3 kg phosphorus, 25 kg inorganic nitrogen, 2 kg halogenated hydrocarbons (AOX), 20 g mercury (and compounds), 100 g cadmium (and compounds), 500 g chromium, nickel or lead (and compounds), 1 kg copper (and

compounds), or 3,000 m^3 of wastewater divided by T(f), where T(f) is the dilution factor by which the waste water must be diluted in order to lose its acute toxic effect on fish. Separate assessment methods are used for stormwater and for discharges from inhabitants not connected to the sewage system. As shown in Figure 11-2, the charge amounts per damage unit have increased from 12 DM at the introduction of the charge to a current level of 60 DM and are scheduled to reach 70 DM in 1997.[27]

Charge assessment is based on discharges allowed in state-issued permits. Dischargers without permits or with permits lacking discharge limits pay charges based on their declared discharges. If permitted discharge limits are surpassed, charges are raised accordingly. Most monitoring is left to polluters with random spot checks by the authorities. However, if a polluter declares in advance that its discharge levels will be at least 20% below levels allowed in its permit over a period of at least three months, the charge is assessed on the basis of the projected reduced discharge level.

The charge amounts in Figure 11-2 can be reduced in several ways. If a discharger uses Best Available Technology for hazardous pollutants and Generally Agreed Technology Standards for non-hazardous pollutants, its charge per damage unit is reduced by 75%.

In addition, investments in treatment facilities are rewarded by reduced charges for a period of three years prior to completion of the new facility, provided that the facility will reduce pollution by at least 20%. The reduced charges are based on the discharge levels anticipated after completion of the facility. If the facility is not completed and operated as planned, the polluter must pay back the charge reductions. Municipal authorities expanding or constructing sewage treatment facilities are eligible for a 3-year charge exemption provided that the new plant will meet public sewage treatment standards.

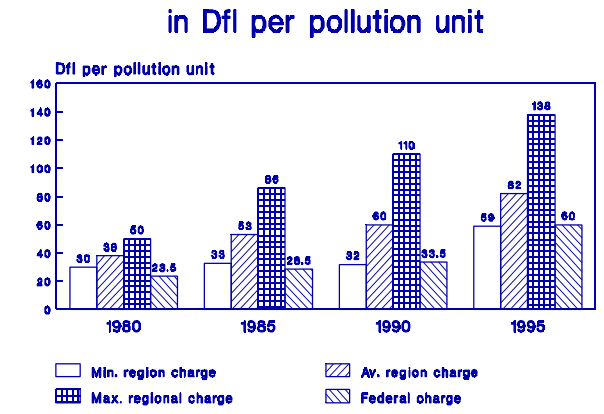
Effluent charge revenues fell from 426 million DM in 1988 to 350 million DM in 1992, despite a 25% rise in the charge rate during this period. The Federal Ministry of the Environment estimates that about 60% of the revenues are paid by communities and 40% by industry. According to Smith (1995), administrative expenses associated with the charge system consume roughly 15% of charge revenues.[28] Together with indirect discharge fees, the remaining wastewater charge revenues cover all the costs of operating treatment facilities, but only about half the costs of constructing them. The other half comes from Government funds. However, the contribution of effluent charge revenues to treatment facilities is small compared to that of indirect discharge (sewerage) fees, which generated about 10 billion DM in 1991.[29]

In the period 1977-1987, industrial discharges of waste water (to surface waters and to sewerage) in Germany declined in volume by 14% while industrial production increased by 14%.[30] Although it is difficult to determine the extent to which this decrease was caused by effluent charges, the charges appear to have incentive effects. Brown and Johnson (1984) showed that the chemical company BASF achieved unit abatement costs that were lower than the charge level. BASF instituted an internal incentive system under which individual branches received accounting charges per unit of effluent. This system

resulted in significant voluntary discharge decreases through recycling, product changes, and other measures.[31]

Two surveys of dischargers in the late 1970s (after the announcement of the charges but before their adoption) found acceleration of abatement measures at affected facilities. In at least some cases, the authors linked the abatement measures to the charges. One of the survey authors, however, claims that the close links of the charge system with federal abatement technology standards has lessened the potential efficiency of the charge system. The significant reductions (currently 75%) for compliance with technology standards could be interpreted to mean that the full charges are essentially non-compliance fees.[32] Another survey found that for municipal wastewater treatment facilities paying the reduced rates, charges make up only 1-2% of total wastewater treatment costs, whereas in one case of non-compliance, charges account for about 10% of total costs.[33]

Figure 11-3: EFFLUENT CHARGES IN THE NETHERLANDS

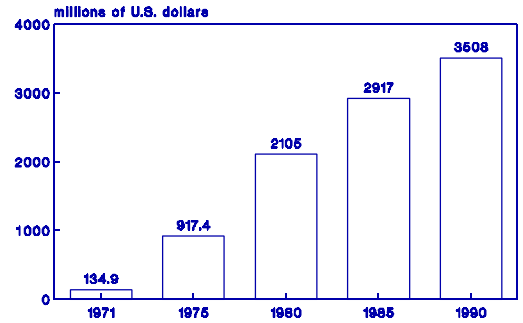


Source: Uiterkamp and Savornin Lohman, p. 190.

11.1.3.4. Effluent Charges in the Netherlands

Introduced in the 1970 Pollution of Surface Waters Act, effluent charges in the Netherlands are believed to have significant incentive effect on polluters. For discharges into federal waters, charges are imposed and collected by the federal government. For discharges into regional waters and into sewerage, charges are imposed and collected by regional water boards, which are also responsible for building and operating wastewater treatment plants. Regional charges are the same for indirect as for direct discharges. As shown in Figure 11-3, regional charges vary. The main reason for the variation is not regional differences in impacts of pollution but rather differences in costs associated with wastewater treatment.

Figure 11-4: EFFLUENT CHARGE REVENUES IN THE NETHERLANDS



Source: Bressers and Schuddeboom, p. 157

Figure 11-4 shows that charge revenues have risen significantly since they were first

introduced. The revenues cover nearly all public wastewater treatment plant construction and operation costs. Charge administration costs have been estimated at 3.5% of revenues.

Charges are based on pollution units. For oxygen-consuming substances, a pollution unit is defined as the average amount of oxygen-consuming material produced by one person in one day, which is further defined as 136 g of oxygen-producing material. For heavy metals discharged into federal waters, one pollution unit is defined as 100 g of the sum of mercury, cadmium and arsenic, and 1,000 g of the sum of copper, zinc, lead, nickel and chromium. For discharges to sewerage and regional waters, arsenic discharges are included in the latter group. The government planned to add halogenated hydrocarbons to the charge base in 1996.

For charge assessment purposes, there are three groups of dischargers:

1. For households and businesses generating fewer than 5 pollution units per day, charges are usually fixed at 3 pollution units. This group accounts for about 65% of charge revenues.

2. For dischargers of 5 to 1,000 pollution units (in some industries, the maximum is 100 pollution units) of organic pollutants per day, charges are determined by combining an industry coefficient with easily obtainable data such as water use and amounts of raw materials. Facilities that believe they are being overcharged can, at their own expense, conduct sampling and measurement and be charged according to the findings. This group contributes approximately 15% of charge revenues.

3. Industrial facilities and municipal treatment plants discharging over 1,000 (or in some industries 100) pollution units per day of organic pollutants or over 10 pollution units per day of heavy metals are charged according to actual pollution amounts that they are required to measure. Municipal treatment plants, however, are not charged for discharges into regional waters and pay reduced charges (30% of full charge in 1995 and 50% in 1996 and thereafter) for discharges into federal waters. This group accounts for about 20% of charge revenues.

Since group 1 pays fixed charges and group 2 pays charges according to its industry and inputs rather than its actual pollution, the charges are likely to have little effect on these groups' pollution control. (One possible effect of the group 2 charges, however, is to promote water conservation.) For group 3 facilities, however, charges are directly linked to pollution.[34]

At least one study has found that effluent charges in the Netherlands have caused a significant fall in discharges. Bressers (1994) performed three statistical analyses on the effects of the charges: One cross-industry analysis examined organic pollution decreases by industrial sector as a function of the ratio of effluent to production value. (The study refers to this ratio as the "charge factor.") Two other cross-region analyses examined the "relative success of abatement" for heavy metals and organic pollution as a function of effluent charges. The relative success of abatement was "calculated as the difference

between the actual percentage of abatement and the percentage of abatement expected in view of the industrial structure of the region."

In the first analysis, which included 14 industries accounting for 90% of industrial organic water discharges in 1969, the charge factor was highly correlated with pollution decreases, with r=.73. The same analysis was conducted excluding two industries, potato-starch and animal husbandry. The former industry had been allowed to pay reduced fees and the latter consisted of thousands of small farms that were rarely charged on the basis of actual pollution. For the charge factor in this reduced analysis, r=.84.

The second analysis found that 96% of the decrease in organic water pollution in a given region could be explained statistically by "the decrease to be expected as a result of the differences in the regional structure of industry" and the increase in effluent charges. The increase in the rate charged during 1974-80 was strongly correlated with the relative abatement success, r=.86. Excluding the two water quality districts (out of 15 in the full sample) that had the most and the least relative abatement success, r=.92. The third analysis, focusing on the 13 regions that imposed heavy metal effluent charges, found that the relationship between charges and relative abatement success was significant but not as strong as for organic pollution, r=.65.

The study also included the results of questionnaires sent to regional water board administrators to obtain their opinion of the factors behind falls in discharges. "In general," the study concluded, "the results [of the questionnaires] correspond with those of the statistical analyses, at least as far as the main points are concerned." In the case of organic pollution, those questioned believed that charges were the most important factor behind the fall in discharges. For heavy metals, however, the administrators attached equal importance to other policy instruments, such as informal negotiation. The study pointed out that such negotiation and charges appeared to complement each other.

11.1.3.5. Effluent Charges in France[35]

France's six river basin authorities, each with a committee and an agency, have been levying effluent charges since 1968. Each river basin's committee functions like a parliament, while each agency serves as an executive body. Each river basin board sets its own charge rates annually, subject to approval by the basin committee.

The original basis for assessment was weight of suspended matter and weight of organic matter, since these two pollutants were relatively easy to detect and control. Charges parameters were later expanded to include salinity (1973), toxicity (1974), nitrogen and phosphorus (1982), and halogenated hydrocarbons, toxics, and other metals (1992). Discharges are estimated based on the emissions class and activity level of the discharger or, in the case of municipalities, on the basis of population and daily discharge per inhabitant. The basin authorities and dischargers may request actual measurement, the costs of which are borne by whoever makes the request.

The charge applies to all municipalities with more than 400 inhabitants and to all non-municipal facilities discharging at least 200 population equivalents a year. For facilities

connected to a public sewage system, the charge applies only if discharges exceed 6,000 m^3 per year.

It is not clear to what extent the charges have discouraged pollution. OECD (1994) concluded that the charges could be considered primarily as revenue-raising instruments. Charge levels are based not on perceived environmental costs of discharges but rather on the revenue needs of the river basin authority. The effluent charges, as well as fees for extracting ground and surface water, generate revenues that are used mainly to finance water pollution control investments by farmers, industry, and municipalities. Some of the assistance takes the form of low-interest loans, but most of it is grants that usually cover 30-50% of the total cost of a given investment. During the period 1982-1991, $6 billion in assistance was provided for projects totalling $14 billion in expenditures. The 1992-96 action plan provides for $6.5 billion in assistance for projects expected to total $15 billion.

11.1.3.6. Effluent Charges in Less Industrialized Countries

As shown in Table 11-8, several Eastern European countries have imposed effluent fees. These countries, as well as China and most of the former Soviet Union, impose non-compliance charges that are far higher for pollution in excess of certain specified amounts. Revenues from most of these charges are used to fund environmental protection activities, but Slovenia's charge generates revenues for the general federal budget.

Table 11-8: WATER EFFLUENT CHARGES IN EASTERN EUROPE[36]

Country	Charge base and rate	1993 revenues
Czech Republic	Formula based on BOD5, undissolvable substances, crude oil substances, evident alkalinity and acidity, dissolved inorganic salts[37]	$47 million
Slovak Republic	Same as for Czech charges	$10 million
Poland	BOD5: $538/ton COD: $397/ton suspended solids: $48/ton heavy metals: $5,536/ton chloride and sulfate ions: $30/ton	$75 million
Romania	Oxygen-consuming substances: $2.3/ton Suspended substances in solution: $0.58/ton	Unknown
Slovenia	$3 per population equivalent[38]	$6 million

Source: Regional Environmental Center for Central and Eastern Europe (1995), p. 14.

Like other environmental charges in Eastern Europe and the former Soviet Union, many of the effluent charges in Table 11-8 are limited in their effectiveness by problems such as weak enforcement, polluters' inability or unwillingness to pay, and inflation. In

1993, for example, Poland's charge collection rate was only 53%. Slovak charge revenue fell in local currency by 28% from 1992 to 1993 because of polluters' financial hardships and recession. Lack of widespread interest in environmental issues, limited experience with incentive mechanisms, and complicated charge mechanisms have also been cited as problems with charges in Eastern Europe.

Four states in Brazil have introduced (or begun to introduce) charges for industrial sewage treatment based on pollution content. As shown in Table 11-9, sewage charges in Sao Paulo state based on pollution content have been found to have a significant impact on pollution. The study indicated that the reductions had been achieved through changes in production methods, use of cleaner inputs, and recycling. Having significantly underestimated the responsiveness of polluters to increased charges, the state sewage treatment company now suffers from overcapacity at a treatment plant.[39]

Table 11-9: IMPACT OF SEWAGE CHARGES ON POLLUTION IN SAO PAULO STATE, BRAZIL

(% reduction in unit pollution coefficient, 1980-82)

Industry	BOD	Suspended solids
Pharmaceutical	30	46
Food	42	43
Milk derivatives	57	55

Source: Margulis (1994), p. 111.

China, India, Korea, Malaysia, the Philippines, and Thailand are among the Asian countries to have imposed effluent fees. For example, palm oil and rubber factories in Malaysia have been subject to effluent fees since 1978. The fee was originally set at M$ 100 ($39) per metric ton of the BOD load in excess of 500 ppm, and an additional license fee was set at M$ 100 per metric ton of BOD load. Firms could obtain waivers by conducting research on waste treatment. The effluent fee scheme has been credited with lowering effluent to the target level of 100 mg per liter.[40]

11.1.4. Noise

Noise pollution charges have been levied at airports in Belgium, France, Germany, Japan, the Netherlands, Norway, and Switzerland. In Switzerland, planes are taxed from 0 to 400 SF ($337) per take-off depending on their noise class.[41] In Germany, the percentage of aircraft conforming with stricter noise standards increased in the late 1980s, but it is unclear whether this increase was due to noise pollution charges.[42]

11.1.5. Charges on Environmentally Damaging Products and Activities

Levied in numerous industrialized countries, product charges are imposed either on a product or some characteristic of that product. Although some of these charges may discourage consumption, many of them are advance disposal fees intended to finance the proper disposal of the products after their use. Products on which charges have been imposed include automotive air conditioners (Canada), batteries (Canada, Denmark, Portugal, and Sweden), beverage containers (Belgium, Finland, Norway, and Sweden), building materials (Denmark), CFCs (Australia and Denmark), fertilizers (Austria, Finland, Norway, and Sweden), light bulbs (Denmark and Korea), lubricating oil (Finland, France, Italy, Norway, and Spain), packaging (Belgium and Germany), pesticides (Belgium, Denmark, Norway, and Sweden), plastic and paper bags (Italy, Iceland, and Denmark), sulfur in oil (Finland, Norway, and Sweden), and tires (Taiwan and Canada).

In 1993, South Korea imposed advance disposal fees on several products that are difficult to treat or recycle. As shown in Table 11-10, a large number of products are subject to the fees, but the amounts are rather low.

11.1.5.1. Charges on Agricultural Inputs

Several countries have imposed product charges on pesticides and fertilizers. Estimates of price elasticity of demand for these products vary widely, depending perhaps on the time period studied, crops, geographic area, and other factors. However, some of these charges are more likely to have incentive impact than the relatively low charges imposed on these products by U.S. states.

Norway has levied charges on fertilizers and pesticides since 1988. The fertilizer taxes are NKr 1.17 ($0.18) per kg of nitrogen and Nkr 2.23 ($0.35) per kg of phosphorous, resulting in average taxation of approximately 7% of the wholesale price. The pesticide tax is 13% of the purchase price. In Finland, charges of Mk. 1.5 ($0.32) per kg were imposed on phosphate fertilizers in 1990. Relatively low charges on fertilizers in Austria, which are no longer in effect, are reported to have had a significant impact on fertilizer use.

In Denmark, retail sales of pesticides are subject to a 20% tax. Dubgaard estimated price elasticity of demand for pesticides in Denmark at -0.3. This estimate suggests that the 20% tax results in a reduction in pesticide use of roughly 7%.[43]

As shown in Table 11-11, Sweden imposed two different charges on fertilizers in the 1980s. At their highest level, in 1991, the charges equaled 30-35% of the sales price of phosphate and nitrogen. Figure 11-5 suggests that the charges have had a significant impact on fertilizer use. The amount of land under cultivation has also decreased but not in the same proportion as fertilizer use. The reduction in use appears to be most significant during the period when the tax was at its highest.[44] The Swedish Board of Agriculture administers the charge. Its annual administrative costs associated with the charge have been estimated at 500,000 SEK ($74,000), roughly 0.4% of total annual charge

revenues of approximately 130 million SEK ($19 million).

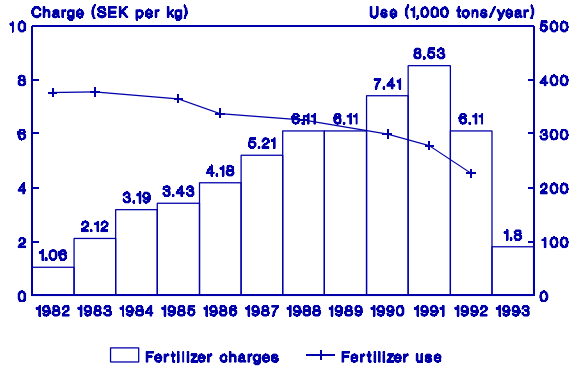
Table 11-10: ADVANCE DISPOSAL FEES IN SOUTH KOREA[45]

Product	Fee amount ($=780 won)
Insecticide / toxics container: <500 ml >500 ml Butane gas container	5 won 11 won 6 won
Glass cosmetics bottle: <100 ml >100 ml Metal cosmetics container: spray others	2 won 3 won 6 won 4 won
Candy containers: more than 3 pieces more than 4 pieces	5 won 10 won
Batteries (lithium, nickel-cadmium, manganese, manganese alkalide)	1.5 won
Anti-freeze solution	20 won
Fluorescent light bulbs	5 won
Chewing gum	0.25% of price
Paper diaper	1 won
Plastics	0.7% of price

Source: Rhee (1994), "The Use of Economic Instruments in Environmental Protection in Korea," p. 104.

Revenues from the price regulation charge have been used to subsidize agriculture, while revenues from the environmental charge have been used to promote sustainable agriculture, including investments in manure management and research and educational programs. Some of the reductions in fertilizer use depicted in Figure 11-5 can probably be attributed to the educational activities funded by the environmental charge.[46]

Figure 11-5: FERTILIZER CHARGES AND USE IN SWEDEN



Source: The Swedish Experience: Taxes and Charges in Environmental Policy

Table 11-11: FERTILIZER CHARGES IN SWEDEN
(in SEK per kg)

Date	Price Regulation Charge			Environmen-tal Charge		Total charge		
	N	P	K	N	P	N	P	K
7/82	0.3	0.58	0.18			0.30	0.58	0.18
7/83	0.6	1.16	0.36			0.60	1.16	0.36
7/84	0.65	1.25	0.39	0.30	0.60	0.95	1.85	0.39
1/85	0.72	1.38	0.43	0.30	0.60	1.02	1.98	0.43
7/85	0.93	1.79	0.56	0.30	0.60	1.23	2.39	0.56
7/86	1.12	2.43	0.76	0.30	0.60	1.42	3.03	0.76
7/88	1.12	2.43	0.76	0.60	1.20	1.72	3.63	0.76
11/90	1.46	3.16	0.99	0.60	1.20	2.06	4.36	0.99
3/91	1.75	3.79	1.19	0.60	1.20	2.35	4.99	1.19
7/92	1.12	2.43	0.76	0.60	1.20	1.72	3.63	0.76
12/92	0	0	0	0.60	1.20	0.60	1.20	0

Source: Swedish Ministry of the Environment and Natural Resources (1995), p. 12.

11.1.5.2. Energy/carbon Taxes

Energy taxes can be considered product charges. One type of energy tax that has become a frequent topic of discussion in environmental protection is a carbon tax. Levied on fuels based on their carbon content and intended to limit emissions of carbon dioxide, carbon taxes have been adopted in Denmark, Finland, the Netherlands, Norway, and Sweden. As noted above, Poland also has a small tax on CO_2 emissions that amounts to a carbon tax. Carbon taxes are generally small relative to other fuel taxes, although the relative size of the carbon tax varies according to the type of fuel. Rates often vary depending on the sector or use of the fuel. In Finland and the Netherlands, the taxes are assessed partly on carbon content and partly on energy content. The taxes are summarized in Table 11-12.

In 1990, Finland became the first country to adopt a carbon tax, setting its level at Mk 6.66 ($1.45) per metric ton of CO_2. The tax was raised to Mk 13.59 ($2.96) in 1993 and to Mk 38.3 ($8.34) in 1995. It is no longer based purely on carbon content but rather 60/40 on carbon/energy content, the energy content portion being 3.5 Mk per MwH ($0.21 per

gigajoule). Products used as raw materials for industrial production or as fuel for planes and certain other vessels are exempt from the tax.[47] Energy produced from peat is also exempt. According to Finnish government studies, CO_2 emissions are five percent lower than they would be without the tax. The government says that the tax has stimulated investment in renewable energy technology such as biomass gasification. However, industry representatives claim "that this tax is just another way to increase budget revenues."[48]

Table 11-12: ENERGY/CARBON TAXES[49]
(in $ per ton of CO_2 unless otherwise stated)

Country	Year Adopted	Rate	Annual Revenue	Observations
Denmark	1992	$9-$18	$560 million (1993)	Gasoline, natural gas, and biofuels exempt. Aviation, shipping, and refinery gas exempt. 50% rebate for larger businesses.
Finland	1990	$8 + 21¢/gjoule	$314 million (1994)	Industry raw materials and fuel for planes and certain vessels exempt. 60/40 carbon/energy content.
Netherlands	1990	$16.4 + 91¢/giga-joule	$850 million (1995)	Full rate not phased in until 1998. 50/50 carbon/energy content.
Norway	1991	$15-$47	$900 million (1994)	Coal used in industry exempt.
Sweden	1991	$27-55	$1.7 billion (FY93-4)	Effective 7/1/96, industry pays 50% of full rate. Uses other than heating or motor fuels and fuel for ships, planes, train locomotives, and electricity generation exempt.

Sources: Muller, "Mitigating Climate Change," p. 17; OECD (1996), *Implementation Strategies for Environmental Taxes*, pp. 89-94; Netherlands Ministry of Housing, Spatial Planning and Environment.

In Denmark, a tax of 100 DK ($17.6) per metric ton of CO_2 was adopted in 1992 as part of a broader energy tax and subsidy package. Table 11-13 shows several features of this tax common in carbon taxes in other countries as well. First, the amount of the tax differs according to the type of fuel, specifically its carbon content. The carbon tax is 242 DK ($42.5) per metric ton on coal but only 178 DK ($31.3) per metric ton on lignite. Second, the amount of the carbon tax is relatively small compared to other taxes on energy, constituting less than a third of taxes on petroleum coke, 26% of taxes on electricity, and 12% of taxes on gas used as motor fuel. Third, there are numerous carbon tax exemptions.

Gasoline (but not diesel), natural gas, and biofuels are exempt, and value added tax registered businesses generally receive 50% rebates on their payments. Such rebates are intended to assist large, energy-intensive businesses. Households, however, receive no rebates. Carbon taxes on electricity generated by renewable energies and fuels are offset by subsidies of 0.10-0.17 DK (1.76-3¢) per Kwh.

Table 11-13: 1994 ENERGY TAXES IN DENMARK[50]
(not including 25% value added tax)

Energy source	Unit	Excise tax	CO_2 tax
Unleaded petrol	DK/liter	2.45	exempt
Leaded petrol	DK/liter	3.10	exempt
Light diesel oil	DK/liter	1.67	0.27
Ordinary diesel oil	DK/liter	1.77	0.27
Light fuel oil	DK/liter	1.49	0.27
Heavy fuel oil	DK/kg	1.66	0.32
Fuel tar	DK/kg	1.50	0.28
Kerosine, heating	DK/liter	1.49	0.27
Kerosine	DK/liter	1.77	0.27
Coal	DK/metric ton	690	242
Petroleum coke	DK/metric ton	690	323
Lignite	DK/metric ton	505	178
Gas used as motor fuel	DK/liter	1.18	0.16
Other gas (LPG)	DK/kg	2.00	0.30
Refinery gas	DK/kg	2.00	0.29
Electricity	DK/Kwh	0.30	0.10
Electricity, heating	DK/Kwh	0.27	0.10

Source: OECD (1996), p. 90.

Sweden introduced a carbon tax of 250 SEK ($36.8) per metric ton in 1991 as part of a broader tax system reform in which general energy taxes were reduced and the value added tax was extended to energy. In 1993, the carbon tax for industry was lowered to 80 SEK ($12) per metric ton but raised to 320 SEK ($47.2) per metric ton for other consumers, and the general energy tax was abolished for manufacturing industry and commercial horticulture. Several energy-intensive industries were entitled to further carbon tax

reductions. The rate has risen every year to 370 SEK ($50.1) per metric ton in 1996, with industry paying 25% of the full rate. In general, the tax applies only to motor and heating fuels. Biofuels and fuels used for electricity generation are exempt, as are fuels for ships, planes, and train locomotives.[51]

According to a study by the Swedish Ministry of the Environment and Natural Resources, the carbon tax has influenced energy consumption patterns. Some plant owners who have shifted their energy sources from fuel oil to biofuels claim that the carbon tax was a decisive factor in their shift. In the six months after the carbon tax was reduced for industry in 1993, heavy fuel oil consumption rose by about 20% compared to the same period of the previous year. The preferential rate for industry also led some facilities to sell their biobased by-products to heating plants, which were taxed at the full rate and thus eager to use biofuels.[52]

Effective July 1, 1996, industry's 75% reduction was lowered to 50%, up to a level equivalent to 0.8% of annual turnover. For additional amounts beyond the 0.8% turnover threshold, companies pay 12% of the full rate. Several energy-intensive companies—mostly in the chemical, cement, lime, and glass sectors—have their payments capped at 1.2% of turnover. A Confederation of Swedish Industries representative stated that the tax increase would cause Swedish firms to lose market share to foreign competitors generating more emissions and characterized the measure as "completely counter-productive from the point of view of the environment, employment growth and future investment." It has been suggested that industry in Sweden is not opposed to carbon taxation provided that other countries adopt similar taxes. One problem with carbon taxes and other measures to limit CO_2 emissions is that they must be implemented in a sufficient number of countries to effectively address climate change.[53]

The Netherlands first adopted a carbon tax in 1990 but replaced it with a 50/50 carbon/energy tax in 1992. This tax is referred to as the Environmental Tax on Fuels. Another carbon/energy tax, the Regulatory Tax on Energy, entered into effect on January 1, 1996. As shown in Table 11-14, the carbon/energy tax of the environmental levy is 5.16 Dfl per metric ton of CO_2 and 0.3906 Dfl per gigajoule, and the carbon/energy tax of the regulatory tax is 27.00 Dfl ($16.4) per metric ton CO_2 and 1.506 Dfl ($0.91) per gigajoule.

Table 11-14: CARBON/ENERGY TAXES IN THE NETHERLANDS
(in Dfl)

	Environmental tax	Regulatory tax	Total
Carbon (per metric ton CO_2)	5.16	27.00	32.16
Energy (per gigajoule)	0.3906	1.506	1.8966

Sources: Netherlands Ministry of Housing, Spatial Planning and Environment, "The Netherlands Environmental Tax on Fuels" and "The Netherlands Regulatory Tax on Energy."

Table 11-15 shows the two taxes as applied to different types of fuel as of January 1, 1996. As in other countries, the carbon/energy taxes are not the only levies on fuel. The various levies have different purposes. The excise and environmental taxes are intended primarily to raise revenue, and the COVA levy finances strategic oil reserve maintenance. The regulatory tax was introduced to influence behavior, with revenue generation as a secondary objective. Not included in this table is the value added tax of 17.5% on all fuel types and on the taxes paid on them.

As can be seen in table 11-15, the carbon/energy taxes have not been uniformly applied to all fuels. Some fuels are exempt from either the environmental or the regulatory tax. The rate for natural gas depends on the amount used by the consumer subject to the tax. The appropriate rate for electricity was determined based on estimates of the amounts of electrical energy generated by different types of sources.

The regulatory tax targets small-scale energy consumers. The government maintains that other policies are already encouraging large consumers to save energy and that large additional energy taxes would put industrial energy users at a disadvantage compared to competitors in other countries without such taxes.

As noted above, the regulatory tax is considered an incentive mechanism with only secondary revenue-raising objectives. Tax revenues are being recycled back to the economy through corresponding reductions in personal and corporate income taxes. The regulatory tax introduction and income tax reductions were legislatively bound to each other. According to an official source, the revenue recycling is "in line with the government's aim of shifting the tax burden away from labor and capital based income and towards use of the environment."

The government believes that the regulatory tax will reduce CO_2 emissions by 1.7 to 2.7 million metric tons per year (1.5% of total CO_2 emissions in the Netherlands) by the year 2000. Groups targeted by the tax are expected to reduce CO_2 emissions by 5%.[54]

11.1.5.3. Preferential Taxation of Environmentally Friendly Products

One type of economic incentive similar to product charges is the preferential taxation of environmentally friendly products. For example, Australia, Mexico, New Zealand, Singapore, Taiwan, Thailand, and most European countries have taxed leaded gasoline at a higher rate than unleaded gasoline. Foreign countries appear to have learned from the U.S. experience in this area. Motorists in the U.S. often misfueled their vehicles with leaded fuel because it was cheaper than unleaded. Not only did the use of leaded fuel release lead into the environment, it also caused releases of other emissions by damaging catalytic converters. Preferential taxation measures in other countries have given motorists an incentive to use unleaded fuel, thereby contributing to an increase in its market share. As shown in Table 11-16, the differential is usually limited to 10% of the price of unleaded fuel.

Table 11-15: CARBON/ENERGY TAXES APPLIED TO FUELS IN THE NETHERLANDS[55]
(in Dfl)

Product	Unit	Excises	Environmental tax	COVA	Regulatory tax[56]
leaded gasoline	1000 liters	1246.10	25.10	13.50	n / a
unleaded gasoline	1000 liters	1105.30	25.10	13.50	n / a
light fuel oil	1000 liters	102.60	27.50	13.50	84.60
gasoil	1000 liters	102.60	27.70	13.50	85.30
diesel	1000 liters	649.20	27.70	13.50	n / a
heavy fuel oil	metric ton	34.24	32.33	0.00	n / a
coal	metric ton	n / a	23.38	n / a	n / a
LPG[57]	metric ton	78.72	33.08	n / a	100.9
natural gas	m^3	n / a	<10 million: 0.02155 >10 million: 0.1410	n / a	<170,000: 0.0953
process gas	1,000 gjoule	n / a	236.82	n / a	n / a
petrocoke residuals	metric ton	n / a	32.47	n / a	n / a
liquid residuals	metric ton	n / a	32.33	n / a	n / a
gaseous residuals	1,000 gjoule	n / a	236.82	n / a	n / a
electricity	Kwh	n / a	n / a	n / a	0.0295

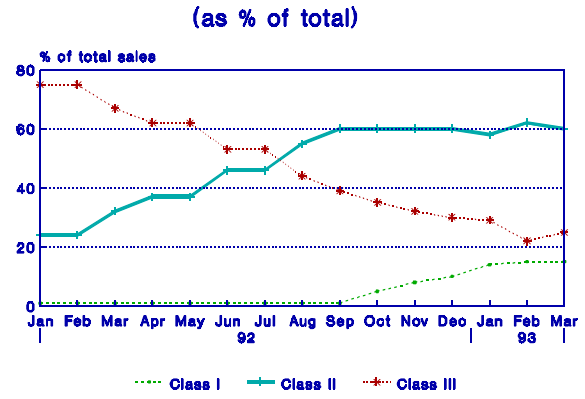
Source: Netherlands Ministry of Housing, Spatial Planning and Environment, "The Netherlands' Regulatory Tax on Energy," p. 10.

In addition to taxing leaded gasoline at higher rates than unleaded, Sweden has used several other taxation mechanisms in an effort to promote the use of cleaner fuels. In 1991, a tax was imposed on diesel (as well as peat and coal) based on its sulfur content. The tax was set at 27 SEK ($4) per m^3 oil for each tenth of percentage weight of sulfur, an amount corresponding to 30 SEK ($4.4) per kg sulfur. Fuels with a sulfur content no higher than 0.1% are exempt. Rebates are also available for facilities that control sulfur emissions. Norway has a similar tax on sulfur in fuel.

The Swedish Environmental Protection Agency credited the sulfur tax with lowering the sulfur content of diesel fuel from 0.15% in 1990 to 0.1% in 1992. In an effort to encourage the use of even cleaner fuels, Sweden classified diesel fuels into three different classes and instituted tax rebates for the two cleanest classes. The tax discount was first set at 350 SEK ($51.6) per cubic meter for class I and 150 SEK ($22.1) per cubic meter for class II in 1991. In 1992, the discounts were increased by an additional 100 SEK ($14.7). The rebates have since been changed several more times. In 1995, they were 490 SEK ($72.2) per m^3 for class I and 270 SEK ($40) per m^3 for class II.

When the tax rebates were increased in 1992, the standards for the two cleaner fuel classes were also changed. The original standards concerned only sulfur and aromatics content and distillation range. The new standards lowered the sulfur standard for class II fuel to 0.005% and added several parameters. The 1992 standards for the two cleaner fuel classes are shown in Table 11-17.

Figure 11-6: SALES OF DIFFERENT CLASSES OF DIESEL FUEL IN SWEDEN



Source: Bergman, p. 255

As shown in Figure 11-6, the percent age of diesel in classes I and II rose from a combined total of under 1% to 60% for class II and 15% for class I after the introduction of this tax differentiation. After initially relying on imports to obtain the cleaner fuels, oil companies then made significant investments to increase their capacities to produce class I and II diesel fuel, partly because of the differential taxation but also because of lower than expected production costs for class I and II. One factor that lowered costs was a downturn in the market for jet oil, which is similar to the cleaner classes of diesel subject to rebates. The downturn freed up capacity for the production of class I and II diesel. Since the extra cost is estimated at 300 SEK ($44.2) per cubic meter for class I and 170 SEK ($25) per cubic meter for class II, producers have a strong interest in producing the cleaner classes. Moreover, the tax differentiation increased public awareness of diesel fuels, leading many consumers to use only I and II and many communities to ban the sale of class III. However, some consumers are skeptical about the cleaner fuels, believing that they may be harmful to engines.

Table 11-16: DIFFERENTIAL TAXATION OF LEADED GASOLINE
($/liter in 1994)

Country	Leaded fuel price	Tax differential
Belgium	1.02	0.099
Denmark	0.89	0.034
France	1.011	0.07
Germany	1.042	0.073
Greece	0.827	0.071
Ireland	0.891	0.049
Italy	1.05	0.078
Luxembourg	0.807	0.092
Netherlands	1.132	0.09
New Zealand	0.563	0.016
Norway	1.17	0.014
Portugal	0.931	0.046
Spain	0.813	0.04
Sweden	1.017	0.077
Switzerland	0.911	0.063
Turkey	0.547	0.015
United Kingdom	0.871	0.086

Source: IEA, *Energy Prices and Taxes*, 3rd Quarter 1995.

SEPA believes that it is difficult to determine the net benefits or cost-effectiveness of the differential taxation, but that a command-and-control approach would have cost more and taken longer to achieve the desired result and that emissions reductions resulting from the system have led to more health benefits in cities than abatement investments at large point sources. Moreover, administrative costs are low, as the rebate was built into an existing tax.

Table 11-17: 1992 CLASSIFICATION OF DIESEL FUELS AND TAX REBATES IN SWEDEN

Parameters	Class I	Class II
Sulfur, max. %	0.001	0.005
Aromatics, max. %	5	20
PAH, max. %	0	0.1
Cetane index	50	47
Density, kg/m_3	800-820	800-820
Initial boiling point	180 C	180 C
Max.Temp. at 95% recovery	285 C	295 C
1993 tax rebate (SEK per liter)	0.535	0.25
1995 tax rebate (SEK per liter)	0.49	0.27

Sources: Bergman (1994), p. 253; OECD (1996), p. 94.

One problem has been determining appropriate rebate amounts. At their original levels, the rebates had little effect on the diesel fuel market. However, the 1992 rebate increases combined with developments on the oil market caused a rapid rise in cleaner fuel use. At their current level, the rebates might be higher than socially desirable. SEPA maintains that class I is sufficiently expensive to produce that it should be used mainly in urban areas, but it is apparently used in other areas as well. The cleaner fuels have also been employed for other relatively inefficient uses such as domestic heating. However, frequent changes in rebates in response to technological and market developments would create uncertainty for companies making investments necessary to produce the cleaner fuels.[58]

In December 1994, Sweden introduced a similar differentiation system for two classes of unleaded gasoline. The cleanest class (based on its sulfur, lead, benzene, and phosphorus content and vapor pressure) was taxed at 3.22 SEK ($0.47) per liter in 1995, whereas the other class was taxed at 3.28 SEK ($0.48) per liter.[59]

In Belgium, Finland, Germany, Greece, Hungary, Japan, the Netherlands, Norway, and Sweden, motor vehicle taxes have been positively related to pollutant emissions. Austria and Germany base annual vehicle ownership taxes on emissions. Japan imposes lower sales tax on cars powered by methanol, electricity, and solar power than on

gasoline-powered cars.

In Belgium, a number of charges designed to reduce waste generation and promote reusable products came into effect on February 1, 1996. These include a 10 BF ($0.33) tax on disposable razors and a 300 BF ($9.9) tax on disposable cameras (if not recycled). Paper and cardboard used in packaging, newspapers, and toilet paper are subject to a tax of 10 BF ($0.33) per kilo unless they contain a certain percentage of recycled fibers by specified dates. For paper and cardboard made from non-chlorine bleached pulp, the tax is 5 BF ($0.16) per kilo. Taxes have also been imposed on pesticides in non-agricultural products and on batteries. A policy advisor for the Belgian Ministry of Environment said that the Ministry did not consider these taxes as revenue-raising measures but rather as incentive mechanisms.[60]

A 6-7% tax on disposable diapers has been imposed in parts of Canada.[61] Several countries impose higher charges on disposable beverage containers to encourage the use of refillables.[62]

In Germany, many manufacturers and distributors participate in a packaging recycling system managed by the company Duales System Deutschland (DSD). To fund DSD's activities, participating companies pay fees on packaging depending on the type and weight of the packaging materials. Fees range from 0.16 DM ($0.11) per kg for glass (an easy material to sort) to 3 DM ($2) per kg for plastics (difficult to sort). Although these fees are not government-imposed product charges, they have a similar effect. Industry set up the DSD system to comply with the German Packaging Ordinance obliging producers to take back and recycle their packaging materials.[63]

11.1.5.4. Road User Fees

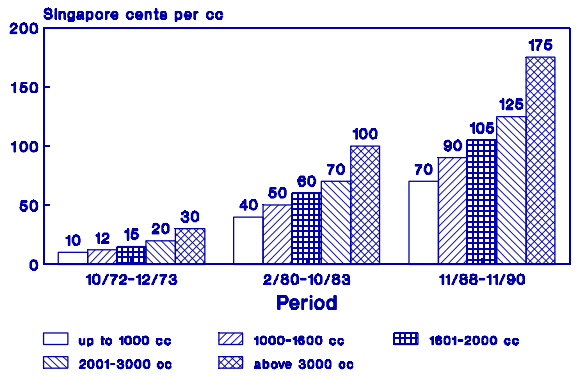
Several countries levy taxes to reduce road use. Germany, Belgium, Luxembourg, the Netherlands, and Denmark signed an accord in 1994 imposing a tax on trucks using their roads. Annual tax rates were set at 750 ECU ($599) for trucks with three axles or less and 1,250 ECU ($998) for trucks with four axles or more. Daily, weekly, and monthly rates are reduced. Germany, which has the most roads and road usage by trucks in the European Union and which led the initiative to introduce the tax, intends for the tax revenue to finance investments in rail transportation infrastructure.[64] These taxes could be considered environmental charges to the extent that truck transportation contributes to pollution.

Austria has imposed on mountain roads linking Germany and Italy in an effort to limit the damage to its forests caused by vehicle emissions. These tolls have been a significant source of conflict between Austria and neighboring countries, and the European Union has threatened legal action against Austria over the tolls.[65]

Authorities in several countries have attempted to use fees to address the problem of traffic congestion. The Norwegian cities of Oslo, Bergen, and Trondheim have implemented congestion pricing schemes. In Trondheim, Norway's third largest city with a population of 140,000, motorists are charged rates ranging from $0.62 to $1.56 to enter the city between 6 am and 5 pm. Rates are highest during the morning rush hour, between 6

and 10 am. The city has a system of 12 toll stations, all but two of which are unattended. Motorists can pay the fees either by subscribing to the system and receiving a transponder tag or by paying at toll stations with coins or a magnetic strip card. Since the toll ring began operation in 1991, inbound traffic during the toll period has declined by 10%, while traffic during the non-toll period has increased by 9%. Weekday bus travel has increased by 7%. Revenues are 5 times as high as toll capital and operating expenses.

Figure 11-7: SINGAPORE ANNUAL ROAD TAX



Source: Chia and Phang, p. 8

Experiences in France also suggest that congestion pricing has incentive effects. In April 1992, peak-period surcharges were imposed on the highway connecting Paris and Lille. Sunday afternoon peak rates were set 25-50% higher than base rates, while off-peak rates were reduced by 25-50%. Despite an overall rise in weekend traffic since 1992, the tolls decreased congestion by spreading out traffic over a much longer peak period. Moreover, peak period tolls on a congested road from Paris to a popular ski resort diverted a significant amount of traffic to a longer, alternative road where the toll was lower.[66]

Authorities in Vancouver are considering congestion pricing. A study revealed that a C$3 ($2.2) fee charged on vehicles entering the downtown area during the morning peak would decrease the number of automobiles by 19.1% during that period and that a C$6 ($4.4) fee would result in a 31.3% decrease.[67]

11.1.5.5. Singapore Road and Vehicle Taxation[68]

Congestion tolls are among various road and vehicle taxes that Singapore has imple mented in an effort to prevent congestion problems such as those affecting large urban areas in neighboring countries. For convenience, the incentive measures can be classified as ownership or use taxes in the following manner:

Vehicle ownership: Import duty, two registration fees, annual road tax, and Certificates of Entitlement;

Vehicle use: Fuel tax, Area Licensing Fees, parking fees.

In addition to import duties of 45% and registration fees of S$1,000 ($710), Singapore imposes an Additional Registration Fee (ARF) based on the market value of the vehicle. The ARF rose from 15% in 1968 to 175% in 1983, before falling to 150% in 1991. The annual road tax is based on the engine capacity of the vehicle. As shown in Figure 11-7, these rates have risen significantly since the early 1970s. The ARF is reduced if an old vehicle is scrapped when a new one is purchased. The intention of this Preferential

Additional Registration Fee (PARF) is to discourage ownership of older, high-emitting vehicles and to limit the used car market.

In 1990, Singapore implemented a quota scheme under which vehicle owners are required to have Certificates of Entitlement (COEs). COEs are valid for ten years and can be obtained in public auctions held monthly by the Registry of Vehicles. Owners of vehicles more than ten years old are required to pay the prevailing quota price. The COE requirement enables the government to determine the total number of vehicles in circulation based on the country's road capacity. This program could be considered a trading system such as those discussed below and in Section VI but is included here because it is part of Singapore's package of measures to limit congestion. COE prices have increased rapidly: For cars with a capacity over 2,000 cc, they have risen from S$528 ($375) when they were introduced in 1990 to S$17,600 ($12,500) in 1992 to over S$100,000 ($70,000) in 1994.

An element of congestion pricing was built into the COE system in 1991 with the creation of the Weekend Car scheme under which a separate category of Weekend Car COEs was created. Buyers of Weekend COEs enjoyed tax rebates on the registration fee, import duty and COE premium, up to a maximum of S$15,000 ($10,700). They were also entitled to 70% reductions in road tax. Weekend cars could be used only on Sundays and public holidays and during off-peak hours (between 7 pm and 7 am on weekdays and after 3 pm on Saturdays). Weekend vehicles were clearly marked by red number plates that had to be welded onto the vehicle and sealed by an authorized inspection center. To drive the vehicle outside the authorized times, a S$20 ($14) day license had to be displayed on the windshield. Owners had the right to five free day licenses a year.

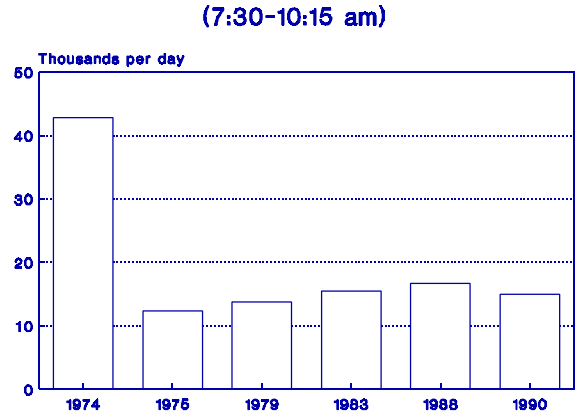
One problem with the Weekend Car scheme was that many owners of large vehicles found it cheaper to purchase Weekend COEs but use their vehicles during peak periods, paying the S$20 daily license. To stop this practice, the Weekend Car scheme was replaced by an Off-Peak Car Scheme on October 1, 1994. This scheme operates like the Weekend scheme except that there is no separate category of COEs, the tax rebates have been raised from S$15,000 to S$17,000 ($12,000), and the annual road tax reduction has been set at S$800 ($570).

Like most other countries, Singapore taxes motor fuels. The unleaded gasoline tax is the higher of S$0.6 ($0.43) per liter or 50% of pump prices (including taxes). Leaded gasoline is taxed an additional S$0.15 ($0.11) per liter. Diesel is taxed at S$0.08 ($0.06) per liter. One problem that arose as a result of these taxes was that motorists purchased fuel in neighboring Malaysia, where a liter of gasoline was about S$0.5 ($0.35) cheaper. Singapore countered this practice by requiring all vehicles leaving the country to have their gasoline tanks at least half full in 1989. In 1991, the tank requirement was raised to 3/4 full.

As the main operator of parking facilities, the government also imposes relatively high parking fees. Parking charges within the Central Business District (CBD) are S$0.9 ($0.64) per half hour during office hours. Outside the CBD, charges are S$0.45 ($0.32) per half hour.

The Area Licensing Scheme (ALS) was adopted in 1975 to reduce congestion in the CBD during peak morning hours (7:30-10:15). Cars entering the CBD with fewer than four persons were required to pay a fee that rose from S$3 ($2.1) in 1975 to S$4 ($2.8) in 1976 to S$5 ($3.6) in 1980. When the fee hours were extended to the evening peak period (4:30-6:30) in 1989, the fee was lowered to S$3. Company cars pay twice this rate. The exemption for cars with at least four persons was removed in 1989. Motorcycles pay S$1 ($0.7) per day.

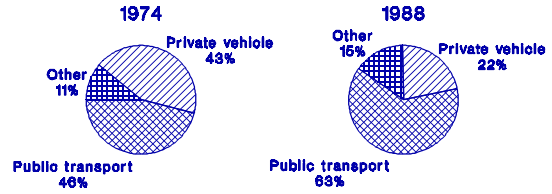
Figure 11-8: PRIVATE CARS ENTERING SINGAPORE CENTRAL BUSINESS DISTRICT



Source: Buchan, pp. 224-5.

Although officials found that the fees limited vehicle use during peak hours, traffic problems between peak periods increased. As a result, the ALS was significantly modified in 1994 to include two types of licenses: a part-day license at S$2 ($1.4) for entry into the CBD during off-peak hours (10:15 am-4:30 pm) and a whole-day license of S$3 to be used between 7:15 am and 6:30 pm.

Figure 11-9: MODES OF TRANSPORTATION IN SINGAPORE



Source: Buchan, p. 226.

As shown in Figure 11-8, the ALS had a large impact on peak-hour traffic, resulting by the end of 1975 in a 71.1% decrease in the number of private vehicles entering the restricted zone between 7:30 and 10:15. Figure 11-9 shows that public transportation became preferred mode of transportation after the introduction of the ALS. The 1989 expansion of the system to evening peak hours resulted in further traffic decreases and increases in average speeds of 10.8% in morning peak hours and 30.4% during the evening peak period.

The COE and other measures are credited with significantly limiting the number of vehicles in Singapore. It has been estimated that without vehicle ownership and use disincentives, the number of vehicles in Singapore would have been 400,000 by 1992 instead of the actual number of 274,000. The U.S. Federal Highway Administration, which has gathered information on traffic management in Singapore and other countries, concluded in a recent article, "The road pricing program, combined with other charges on vehicles ownership, has dramatically reduced traffic and eliminated peak-period congestion in the downtown area. In addition, air pollution has been significantly reduced, and business activities and rents in the downtown area have not suffered." These achieve-

ments are in stark contrast to severe traffic problems in other southeast Asian cities, such as Bangkok and Jakarta.

Singapore's vehicle taxes have also raised significant revenues for the government. By 1992, they accounted for 23% of total government tax revenue.

Singapore intends to convert its current manual scheme to an electronic road pricing system by 1997. Electronic tolls will deduct credits from vehicle transponders and notify the authorities of vehicles in violation of toll rules. The same transponder cards will perhaps be usable for public phone calls and other purchases. Toll charges will vary according to type of vehicle and time of day. The government plans to later extend the system to its entire road system.

11.1.5.6. Other Measures to Curb Congestion

Mexico opted for a different method of limiting congestion in Mexico City. In 1989, regulations were enacted to take 20% of the vehicle fleet out of circulation each working day. Vehicles were assigned their prohibition day based on the last digit of their license plate. Such a system has a large command-and-control element but could create incentives to carpool or use public transportation. Although the program initially lowered traffic volume and gasoline consumption in the city, these reductions were subsequently nullified by the measure's unintended effect of encouraging motorists to use other vehicles on days when their new vehicles were prohibited. In 1990, the increase in the number of vehicles registered was twice the number of cars sold, implying that large numbers of used vehicles were brought into circulation. A survey revealed that 39% of car owners had obtained another (often older) vehicle to avoid being without a car on the vehicle prohibition day. The increased number of older vehicles resulted in increased pollution levels. Moreover, the availability of a second vehicle led family members to reduce their use of public transportation. Similar vehicle restrictions were recently adopted in Manila, in the Philippines. Thailand's Deputy Prime Minister has proposed banning new cars from Bangkok during the period 1997-2000. Owners of old cars would be allowed to transfer their use rights to new cars.[69]

11.2. DEPOSIT-REFUND MECHANISMS

The most common application of deposit-refund mechanisms is beverage containers (see Table 11-18). Numerous countries have deposit systems for glass bottles. Less widespread, but expanding rapidly, are deposit systems for plastic containers, which are now found in at least 11 countries. Deposit sizes reach nearly 50% of the purchase price of the beverage in Denmark and the Netherlands. In some cases, deposit mechanisms are required by law; in others, they are conducted voluntarily by industry. Sweden, Portugal, and parts of Canada and Australia have deposit systems for metal cans. In most places where beverage container deposit systems have been implemented, the percentage of containers returned is over 50%, and it is often near 100%. In some countries, the percentage of containers returned appears to be positively related to the magnitude of the deposit relative to the price of the beverage.[70]

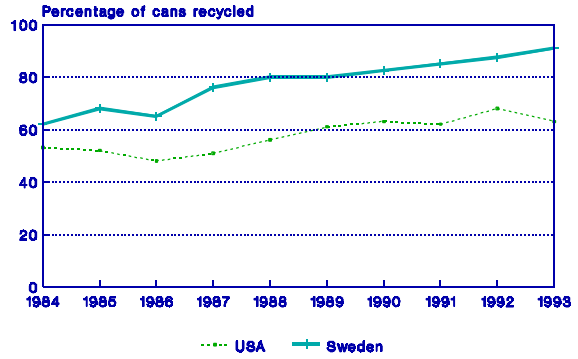
Table 11-18: BEVERAGE CONTAINER DEPOSITS IN SELECTED COUNTRIES[71]

Country	Containers Covered	Deposit Amount
Australia (regions)	Beer, Soft drinks. Cans, plastic, bottles	Cans and PET: 2.5¢ Refill. glass: 6-13¢; One-way glass: 2.5¢
Austria	REFPET bottles; beer, soft drinks, mineral water, juice, wine, liquor, milk	40¢ for REFPET, other rates for refillable glass
Belgium	Beer, soft drinks, soda water. As of 1998, wine and liquor	<50cl:12¢ >50cl:24¢
Canada (regions)	Beer, wine, liquor, soft drinks	Cans: 4-14¢, Plastic: 4-6¢, Glass: 4-29¢
Czech Republic	Glass bottles (beer, wine, and soft drinks)	1l soft drinks: 15¢ Others: 11¢
Denmark	Beer, soft drinks	Glass <99cl:27¢, >99cl:78¢ REFPET:78¢
Finland	One-way beer and soft drinks (metal, glass, plastic)	Small: 11¢, Large: 45¢
Hungary	Glass bottles	0.5l: 6¢, 0.7l: 9¢, 1l: 14-23¢
Iceland	Plastic and glass	Plastic and glass (alcoholic beverages): 9¢ Mineral water: 23¢
Nether-lands	Soft drinks, mineral water (glass and plastic)	<0.5l:16¢, >0.5l:72¢ REFPET:64¢
Norway	Beer, wine, liquor, carbonated and non-carbonated drinks	<0.5l:16¢ >0.5l:40¢
Poland	Plastic and glass	0.5-0.7l glass: 8¢ 2l plastic: 5¢
Sweden	Cans, bottles, PET	Cans:7¢ One-way PET:14-24¢ REFPET:56¢
Switzer-land	Beer, soft drink, and mineral water	Glass<.6l:16¢, >.6l:40¢ PET:40¢

Sources: Container Recycling Institute; Regional Environmental Center for Central and Eastern Europe (1995), p. 14; OECD (1994a), pp. 83-5.

Sweden's deposit on aluminum cans is voluntarily implemented by industry in response to 1982 governmental legislation stipulating that aluminum cans would be banned unless a 75% recycling rate was attained. In 1994, the mandatory rate was raised to 90%. Industry created a corporation to recover the cans. The deposit was initially set at 0.25 SEK ($0.037) per can but was later raised to 0.5 SEK ($0.074) per can. A fee of approximately 1¢ per can has helped make the system self-financing. As shown in Figure 11-10, the recovery rate has risen to over 90%, the highest percentage in the world and nearly 30 percentage points higher than in the U.S. A similar system was recently established for PET bottles.[72]

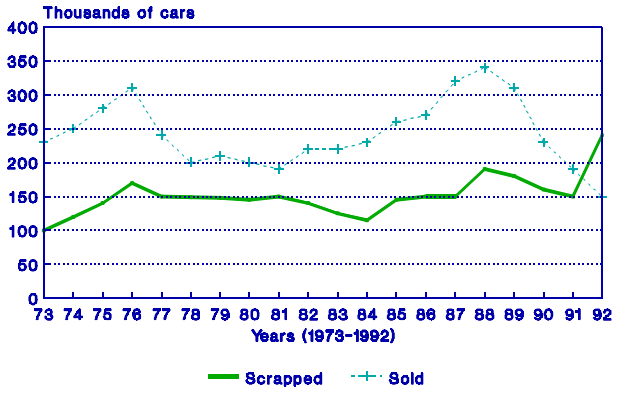
Figure 11-10: ALUMINUM CAN RECYCLING RATES



Source: Container Recycling Institute (1994), p. 41.

Greece, Norway, and Sweden have mandatory deposit-refund systems for car hulks.[73] Under the Swedish system created in 1975, mandatory deposits on new cars finance payments to individuals who return old cars to authorized scrap businesses. Originally, the deposit was 250 SEK ($37) and the refund was 300 SEK ($44), but in 1988, the deposit was raised to 300 SEK ($44) and the refund to 500 SEK ($74). In 1992, the deposit was increased to 500 SEK and the refund was set at 1,500 SEK ($221) for cars returned within nine months of an inspection and 500 SEK ($74) for other cars. The purpose of the differentiation was to encourage the scrapping of older cars emitting more pollutants. As shown in Figure 11-11, the ratio of cars sold to cars scrapped has increased, especially after the system was adopted in 1975 and the refund amounts were increased in 1988 and 1992. Although the scrap car refunds have lowered the number of abandoned cars, the incentive effect has been reduced by deductions of some motorists' unpaid taxes and fines from their refund payments and by their desire to keep old cars for spare parts. Administrative costs of this system are relatively low at approximately 2% of revenues.[74] The deposit-refund system in Greece, under which motorists must purchase a new vehicle with a catalytic converter to qualify for a refund, has significantly increased the prevalence of catalytic converters.[75]

Figure 11-11: CARS SOLD AND SCRAPPED IN SWEDEN



Source: The Swedish Experience: Taxes Charges in Environmental Policy, p. 10

Germany has mandated deposit-refund mechanisms for packaging if

recycling targets are not met voluntarily by industry.[76] The mandate led German companies to create the Duales System Deutschland described above. Austria requires deposits of 12 S ($11.6) for fluorescent light bulbs.[77] The percentage of light bulbs returned is 60-80%.[78]

After revising its Waste Disposal Act in 1988, Taiwan implemented a deposit-refund program for PET bottles. The amount of the deposit is NT$2 (8¢) per bottle. Collectors delivering bottles to recycling plants receive NT$0.50 (2¢) per bottle. As shown in Figure 11-12, recycling rates have risen significantly since adoption of the program.

Under a 1991 amendment to its Solid Waste Management Act, South Korea has introduced a deposit program including a much larger number of products than those countries discussed above.[79] The products affected by the system and the deposit amounts are shown in Table 11-19. Producers and importers of the listed products pay the deposits but can receive refunds as they collect the resulting post-consumer waste. During the first year of operation, deposits amounted to 24.5 billion won ($31.4 million), but refunds were only 1.9 billion won ($2.4 million), indicating an 8% refund rate. This relatively low refund rate could indicate that deposit amounts are too low to significantly influence behavior. The largest deposit applies to large tires and amounts to about $0.50.

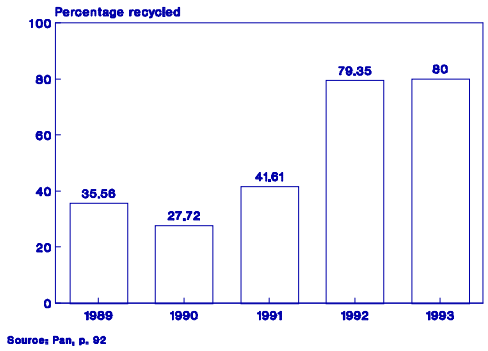
As discussed in Section 5, another type of deposit mechanism is an environmental performance bond. Individuals or companies pay such bonds to responsible authorities but are refunded to the extent that they avoid causing environmental damage or remedy any damage they do cause.

Indonesia has used performance bonds for forestry. Under a scheme initiated in the late 1980s, loggers paid deposits of $4/m^3 of extracted timber and could obtain refunds through reforestation. One problem with this system was that the fee was far lower than replanting costs, giving logging companies insufficient incentive to reforest. Another problem was that the bonds created incentives to clear cut forests to start plantations to qualify for refunds.[80] Similar forestry bonds of approximately $400 per hectare have been introduced in the Philippines. Since reforestation costs have been estimated at $500 per hectare, the Philippines' deposit may be too low to encourage sufficient reforestation.[81]

Malaysia has used deposits since 1960 to encourage the rehabilitation of mined areas. Amounts range from M$1,000-5,000 ($400-2,000) per acre.[82] Other countries in which mining deposits have been used include Canada and Australia.

In January 1996, China announced a scheme to require land developers to pay "reclamation guarantee fees." The State Land Administration said that the fee could cost the equivalent of $1,800 per hectare. The scheme seeks to counter land degradation caused by industry. Accord-

Figure 11-12: PET BOTTLE RECYCLING RATE IN TAIWAN



ing to SLA, "persistent damage to farm land has already become a major factor restricting the development of some local economies."[83]

Table 11-19: DEPOSITS IN SOUTH KOREA

Product	Deposit amount ($=780 won)
Paper pack: less than 250 ml greater than 250 ml	0.2 won 0.4 won
Metal can: lid attached lid separated	2 won 4 won
Glass bottle: less than 100 ml less than 350 ml over 350 ml	1.5 won 2 won 3 won
PET bottle: less than 500 ml less than 1,500 ml over 1,500 ml	3 won 5 won 7 won
Batteries: mercury silver oxide	100 won 50 won
Tires: large medium motorcycle	400 won 100 won 40 won
Lubricating oil	20 won
Televisions	30 won
Washing machines	30 won
Air conditioners	30 won

Source: Rhee (1994), "The Use of Economic Instruments in Environmental Protection in Korea," p. 103.

11.3. MARKETABLE PERMIT SYSTEMS

Although marketable permit systems have been considered in several countries, their use remains much more common in the United States than elsewhere. Systems have been established on a limited scale in Germany, Canada, Chile, and several other countries to reduce air pollution, in Australia to reduce water pollution, and in several countries to limit water use. Singapore and Mexico have used permit systems to lower the use of ozone-depleting substances.

Singapore's Certificate of Entitlements for motor vehicle ownership also constitute a market-based permit system. This quota system is discussed earlier in this section in the sub-section on vehicle taxation. In addition, three Central Asian countries recently

announced a trading scheme involving energy and water.

11.3.1. Air Pollution

Under the terms of Germany's 1985 Federal Immision Control Law and 1986 Technical Instructions on Air Quality Control, new sources of air pollution can be established in areas with especially poor air quality provided that pollution from nearby sources is lowered so that total emissions in the area are lower after construction of the new facility. This rule allows polluters to negotiate to determine who will reduce emissions and by how much. Under another scheme in effect until 1994, an existing facility could obtain a temporary exemption from tighter emissions abatement standards if it and nearby polluters achieved significant combined emissions reductions.

The impact of these offset provisions has been minimal. For existing facilities, trading opportunities were severely limited by a number of factors:

1. The deadline for submitting detailed trading plans to the authorities was one year, whereas the deadline for individual plant improvements was three years. Not only did plans have to be developed within a year, they had to be implemented within 2-5 years.

2. Facilities involved in trading had to be very near each other. In one case, two facilities within 2.5 km of each other were prevented from trading because they did not share a common pollution impact area as determined by law. Intra-firm trading is usually the only viable option.

3. Businesses could not use emissions reductions from newer facilities as credits. Facility operators say including such sources into the program would have significantly increased trading possibilities.

4. Reductions resulting from facility shutdowns could not be counted for trading purposes.

5. The vagueness of the requirement that "technical measures" be undertaken to achieve reductions caused uncertainty.

6. Differences between actual emissions and allowable maximum emissions under clean air laws could not be counted for offsets. Moreover, trading schemes had to result in emission reductions <u>below</u> what would be achieved through individual plant improvements.

7. Trading could occur only for a given substance or between substances with the same health and environmental effects. The question of whether certain substances have the same pollution effects proved difficult to resolve in a timely manner.

8. In the best of cases, the trading scheme allowed firms to delay (until the 1994 deadline) rather than avoid pollution abatement investment at old facilities.

Out of roughly 17,000 pollution abatement initiatives in Federal Environment Office statistics for 1991 and 1992, fewer than 50 involved offsets.[84]

According to the German Industries Association (BDI), the new source offset provisions, much like those for old sources, have involved almost exclusively intra-firm trading. The most common application appears to be the creation of a new source alongside an existing one that it will eventually replace. One recent inter-firm initiative involved several fluoride-emitting ceramics factories concentrated in the Koblenz region. The factories sought to negotiate an arrangement under which only the larger ones would install abatement equipment while the smaller ones would help them pay for it. However, this initiative failed.[85]

Canada's acid rain and CFC reduction programs make limited use of trading rights. The Province of Ontario's electric utility is allowed to trade emissions between its power stations, and the Province allows trading between SO_2 and NO_x emissions. CFC producers are allowed to trade production rights between facilities and to trade between different types of CFCs. Inter-business trading is not allowed under this system. There has been little trading under these programs.

In Santiago, Chile, an air pollution commission has introduced a tradable permit scheme for industrial sources of particulate whose emissions exceed 1,000 m^3/hour. As in the United States, new sources are allowed only if their emissions can be offset by reductions from existing sources. Trading also takes place between sources exceeding their emissions allowances and those emitting less than their allocated amount. Maximum daily emissions (and allowances for each source) are gradually being reduced to a target level to be attained by 1997.[86]

Poland experimented with tradable air pollution permits in the Chorzow area. According to an Eastern European study of incentives in environmental policy, this experiment "proved extremely successful in bringing visible improvements more rapidly and at a lower cost than attainable through traditional instruments." Lack of legal basis for tradable permits has prevented the use of such schemes elsewhere in the country. An environmental protection bill has been proposed including language that would provide a legal framework for trading schemes.[87]

A 1993 revision of Taiwan's Air Pollution Control Act included provisions under which individual sources may be exempted from emission standards if they can control sufficient amounts of the same types of emissions elsewhere in the same air pollution control region. It is not clear how widely these provisions have been applied.[88]

The U.S. Agency for International Development has worked with at least two other countries, the Czech Republic and Kazakhstan, to create air emissions trading programs. As of early 1996, the Czech program was still in a developmental stage.[89] In late 1996, the first trade occurred in Kazakstan when one source gave a package of future rights to emit 10 pollutants to a second source in exchange for rights to emit 6 mostly different pollutants plus a modest cash payment. In both cases the rights were unused permitted amounts. With this trade, air quality is expected to decline since total emissions will

increase.

Like the United States and Canada, Mexico and Singapore sought to ease the phaseout of CFCs through marketable production quotas. In Singapore, CFC use permits were allocated quarterly, half on the basis of historical use and half through sealed bids. In registering to participate in the bidding, users and importers specified the quantity of CFCs they wanted and their offer price. The lowest winning bid price served as the price for all allocations, including those based on historical use. This system gave firms a strong incentive to substitute other products for CFCs or adopt other measures to limit CFC use.[90]

11.3.2. Water Pollution

Three states in Australia take part in the Murray-Darling Basin Commission, which manages water resources for an area in which over half of Australia's agricultural output is produced. The basin system is naturally saline, with some stream inflows saltier than the sea. Extensive irrigation activities in the upstream states of New South Wales and Victoria, encouraged by the sale of irrigation water to farmers at low prices, increased the flow of salt into the river system, reducing water quantity and quality to the downstream state of South Australia. Irrigation activity in South Australia further added to salinity levels of the water before it reached downstream urban users.

Under the Commission's salinity and drainage strategy, each state is responsible for its actions affecting river salinity and no actions are permitted that increase overall river salinity. Credits can be earned for investments that limit the entry of salt into the river system offset. The credits are used to offset debits for drainage into the system.[91] These credits are transferable between states but not between individuals and businesses.[92]

11.3.3. Water Use Rights

The Murray-Darling Basin also has periodic water allocation auctions. These allocations are tradable. Volumes traded, although small compared to total water allocations, have increased steadily. "Since temporary trading, or leasing of water entitlements was introduced in 1989 in the Goulburn Murray Irrigation District of Victoria the volume traded each year has increased from 21927 ML to 206872 ML or 8% of total water use during the drought of 1994."[93] In New Zealand, water use permits may be transferred to another site provided that both sites are in the same catchment area, the transfer is allowed by a regional plan, and the transfer application has been approved by the permitting authority.

Under Chile's 1981 Water Code, water use rights are completely separate from land use rights and can be purchased, transferred, or sold. New water rights are awarded by competitive bidding. Between April 1993 and April 1994, 587 sales transactions involving 720 liters of water per second were recorded in the Santiago water registry for a total estimated value of $366,050. Partly because most water rights (perhaps 50%-65%) are traditional but not legally recognized, water leases are far more common than sales. In one area north of Santiago, the price of a three-month lease was estimated at $90-120 per

liter per second. Transaction costs are said to be relatively high because of the need for infrastructure investments to transfer water, the need for approval from government authorities, and the lack of legally recognized water rights. In general, however, the system appears to promote efficient water allocation.[94] Intra- and intersectoral gains-from-trade of water use rights have been significant.[95]

Water trading takes places in other countries, but no comprehensive list of such initiatives was identified during the course of the research for this report.

11.3.4. Water-energy Trading

In April 1996, the Central Asian republics of Kyrgyzstan, Uzbekistan, and Kazakhstan announced an agreement intended to address the region's water and energy supply problems. Relying on hydroelectric power from the Syr Darya River for its heating needs, Kyrgyzstan stores water in spring and summer to have sufficient supply flowing through its hydroelectric dams in winter. The diversion of water in spring and summer has deprived Uzbekistan and Kazakhstan of water supplies during cotton irrigation season and contributed to a significant fall in the water level of the Aral Sea. Under the agreement, Kyrgyzstan will supply hydroelectricity and ensure sufficient flow of water through the Syr Darya River in return for gas from Uzbekistan and coal from Kazakhstan. While it is too early to assess the effectiveness of this trading scheme, it is patterned after historic water and energy transfers that took place when the entire region was centrally managed as part of the Soviet Union.[96]

11.4. SUBSIDIES

Loosely defined as government financial support of activities believed to be environmentally friendly, subsidies have been used in environmental policy in numerous countries. They take various forms, including grants, low-interest loans, and tax incentives. Although they are far too numerous and varied to be covered comprehensively in this report, a few examples are provided below.

In some cases, subsidies are financed by advance disposal fees and other charges such as those described above. For example, Italy's aforementioned product charges on batteries, plastic beverage containers, and lubricating oil finance the otherwise unprofitable activities of collecting used products. The charge revenue covers the difference between the cost of collecting these used products and their reuse value. Several other countries, including Finland, France, and Spain, rely on charges on lubricating oil to subsidize used oil collection, and Taiwan has used taxes on bottles and tires to subsidize the collection and reuse of these products. In several European countries, water effluent charges fund subsidies for water pollution abatement.

Loans can be a form of environmental subsidy. Germany, for example, has used large portions of its European Recovery Program (ERP) low-interest loan fund to finance environmental protection activities. In 1995, the German government issued over 2,600 loans totaling DM 4.5 billion ($3.1 billion) to companies for environmental purposes under the ERP, including DM 1.8 billion ($1.2 billion) for energy conservation, DM 1.1 billion

($750 million) for air and noise pollution, DM 1.3 billion ($880 million) for waste management, and DM 300 million ($200 million) for water purification. The government-owned Deutsche Ausgleichsbank administers the loans.[97]

In most countries in Eastern Europe and the former Soviet Union, environmental funds have been set up to provide grants and loans for environmental protection initiatives. These funds are financed primarily by pollution charges. One of the largest is Poland's National Fund for Environmental Protection and Water Management, which had revenues of $284.0 million and expenditures of $198.5 million in 1993. Of the expenditures, 47% were for air, 35% for water, and 18% for other environmental protection activities.[98]

Environmental funds are also common in East Asia.[99] As noted earlier in this section, taxes have been imposed on sulfur emissions in Japan to generate revenues for a fund to compensate victims of pollution-related diseases. This fund is administered by the Pollution-Related Health Damage Compensation and Prevention Association. Japan also has a 50 billion yen ($470 million) fund to finance air pollution prevention activities. Fund capital is provided 80% by polluting industries and 20% by government, and fund profits finance a wide range of "health damage prevention project" activities.

Established in 1993, Korea's Environmental Pollution Prevention Fund is financed by pollution fines and charges as well as government contributions. Administered by the semi-governmental Environmental Management Corporation, the fund has provided long-term, low-interest loans for pollution control investments and compensation of pollution victims. As of 1990, the fund contained 11.6 billion won ($14.8 million).

Thailand created a 5 billion baht ($190 million) Environment Fund in October 1991. The fund was initially financed entirely by government and is intended to finance pollution control investments by small- and medium-size enterprises. Indonesia's Pollution Abatement Fund was created to provide $300 million to banks to lend to businesses for pollution control investments and environmental assistance.

According to a study by the American Council for Capital Formation Center for Policy Research, several countries in Eastern Europe, Asia, and Latin America offer substantial tax advantages for investments in pollution control technology. The most common type of tax advantage in foreign countries is accelerated depreciation of pollution control equipment, but tax credits are also offered in some cases. In general, the report found, such tax advantages are significantly less generous in the United States than in the ten foreign countries included in the study.[100]

11.4.1. Subsidies for Environmentally Friendly Agriculture and Land Management

Numerous countries use subsidies to promote environmentally friendly agriculture.[101] Germany, Finland, Norway, and Sweden offer grants to farmers who convert from traditional to organic farming. Canada's provinces subsidize farmers' efforts to comply with codes of acceptable environmental practices, and the country's Land Management Assistance Program provides a variety of land management subsidies. In the Province of New Brunswick, for example, the Ministry of Agriculture offers payments for practices

that increase the organic content of soil and reduce soil erosion, including payments of C$15 ($11) per acre for winter catch crops and of C$50 ($30.5) per acre for green manure crops.

The United Kingdom is one of several European countries that reward farmers for not spraying around the edge of crops. Studies show that the crop-edge program in the U.K. has enhanced bird and butterfly populations while having minimal impact on crop yields. Under Germany's Nature Conservation Act, farmers are rewarded for adopting environmental management practices such as reducing fertilizer use, refraining from converting grasslands into cropland, and refraining from using meadows while insects are hatching.

The European Union's Common Agricultural Policy requires member countries to offer financial assistance to farmers for recommended practices in environmentally sensitive areas such as water protection zones. In nitrate-sensitive areas of the United Kingdom, farmers can receive annual per hectare payments for limiting their use of nitrogenous fertilizers and animal manure, establishing crop cover to avoid bare land in the fall, and keeping hedges and woodland.

Faced with serious manure waste problems, Hong Kong introduced a program in the late 1980s to pay allowances to farmers if they stopped maintaining livestock.[102] Several Alpine countries subsidize sustainable agriculture and animal husbandry activities in mountainous areas to prevent environmental degradation.[103]

Belgium is one of a number of countries subsidizing reforestation activities. In the Belgian region of Flanders, private forest owners can obtain subsidies for reforestation, granting access to the public, and forest grouping.[104] In 1994, Finland announced revisions in its tax structure for forests. Under the revised system, forest reserved for non-commercial purposes and designated in officially approved management plans will not be taxed based on its prospective yield as before, but rather will remain tax-free for a 13-year transition period.[105] The United Kingdom provides grants for the planting of trees and hedges on agricultural land.[106] In Portugal, farmers can obtain subsidies and concessional loans for reforestation and creation of permanent pastures, and Spain and Turkey offer grants for afforestation and other land restoration activities. In Japan, forest owners can receive grants, low-interest loans, and favorable tax treatment in return for observing specified land management practices.[107]

11.4.1.1. Subsidies to Reduce Vehicle Emissions

Many countries have used subsidies to attempt to reduce vehicle emissions. France adopted a law in October 1995 that provides for payments of 5,000 F ($1,000) to 7,000 F ($1,400) for the scrapping of old cars in exchange for new ones. The cars must be at least eight years old and must be disposed of by authorized scrapping firms to qualify for the payments. Payments of 5,000 F are offered for buyers of compact cars and of 7,000 F for buyers of larger models. The offer expires September 30, 1996.[108] Purchasers of electric vehicles are eligible for payments of 5,000 F from the French Government and 10,000 F from the French national electricity company. These payments are equal to approximately 8-10% of the price of an electric vehicle.[109]

In the Canadian province of British Columbia, car owners receive payments of C$750 ($550) to retire older vehicles. Jointly funded by the oil industry and automobile dealers, with support from the public electric and transit companies, the B.C. Scrap-it Program was introduced in April 1996. It is expected to retire up to 1,100 vehicles in its first year and to reduce over 10,000 tons of pollution over the next five years. To qualify for the program, a vehicle must have been manufactured prior to 1983, be driven more than 5,000 kilometers annually, and fail the province's mandatory emissions test. A 1995 study by the B.C. Lung Association found that vehicle scrapping programs were among the most cost-effective emission reduction initiatives. According to the B.C. Automobile Dealers Association President, 40% of vehicles in circulation account for only 25% of distance traveled but 75% of automobile emissions.[110]

Japan plans to assign 10-20 low-emission vehicles (powered by natural gas, methanol, or electricity) to municipalities in 1996. The central government will share maintenance, fuel, and other costs with the municipalities.[111] In Austria, low-noise trucks receive favorable tax treatment.[112] In the Netherlands, public transportation commuters receive tax advantages.[113]

In January 1996, the government of Thailand announced incentives for manufacturers of four-stroke motorcycle engines in an effort to provide alternatives to the two-stroke motorcycles currently common in major Thai cities. According to a 1993 World Bank report, the older design two-stroke engines discharge up to ten times as much pollution per kilometer as the newer four-stroke engines. Manufacturers of four-stroke engines will benefit from 90 percent reductions in import duties for raw materials. Manufacturers who locate in Zone 3 areas (i.e., outside the Bangkok area and the surrounding 15 provinces) will also receive exemptions of machinery import duties, corporate income tax (for eight years), and double tax deductions for electricity, water, and transportation costs. These location incentives could help limit congestion and the strain it imposes on the environment in the Bangkok area.[114]

11.4.2. Subsidies for Resource Conservation

Another area where subsidies have been used extensively is the promotion of resource conservation. Denmark has offered grants for activities such as renewable energy source power generation, energy-saving measures, and used oil collection and exempted energy-efficient light bulbs from the aforementioned product charge on bulbs.[115] The Netherlands has exempted recycling wastes from its recently imposed waste tax and exempted water used to wash recyclable beverage containers from its new groundwater tax. Both of these taxes were described above.

In the Australian community of Kalgoorlie-Boulder, where water is supplied by a 550-km pipeline, a $2.6 million (US$2.0 million) campaign has been initiated with the goal of reducing water use from 7,700 ML / year to 6,700 ML / year. The campaign includes water consumption audits of businesses provided at 50% of cost, a $300,000 (US$232,000) revolving loan fund to finance water- efficient technologies, and a mail-order package of domestic water savings options with the possibility of subsidized replacement of less water-efficient appliances.[116]

In Switzerland, individuals may deduct energy-saving improvements from their taxable income, and businesses' expenditures on energy-efficient equipment, solar power, and other similar investments are subject to accelerated depreciation. Australia exempts certain recycled paper products, solar power equipment, and alternative fuel technology from its Wholesale Tax.[117]

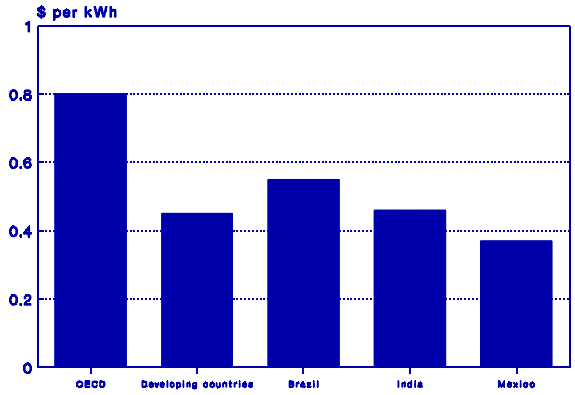
11.4.3. Environmentally Harmful Subsidies

Section 7 described a number of subsidies found in the United States that are believed to be detrimental to the environment. Such subsidies are also common in other countries but cannot be described in detail here.

For example, it has been estimated that tax benefits for businesses contributed to 5% of the total area deforested in the Brazilian Amazon.[118] In much of the world, forest resources, waste collection, water, and electricity are priced far below their value. Fertilizers and pesticides, which are taxed in several European countries, are subsidized in parts of Asia.[119] In much of the world, forest resources, waste collection, water, and electricity are priced far below their value.

As shown in Figure 11-13, electricity is far cheaper in developing countries than in OECD countries. While marginal supply costs in developing countries are generally at least 10¢ per Kwh, energy prices are below 6¢ per Kwh. These countries use about 20% more electricity than they would if consumers paid the true marginal cost of supply.[120]

Figure 11-13: ELECTRIC POWER PRICES, 1988



Source: World Bank (1992), p. 117

11.5. PRODUCT LABELING

The role of product labeling in environmental policy is to inform consumers of the influence of products on the environment. Products that are thought to have environmental advantages could bear labels indicating that they are environmentally friendly. Products that are believed to be harmful to the environment could bear labels indicating that they are environmentally unfriendly.

As noted in Section 9, labeling schemes in the United States have all been either private or limited to certain products or specific product attributes. As shown in Table 11-20, however, governments in numerous other countries have adopted official seal of approval labeling initiatives. In addition, a few multi-national labeling systems have been developed, including the Nordic Council label for Finland, Sweden, Norway, and Iceland and the European Union eco-label for EU member countries. Several private international labeling schemes were discussed in Section 9. The Green Dot placed on packaging of

products managed by the Duales System Deutschland described above is also a form of environmental labeling that can influence consumer behavior. These labeling systems vary in extent and in criteria used to determine products' environmental friendliness.

Table 11-20: ENVIRONMENTAL LABELS IN SELECTED COUNTRIES

Country or Organization	Label Name
Australia	Environmental Choice
Canada	Environmental Choice
France	NF-Environnement
Germany	Blue Angel
India	Ecomark
Japan	Eco-Mark
Korea	Eco-Mark
Netherlands	Milieukeur (Environmental Review Foundation)
New Zealand	Environmental Choice
Singapore	Green Label
Sweden	Bra Miljöval (Good Environmental Choice)
Thailand	Green Label
European Union	Ecolabel
Nordic Council (Norway, Iceland, Finland, Sweden)	White Swan

Source: EPA (September 1993), p. 41.

One of the oldest environmental labeling programs is Germany's Blue Angel. Since the creation of this program in 1977, over 4,000 products, including non-CFC spray cans and retread tires, have received approval from the German Environmental Agency to use the Blue Angel. A jury of representatives from industry, environmental groups, public authorities, and others rates label candidates based on their use of resources, greenhouse gas emissions, and other criteria.[121]

The Blue Angel program appears to be well known and to have had significant incentive effects on German businesses. A 1988 survey found that 79% of German consumers were familiar with the label and that 68% linked it with environmental protection.[122] The German government says that the label allowed the tightening of oil and gas heating appliance emissions standards by over 30% in a few years. It also credits the label with increasing the market for paints, lacquers, and varnishes low in VOC

content, resulting in reductions of solvent air releases of 40,000 tons. One potential problem is that some firms have been reluctant to seek the label for certain products because they fear that it will discourage consumers from purchasing their non-labeled products.[123]

Under a program introduced in 1989, the Japan Environmental Association, an affiliate of the Environmental Agency, has authorized approximately 2,500 products in 61 categories to bear the Eco-Mark environmental friendliness label. However, a 1993 report found that only 30% of the Japanese population purchased eco-friendly products. Authorities attributed this low percentage in part to lack of education on such products and are working with industry to publicize the benefits of environmentally friendly products.[124]

Canada's Environmental Choice label is awarded to products made or offered in a manner that improves energy efficiency, reduces hazardous by-products, or uses recycled materials. Since the introduction of the label in 1988, guidelines have been developed for about 30 product types, and more than 1,400 products have been approved.

Anecdotal evidence suggests that Canada's label has had incentive impacts. A Canadian envelope company reported that the share of recycled paper envelopes in its sales rose from 10% before it became the first envelope to receive the label in 1990 to more than 40% two years later. A 1993 survey found that 51% of the Canadian public was aware of the label. A 1992 survey of companies licensed to use the label found that 71% "agreed" or "strongly agreed" that it was "a good business investment" and that 80% had used the label in their advertising.

Korea initiated its Eco-Mark labeling program in June 1992.[125] Unlike many other labeling schemes, Korea's program has focused on "defining the single most important criterion for each product category." This practice stems from the belief "that the large data requirements for the life cycle approach are difficult to meet in practice." Table 11-21 shows that the labeling criteria for thefirst 12 product categories approved under the program are far simpler than the life cycle assessment criteria employed in several other countries.

The program appears to have had incentive effects. Sales of recycled paper increased by 30% after the introduction of the program. As of 1993, however, there was no evidence that the label had an effect on sales in other product categories.[126]

In 1992, the European Communities (now referred to as the European Union) created an EU-wide eco-label award scheme to "promote the design, production, marketing and use of products which have a reduced environmental impact during their entire life cycle" and "provide consumers with better information on the environmental impact of products, without, however, compromising product or workers' safety or significantly affecting the properties which make a product fit for use." Criteria are developed for each product group before products can be considered for the label. One source reports that the EU has the most thorough product assessment standards of any labeling program and that the rigorous standards have the possible disadvantages of causing delays and high costs.

Table 11-21: KOREAN ECO-MARK PRODUCT CRITERIA

Product category	Criteria
Products made with reused paper	> 50% reused paper
Tissues made with reused paper	> 50% reused paper
Reused plastics	> 60% plastics
Aerosol sprays without CFCs	0% CFCs
Reusable diapers	100% cotton
Non-asbestos brake lining	0% asbestos
Aluminum cans with stoppers	Should use aluminum
Filter for kitchen sinks	Holes no larger than 1.5 mm diameter
Non-bleached and un-dyed towels	Made without dyes or bleach
Water valves	Water should not run after valve is closed.
Packaging materials using wastes	Made with 100% wastes
Soap made with waste edible oil	Made with >50% waste edible oil

Source: EPA (September 1993), p. 92.

Applications are submitted to individual member states and are subject to an application fee that must be between 400 ECU ($500) and 600 ECU ($750). Annual fees for label holders must be between 0.12% and 0.18% of annual sales of the product.[127] The EU labeling scheme has experienced significant implementation delays. As of December 1995, only one company, a washing machine manufacturer, had applied and been approved for the label.[128] In February 1996, the EU Environment Commissioner called the eco-labeling program a failure and announced that it would be overhauled.[129]

As noted in Section 9, environmental labeling schemes need not be national or international in scope. In parts of Australia, for example, the authorities have rated shower systems on their water use efficiency. Consumers are then informed of the ratings so that they can purchase water-efficient systems if they so choose.[130]

11.6. INFORMATION DISCLOSURE REQUIREMENTS

Requirements that firms examine and report on their environmental performance to government and the public, such as the Toxic Release Inventory requirement in the United States, give polluters an incentive to behave in an environmentally responsible manner. Other factors being equal, businesses with relatively strong environmental performances might be able to attract more customers than their competitors.

In November 1995, the OECD agreed to a Council Act recommendation proposed by the United States that each member country develop a pollution release and transfer database.[131] In February 1996, the OECD ministerial Environment Policy Committee endorsed this initiative as "an important step towards better informing citizens about pollution sources and risks in their communities."[132] Canada, the United Kingdom, and the Netherlands already have such databases, and several other countries are creating them. The European Union is reviewing integrated pollution prevention legislation that is expected to include a database provision.[133]

At least two international organizations, the International Standards Organization and the European Union, have prepared guidelines for environmental performance auditing in businesses. In both of these cases, however, the guidelines are voluntary. The European standards-setting body, CEN, has prepared a document that attempts to help companies bridge the gap between the two sets of guidelines.

The European Union's eco-management and audit scheme (EMAS) was created by Council Regulation No. 1836/93 of June 29, 1993. Although it is voluntary, it may still have a significant incentive effect. A company's mere decision on whether to participate in such a program could influence the public. Moreover, experiences with such programs could lead the EU or some of its member states to either make the program mandatory or create additional incentives for participation. One incentive the EU intends to consider is the introduction of a logo for participating companies.

In line with the spirit of the EMAS, the Ministers of Environment and Water Management in the Netherlands submitted a proposal in January 1996 that would require about 300 industrial firms to report on their environmental performance to the government and the public. The reports would have to include the effects of a company's activities on the atmosphere, soil, and surface waters, the environmental protection measures taken by the company, and the results expected from the measures. Companies already participating in the EMAS would be exempted from the new Dutch requirements.[134]

In Indonesia, the Environmental Impact Management Agency rates numerous factories on their compliance with national environmental standards and their implementation of environmental management systems. The first of these surveys in June 1995 rated 187 factories and the second in December 1995 rated 213. Five color categories were used to rate environmental performance: gold for firms that use best technology, green for firms that exceed national standards, blue for compliance with national standards, red for firms that fail to meet national standards, and black for those without environmental management systems. Evidence suggests that this system could already be influencing behavior: the percentage of factories in the bottom two categories dropped from more than 60% in the first survey to 56% in the second survey, and three of the six factories rated as black in the first survey improved their performance.[135]

Environmental impact assessments (EIAs), which appear to have been initiated in the United States, have since become common in numerous other countries. Canada, Australia, and the Netherlands adopted EIA requirements in 1973, 1974, and 1981, respectively. OECD issued recommendations on conducting EIAs in 1974 and 1979. The

European Communities (now the EU) issued a directive in 1985 requiring member countries to assess the environmental impacts of certain public and private projects. Several East Asian countries, including Japan, Korea, Indonesia, Taiwan, and Thailand, also required EIAs. The types of projects subject to the requirements and the degree of public participation varies.[136] The Slovak Republic has required EIAs since 1992. As noted in Section 9, the information generated by EIAs can influence behavior, especially if the public is well informed.

11.7. VOLUNTARY PROGRAMS

As discussed in Section 10, voluntary programs have played a role in addressing numerous environmental problems in the United States. Among the incentives to undertake voluntary initiatives are the possibility of generating positive publicity and of avoiding more onerous regulations that environmental authorities might otherwise impose. In addition, some governments provide free or subsidized technical assistance under voluntary programs. The large number of programs in various countries rules out comprehensive coverage here.

The Netherlands' use of covenants, agreements between industry and government, to address environmental problems has attracted considerable attention in recent years. Covenants generally have the legal status of private law agreements, allowing the authorities to seek legal recourse for enforcement. As of 1995, 26 environmental covenants have been signed between industry and the government concerning products, packaging, waste, and other matters. In the field of air pollution, covenants have been concluded on the reduction of SO_2 and NO_x from power plants, the reduction of VOC emissions from industry, small businesses, and households, and the phaseout of CFCs.[137]

In Japan, voluntary pollution control agreements date back to the 1950s. As of September 1991, about 37,000 agreements were in effect. Of the 2,553 agreements concluded over the previous 12 months, 476 involved local citizen participation, of which 259 were reached directly between citizens and businesses.

Under Indonesia's PROKASIH (or Clean Rivers Program), the largest polluters are encouraged to sign agreements to reduce pollution by specific amounts over a specific time period. In the first 2 1/2 years after the start of the program, about 1,000 polluters signed agreements, the majority of which took measures to reduce pollution. The government has released information on which signatories have complied and which have not and encouraged press coverage of signatories' performance under the program.[138]

11.8. DEBT-FOR-NATURE SWAPS AND JOINT IMPLEMENTATION

Under debt-for-nature swaps, partial debt forgiveness is granted to less-developed countries (LDCs) on the condition that they fund environmental programs. One rationale behind such swaps is that indebtedness and environmental degradation are often linked. Once indebted, LDCs frequently subordinate the environment to more immediate problems and exploit their natural resources in an unsustainable manner to generate

revenue for debt servicing.

Since the amount of debt forgiven is usually smaller than the cost the LDC incurs for the conditional environmental program, the LDC has an incentive to accept such swap offers. Since a lot of the environmental degradation and pollution in LDCs, such as emissions of CO_2 and CFCs and destruction of rain forests, has negative repercussions throughout the world, wealthier creditor nations gain from debt-for-nature swaps as well. Swaps can also improve commercial banks' debt portfolios by discounting bad debt.[139]

As described in Section 6, joint implementation (JI) refers to a process under which organizations in one country undertake mitigation and sequestration of greenhouse gas emissions in another. Other countries have not carried out JI activities to the same extent as the United States. However, Japan is asking businesses to participate in JI projects. It plans to set up an "APEC environment technology exchange virtual center" to promote the transfer of Japanese carbon dioxide emission containment technologies to members of the Asia-Pacific Economic Cooperation Forum.[140]

Biotechnology development agreements concluded between landowners and biotechnology businesses have the potential to create incentives for biodiversity preservation by allowing landowners to sell genetic resource found on their land.[141] An agreement of this nature between the pharmaceutical company Merck and the National Biodiversity Institute (INBio-Instituto Nacional de Biodiversidad) in Costa Rica has attracted considerable attention. Under the terms of this agreement, INBio received a $1 million payment, over $100,000 worth of equipment, and staff training locally and at Merck facilities. INBio is also entitled to a percentage of royalty payments for discoveries made by Merck and must share its percentage with the Costa Rica Ministry of Natural Resources. Merck has first rights to patent discoveries.

Frisvold and Condon (1994) concluded that the Merck agreement "provides only modest incentives for biodiversity preservation," incentives that "are small not only in absolute terms, but, more importantly, they are small relative to incentives for conversion created by existing agricultural policies." Such agreements, they find, "can play only a limited role in a comprehensive strategy to increase incentives for biodiversity conversation." However, Blum (1993) maintains, "Merck/INBiolike agreements represent a profitable alternative to deforestation and provide nations with a greater incentive to preserve their biodiversity than is provided by any type of legislative action or regulation."[142]

11.9. TREND OF INCREASING USE OF ECONOMIC INSTRUMENTS IN FOREIGN COUNTRIES

To provide insight into trends in the use of economic incentives, the 1994 OECD report compared the extent of incentives in eight countries (Finland, France, Germany, Italy, Netherlands, Norway, Sweden, and the United States) in 1987 and 1992. (These were the only eight countries for which data had been collected for both years of the comparison.) Because the 1987 survey studied subsidies and other mechanisms not studied in 1992 and because the 1992 survey included more data sources, the comparison of the two years is

difficult. In general, however, the report concluded that increases had been "minor in France, Germany, and Italy, moderate in the Netherlands and Norway and extensive in Finland, Sweden and the USA."[143]

Examining the countries not included in the OECD comparison and the period since the comparison, the trend remains. Many of the incentive mechanisms described above had not been implemented at the time of publication of the previous version of this report (1992). New incentive mechanisms appear to far outnumber the mechanisms that have been eliminated.

Further evidence of the trend of increased use of economic instruments is found in the European Union's recent environmental policy statements. The Union's fifth environmental action program adopted in 1992 stated that the "traditional regulatory approach would be continued but supplemented with a wider range of instruments such as the use of economic and fiscal measures (i.e. 'market-based' instruments)." In 1994, the Union "published a new framework of controls over the availability of state aid for environmental purposes." In 1995, the Union prepared a proposal for a Council Directive introducing a tax on carbon dioxide emissions and energy.[144] (However, the Union stopped short of adopting a carbon tax directive.) The Union's initiatives on eco-labeling and eco-management and auditing were discussed above.

The Organization for Economic Cooperation and Development has also expressed interest in increasing the use of economic incentives. The Communiqué from the OECD Environment Policy Committee Meeting held on February 19-20, 1996 stated, "[OECD environment] Ministers welcomed the expanding use of market-based instruments within OECD countries both to improve efficiency and to address dispersed sources of pollution, which are difficult and costly to manage through regulation alone." The ministers urged the OECD to conduct within two years "a wide-ranging analysis of the effects of subsidies and tax disincentives to sound environmental practices in various economic sectors, and the costs and benefits of their elimination or reform, as proposed by the G-7 Environment Ministers in May 1995" and by 1997 "a further examination of the potential for environmental (or "green") tax reform."[145]

The United Nations has also expressed increased interest in economic instruments. After a two-week session of the U.N. Commission on Sustainable Development in April and May of 1996, the Commission chairman said that economic incentives for businesses to protect the environment would be a major goal of a 1997 U.N. General Assembly meeting.[146]

A related trend is several countries' incorporation of environmental considerations into the design of their taxation system in an attempt to shift the tax burden from labor and capital to the use of natural resources and the environment. This principle played a role in recent tax reforms in the Netherlands, Denmark, Norway, Sweden, and Finland. Even in some other countries that have introduced environmental taxes outside the context of major tax reforms, the environmental tax revenues have sometimes been recycled back to the population or compensated by reductions in other taxes. Indicative of this trend, Table 11-22 shows that the percentage of total tax revenues derived from environmental taxes

has risen in many countries.

Table 11-22: SHARE OF ENVIRONMENTAL TAXES IN TOTAL TAX REVENUES IN OECD COUNTRIES

Country	1990 (%)	1993 (%)
Austria	4.00	4.35
Belgium	3.83	4.49
Canada	2.87	3.44
Denmark	7.08	7.30
Finland	4.72	5.40
France	4.88	4.92
Germany	5.46	6.12
Greece	7.43	11.85
Ireland	10.35	8.98
Italy	7.82	6.52
Japan	5.11	5.49
Netherlands	5.12	6.12
New Zealand	5.08	4.76
Norway	9.40	10.75
Portugal	10.63	11.52
Spain	5.82	7.54
Sweden	5.77	6.34
Switzerland	4.26	4.65
United Kingdom	7.35	8.23
United States	2.88	3.24
Unweighted Average	6.02	6.67

Source: Morgenstern (1995), p. 12.

Less developed countries have also implemented many economic incentives and expressed interest in adding new ones and improving the existing ones. In 1994, for example, China launched a comprehensive two-year study of its charge system with the intention of expanding and enhancing it.[147]

11.10. CONCLUSIONS

1. The use of economic incentives in environmental management appears to be increasing throughout the world. The available information suggests that this trend holds for every type of economic incentive discussed in this section. Numerous countries have recently implemented a range of economic incentives and are considering others.

2. Among the incentives more widely used in foreign countries than in the United States are environmental product labeling, differential taxation of motor fuels, noise pollution charges, and carbon taxes.

3. Most industrialized countries have user fees for municipal waste and water/sewage and deposit-refund systems for beverage containers. Water user fees are lower in the United States than in most other OECD countries.

4. Market-based permit systems are more common in the United States than elsewhere. To address the problems of SO_2 emissions and leaded gasoline, for example, the United States has used market-based permits, whereas other OECD countries such as France, Japan, Portugal, and Sweden have opted for taxes.

5. Most countries have imposed taxes on gasoline, including higher tax rates for leaded gasoline. These rates are significantly lower in the United States than in all other OECD countries.

6. Taxation of pollution control investments appears to be more generous in most industrialized countries than in the United States.

7. Product charges tend to be revenue-raising instruments with little incentive effect. The lack of incentive can be attributed primarily to the low level of the charges. Moreover, some charges are not closely linked to waste generation or product consumption. However, some of the product charges described in this section, such as fertilizer taxes and the preferential taxation of cleaner motor fuels, do appear to have significant incentive effects.

8. As evidenced by experiences in France, Norway, and Singapore, congestion-based tolls appear to have the potential to significantly reduce traffic during peak hours.

9. Several user and pollution charges appear to have incentive effects. Examples include Sweden's NO_x emission charge, water effluent charges in Germany and the Netherlands, waste charges in Denmark and Korea, and water user or extraction charges in Australia and several Asian countries. However, many user and pollution charges are primarily revenue-raising.

10. Several countries, including Denmark, Finland, the Netherlands, Norway, and Sweden, have attempted to incorporate environmental considerations into the design of their taxation systems in an effort to shift the tax burden from labor and capital to the use of natural resources. In other countries that have introduced environmental taxes outside

the context of major tax reforms, the taxes have sometimes been recycled back to the population or compensated by reductions in other taxes.

11. Deposit-refund systems for car hulks and beverage containers appear to have significant incentive effects. The strength of the effect depends on the relative magnitude of the deposit and refund.

12. Newly industrialized and less developed countries are making extensive use of economic incentives for environmental protection. Deposit-refund systems and user fees appear to be the most common incentives in these countries, but waste and emissions charges are very common in Eastern Europe and the former Soviet Union.

Endnotes for Section 11

1. OECD (1994a), p. 97.

2. OECD (1995b), p. 95. Unless otherwise stated, all national currencies are converted into U.S. dollars at the exchange rates of March 14, 1996, as listed in the *Wall Street Journal* of March 15, 1996.

3. OECD (1994a), p. 64.

4. Netherlands Ministry of Housing, Spatial Planning and the Environment, "The Netherlands' Environmental Tax on Waste: Questions and Answers," p. 2.

5. *IER*, December 13, 1995, p. 953.

6. Rhee (1995). The currency conversions are taken from this article.

7. OECD (1995b), pp. 14, 98.

8. *Landesabfallabgabengesetz*, Article 4.

9. OECD (1995b), p. 96 and *DEN*, October 12, 1995, p. B-3.

10. *IER*, June 19, 1991, p. 350.

11. RECCEE (1995), p. 11.

12. Ibid, pp. 59-60, 154-5.

13. See OECD (1994a), Chapter 6.

14. Swedish Ministry of the Environment and Natural Resources (1995), pp. 44-49, and OECD (1994a), p. 59.

15. Palmisano (1994), pp. 362-6.

16. Ibid, p. 366.

17. *IER*, May 15, 1996, p. 406.

18. RECCEE (1995), p. 10. The source stated all charges in ECU, which have been converted to U.S. dollars according to procedure described above.

19. *DEN*, February 13, 1996, p. A-8.

20. Langford (1995).

21. RECCEE (1995), pp. 57-8, 152-3.

22. Steele and Ozdemiroglu (1993), p. 198.

23. Netherlands Ministry of Housing, Spatial Planning and the Environment, "The Netherlands' Environmental Tax on Groundwater: Questions and Answers," pp. 2-4.

24. *IER*, February 8, 1995, p. 106.

25. Steele and Ozdemiroglu (1993), p. 198.

26. The twelve countries studied are Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, and the United Kingdom. These were the only European Communities (now called the European Union) member states at the time of the research. Since water pollution control policy is the responsibility of regions in Belgium, the survey provides separate coverage of charge systems in Flanders and Wallonia, the largest of the country's three regions. In the United Kingdom, the survey is limited to England and Wales.

27. The charge amounts in figure # and the damage unit parameters are specified in the Effluent Charge Law (*Abwasserabgabengesetz*).

28. Stephen Smith (1995), *"Green" Taxes and Charges: Policy and Practice in Britain and Germany*, p. 28.

29. User fee and effluent charge revenue figures and shares paid by industry and government obtained from Schoot Uiterkamp, Leek, and de Savornin Lohman (1995), *Waste Water Charge Schemes in the European Union, Part 2: Country Descriptions*, pp. 107-109.

30. M.S. Andersen (1993), *Governancy by Green Taxes - Implementing Clean Water Policies in Denmark, France, Germany, and the Netherlands 1979-1990*, PhD dissertation, Institute of Political Science, Aarhus University, as cited in Schoot Uiterkamp, Leek, and de Savornin Lohman (1995), Part 2, p. 112.

31. Magda Lovei, "Environmental Financing: The Experience of OECD Countries and Implications for Transition Economies," in Centre for Co-operation with the Economies in Transition, *Environmental Funds in Economies in Transition*, OECD, Paris, p. 72.

32. The two surveys and other information on incentive effects of German effluent charges are discussed in Smith (1995), pp. 29-31.

33. Andersen (1994), as cited in Schoot Uiterkamp et al. (1995), Part 2, p. 110.

34. Unless otherwise stated, the information above on effluent charges in the Netherlands was provided by Schoot Uiterkamp et al. (1995).

35. The information on France's effluent charges is based on Cadiou and Duc (1994) and OECD (1994a).

36. Regional Environmental Center for Central and Eastern Europe (1995), p. 14. BOD5 refers to biological oxygen demand during the first five days.

37. For more information on this formula, see ibid, pp. 55-6.

38. Population equivalent is based on quantity of pollutants multiplied by pollution coefficients that vary according to the type of production. For more information, see ibid, p. 165.

39. Margulis (1994).

40. Steele and Ozdemiroglu (1993), p. 218.

41. OECD (1995b), p. 94.

42. OECD (1994a), p. 59.

43. OECD Environment Monograph #89 (1994b), pp. 55-6.

44. The charge shown in figure 5 is the sum of charges on nitrogen, phosphate, and potassium. The amounts of these three substances in fertilizers varies.

45. Rhee (1994), p. 104.

46. Swedish Ministry of the Environment and Natural Resources (1995), pp. 11-14.

47. OECD (1996), p. 91

48. *IER*, February 8, 1995, p. 104.

49. The table draws upon information from Muller (1996), p. 17 and OECD (1996), pp. 89-94. The tax rates for Norway were expressed in dollars by Muller. The rates for the other four countries and all the revenue estimates were converted into dollars following the practice noted under note 2.

50. OECD (1996), p. 90.

51. Ibid, pp. 93-4.

52. Swedish Ministry of the Environment and Natural Resources (1995), pp. 24-31.

53. *Financial Times*, March 20, 1996, p. 10.

54. Information on energy/carbon taxes in the Netherlands provided by two unpublished Netherlands Ministry of Housing, Spatial Planning and Environment documents: "The Netherlands' Environmental Tax on Fuels" and "The Netherlands' Regulatory Tax on Energy."

55. With the exception of the regulatory tax, these are the rates as of January 1, 1996. As explained below, the regulatory tax on light fuel oil, gasoil, LPG, and natural gas is being phased in three roughly equal increments between 1996 and 1998.

56. This is the full rate which will be in effect in 1998. For all products except electricity, the 1996 rate is roughly 1/3 and the 1997 roughly 2/3 of the full rate. For electricity, the full rate was imposed on January 1, 1996.

57. LPG used as motor fuel is exempt from the regulatory tax, whereas LPG used for heating is exempt from the excise duty.

58. Information on differential taxation of diesel fuel in Sweden based on Bergman (1994) and Ministry of the Environment and Natural Resources (1995).

59. OECD (1996), p. 94.

60. *IER*, February 7, 1996, p. 95.

61. OECD (1994a), p. 81

62. OECD (1995b), pp. 86-9.

63. German Information Center (1995). Internet: www.germany-info.org/close-up/environ.htm.

64. *IER*, February 23, 1994, pp. 163-4.

65. *IER*, April 17, 1996, p. 301.

66. Federal Highway Administration, "Congestion Pricing News," Spring 1996, p. 7.

67. Gavin Davidson, Congestion Pricing Forum.

68. Information in this subsection is based on Buchan (1994) and Chia and Phang (1994).

69. Information on the Mexico City vehicle restrictions was provided by Ocampo (1994). The Thai proposal was discussed in *Financial Times*, July 8, 1996.

70. OECD (1994a), pp. 83-6, 121.

71. Information on most countries provided by Container Recycling Institute. Information on Australia, Canada, and Iceland provided by OECD (1994a), pp. 83-5. Information on Czech Republic, Hungary, and Poland provided by Regional Environmental Center for Central and Eastern Europe (1995), p. 16. CRI amounts stated in $US. OECD and RECCEE amounts stated in ECU but converted to $US by authors.

72. Container Recycling Institute (1994), pp. 29-32.

73. OECD (1994a), p. 83.

74. Swedish Ministry of the Environment and Natural Resources (1995), pp. 9-11.

75. OECD (1994a), p. 71.

76. OECD (1994a), p. 86.

77. Helmut Wagner, Commercial Counselor, Embassy of Austria, personal communication, 1996.

78. OECD (1994), p. 86.

79. Ruffing (1995).

80. O'Connor (1994), p. 130.

81. Steele and Ozdemiroglu (1993), p. 177.

82. Ibid, p. 173.

83. DEN, January 17, 1996, p. A3.

84. Schärer (1995), p. 256. The limitations of Germany's trading provisions for old sources are described in Kalmbach and Troge (1989), pp. 30-35.

85. Dittman and Sander, Bundesverband der Deutschen Industrie, personal communication, May 1996.

86. Margulis (1994), p. 116.

87. RECCEE (1995), p. 102.

88. Pan (1994), p. 85.

89. Harvard Institute for International Development, "Highlights in Environmental Economics & Policy," p. 4.

90. O'Connor (1994), p. 132.

91. Musgrave (1995).

92. OECD (1994a), p. 89.

93. Langford (1995).

94. Brehm and Quiroz (1995). Figures stated in U.S. dollars in the source.

95. Hearne and Easter (1995).

96. *Financial Times*, April 9, 1996.

97. *IER*, May 1, 1996, p. 370.

98. Francis (1995), pp. 43-4.

99. Information on these funds based on O'Connor (1994), pp. 127-8.

100. Thorning (1992), pp. 1-3.

101. Most of the information on environmental subsidies for agriculture is taken from Rolfe (1993), "Using Subsidies to Promote Environmental Protection in Agriculture: A Review of Programs in North America and Europe."

102. *International Environment Reporter Resource File: Hong Kong*, p. 164.

103. *IER*, February 7, 1996, pp. 103-4.

104. Lust, "The Forest Incentive System in Belgium."

105. *IER*, February 8, 1995, p. 105.

106. Rolfe, p. 13.

107. OECD (1994b), pp. 58-9.

108. *Décret 95-1119*.

109. French Ministry of Foreign Affairs (1995).

110. *IER*, May 1, 1996, p. 367.

111. *DEN*, September 6, 1995, p. A-5.

112. OECD (1995b), p. 90.

113. Ibid, p. 69.

114. *IER*, February 7, 1996, pp. 100-1.

115. OECD (1995b), p. 93.

116. Langford (1995).

117. OECD (1995b), pp. 90, 92.

118. Margulis (1994), p. 110.

119. Steele and Ozdemiroglu (1993), pp. 213-4.

120. World Bank (1992), p. 117.

121. Information on Germany's Blue Angel, France's NF Environnement, and Canada's Environmental Choice labels was obtained from the Canadian Department of Environment internet site: www.ns.doe.ca.

122. EPA (1993), p. 44.

123. EPA (1994a), pp. 23-4.

124. *DEN*, February 15, 1996, pp. B2-3.

125. Unless otherwise stated, information on Korea's Eco-Mark program based on EPA (1993), pp. 90-2.

126. EPA (1994a), p. 22.

127. Council Regulation No. 880/92, March 23, 1992 on a Community Eco-label Award Scheme, and Commission Decision No. 93/326, May 13, 1993 Establishing Indicative Guidelines for the Fixing of Costs and Fees in Connection with the Community Eco-label. The quotation is from Article 1 of the Regulation. The fees are set in Articles 2 and 3 of the Decision.

128. IER, December 13, 1995, p. 940.

129. IER, March 6, 1996, p. 154.

130. Langford (1995).

131. *DEN*, December 11, 1995, p. A1.

132. *DEN*, February 21, 1996, p. E4.

133. *DEN*, December 11, 1995, p. A1.

134. *DEN*, January 25, 1996, pp. B3-4.

135. Ibid, p. B3.

136. O'Connor (1994), pp. 149-56.

137. OECD (1994a), *Environmental Performance Reviews: The Netherlands*, pp. 66, 130-1.

138. O'Connor (1994), pp. 134-5.

139. USDA Forest Service (September 1994).

140. *DEN*, December 1, 1995, p. A4.

141. Unless otherwise stated, all information on biotechnology development agreements provided by Frisvold and Condon (1994).

142. Quoted in Frisvold and Condon.

143. OECD (1994a), p. 106.

144. Chance (1995).

145. *DEN*, February 21, 1996, E5-6.

146. *IER*, May 15, 1996, p. 392.

147. Potier (1995), p. 18.

12. CONCLUSIONS

At least 100 different economic incentive mechanisms are currently being used in the United States, up from approximately 40 in 1992 when EPA's first survey was conducted. Economic incentives are being used at many levels of government from individual towns to the federal government. Some of them have multiple applications in different states or cities. Although it would be desirable to be able to summarize the cost savings from the use of each of these instruments, the financial consequences to individual economic sectors, the impacts on technical change and innovation in pollution control, and the environmental effects of each of these mechanisms, few have been studied in such detail.

Approximately 30 quantitative comparative studies now exist, all of which indicate that economic incentives should be more economically efficient than command-and-control approaches for controlling environmental pollution. The predicted efficiency gains can quite large, but it must be kept in mind that retrospective studies have found that the savings actually realized fall well short of the potential, particularly so for many of the trading mechanisms. There is relatively little information available on the environmental effects of economic incentives. Although incentives are being increasingly used, they have not always been implemented in the ways advocated by economists. Not surprisingly, therefore, the results have sometimes fallen short of what economists hoped for. A review of the principal types of incentives suggest several reasons for this result.

Fees and charges, with few exceptions, have not been set equal to marginal treatment cost, let alone the theoretically more defensible and generally higher values determined by the marginal damages the pollution causes. Rather, revenue goals have been the principal drving force behind many of the charge-based incentive mechanisms and fees and charges generally have been too low to have a true incentive effect. In situations where fees and charges approximate marginal treatment cost, such as the Swedish NO_x charge and water pollution charges in the Netherlands, the impacts on technical change and innovation are large, as is the measured environmental improvement. Additional study of the impact of pollution taxes and charges that approximate marginal abatement costs is likely to be instructive; potential subject areas include (1) the impact of POTW user fees on industrial users' discharge, (2) the impact of existing pricing mechanisms for commercial and industrial generators of solid and hazardous waste, and (3) further studies on unit pricing of household waste disposal.[1]

Among the market-based trading systems with which there is experience, only the lead phase down, wood stove permit and acid rain examples can be termed a full success and even in these programs there are numerous instances where potentially profitable trades were not completed. Other emission and effluent trading systems are subject to severe regulatory constraints that have raised barriers to trading. In nearly every case, actual cost savings have fallen far short of originally projected amounts. If, as seems likely, the United States will want to expand the opportunities for market-based trading of pollution reduction credits or allowances, it is important that unnecessary constraints not be imposed in future applications and that transactions costs be minimized.

Deposit-refund systems are used for several products at the state level and in Europe. Beverage container deposits appear to be effective in reducing litter. With the exception

of beverage container deposits, however, there is only limited knowledge of impact and virtually no analysis of costs and benefits. Lead-acid battery deposits are largely a private sector initiative, though some states also require deposits. The near-universal application of this incentive, whether private or public, and the very high rates of recycling that it achieves, make it worthy of further examination. What special features allow it to thrive where other deposit systems engender controversy and high cost?

Several programs that act solely to provide information appear to be having great impact. Many firms have made public announcements of a corporate commitment to reduce pollution voluntarily in response to reports filed under SARA Title III. One attractive feature of information requirements is that response is highly flexible; corporations are free to do nothing or to seek pollution reductions as they see fit. Where pollution reduction can be achieved at reasonable cost, many corporations see it in their self interest to make those efforts.

Liability mechanisms can and do act as incentives. Structuring liability rules to internalize the cost of pollution, without deviating from this objective by a wide margin, may be difficult to accomplish, if the experience with hazardous waste cleanup and natural resource damage assessment are any guide.

Subsidies have both positive and negative effects on the environment. Economists generally do not favor subsidies, believing that there are superior mechanisms to improve the environment. Economists would favor elimination of environmentally-unfriendly subsidies.

Voluntary programs have a mixed record, with several not meeting initial expectations. The lack of a statutory basis for the programs, different expectations on the part of EPA and program participants, and in some cases mistrust, have slowed progress with many programs.

Finally, a review of the use of economic incentives outside the United States suggests a somewhat different mix of incentive mechanisms but generally similar conclusions as to their effectiveness and efficiency as in the United States. The United States uses many more marketable permit systems than European countries, but much less environmental labeling. Although charges and fees are used more widely in Europe, they also tend to be revenue-raising instruments with few incentive impacts, as in the United States. The lack of incentive impact of charges is due primarily to their low magnitude and because a number of the charges are not closely linked to waste generation or product consumption. As in the United States, however, official interest in economic incentives appears to be increasing in Europe and indeed throughout much of the world.

Endnotes for Section 12

1. It should be noted that the EPA Office of Water is examining effluent fees and various pollutant trading systems to support the Clean Water Act reauthorization process.

APPENDIX A. BIBLIOGRAPHY

For other reports on economic incentives funded by the EPA Economy and Environment Program and its predecessors, see the subject view of the report inventory at the following Web address: http://www.epa.gov/docs/oppe/eaed/eedhmpg.htm

Abwasserabgabengesetz (German Effluent Charge Law). 1976.

Ackerman, Frank. 1994. "Advance Disposal Fees and Incentives for Waste Reduction." *New Partnerships: Economic Incentives for Environmental Management*. Air and Waste Management Association.

Ackerman, Frank, Dmitri Cavander, John Stutz, and Brian Zukerman. 1995. *Preliminary Analysis: The Costs and Benefits of Bottle Bills*, Draft report to the U.S. EPA Office of Solid Waste and Emergency Response. Boston, MA: Tellus Institute.

Acton, Joe. Environmental Protection Agency. Personal communication. 1996.

American Farmland Trust. April 12, 1996. Unpublished table of agricultural conservation ease-ment programs.

Anderson, Robert. 1977. "Economic Incentives for the Recovery of Secondary Lead." *Resource Recovery and Conservation*. Vol 2: 193-209.

Anderson, Robert C., Mike Rusin, and Lisa Hoffman. June 1990. *The Use of Economic Incentive Mechanisms in Environmental Management*. American Petroleum Institute Research Paper #051. www.api.org/cat/SEC12a.htm#81

Anderson, Robert and Mark Rockel. April 1991. *Economic Valuation of Wetlands*. American Petroleum Institute Discussion Paper #065. www.api.org/cat/SEC12.htm#22

Anderson, Robert. September 1994. *Federal Subsidies for Alternative Fuels and Alternative Fuel Vehicles*. American Petroleum Institute Discussion Paper #076. www.api.org/cat/SEC12.htm#11

Arner, Robert, and Kimberly Davis. May 17, 1994. *Northern Virginia Variable Rate Demonstration Project: "Pay as you throw" Interim Report*. Northern Virginia Planning District Commission.

Arora, Seema and Timothy N. Cason. September 1995. *Why Do Firms Overcomply with Environmental Regulations? Understanding Participation in EPA's 33/50 Program*. Resources for the Future Discussion Paper 95-38. www.rff.org/dpapers/abstract/9538.htm

Atkinson, Scott, and D. Lewis. 1974. "A Cost-Effectiveness Analysis of Alternative Air Quality Control Strategies," *Journal of Environmental Economics and Management*, Vol. 1: 237-

250.

Barrett, Julia. Wisconsin Department of Natural Resources. Personal communication. May 1996.

Barthold, Thomas A. Winter 1994. "Issues in the Design of Environmental Excise Taxes." *Journal of Economic Perspectives*. Volume 8. Number 1.

Batteese, Robert. October 1988. "Returnable Pesticide Containers: Maine's Deposit and Collection System." Maine Board of Pesticides Control. Unpublished speech.

Batteese, Robert. Maine Board of Pesticides Control. Personal communication. 1996.

Bauer, Scott and Marie Lynn Miranda. April 1996. "The Urban Performance of Unit Pricing: An Analysis of Variable Rates for Residential Garbage Collection in Urban Areas." Report prepared for Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency. www.epa.gov/docs/oppe/eaed/upaperf1.pdf.

Bergman, Hans. 1994. "Environmentally Differentiated Taxes on Diesel Oils: The Swedish Experience." OECD. *Applying Economic Instruments to Environmental Policies in OECD and Dynamic Non-Member Economies.*

Beverage World 1995-1996 Databank.

Bonderud, Kendra, and Ron Shanovich. January 1995. *Solid Waste Recycling and Waste Reduction.* State of Wisconsin. Legislative Fiscal Bureau.

Boroski, Rob. Texas Natural Resource Conservation Commission. Personal communication. 1996.

Brehm, Monica Ríos and Jorge Quiroz. 1995. *The Market for Water Rights in Chile: Major Issues.* World Bank Technical Paper Number 285.

Bressers, Hans Th. A. and Jeannette Schuddeboom. 1994. "A Survey of Effluent Charges and Other Economic Instruments in Dutch Environmental Policy." OECD. *Applying Economic Instruments to Environmental Policies in OECD and Dynamic Non-Member Economies.*

Brooks, Greg. March 19, 1996. "91 Express Lanes Transponder Distribution Ahead of Schedule: Transponders in Use on World's First Fully Automated Toll Road Ahead of Forecasts by Four Months." Congestion Pricing Forum release.

Buchan, Keith. 1994. "The Singapore Licensing Scheme." OECD. *Applying Economic Instruments to Environmental Policies in OECD and Dynamic Non-Member Economies.*

Buist, Henry, Carolyn Fischer, John Michos, and Abebayehu Tegene. Undated. "Purchase of Development Rights and the Economics of Easements." USDA Economic Research

Service AER-718.

Bureau of National Affairs. November 1993. *International Environment Reporter Resource File: Finland.* 229:0101.

Bureau of National Affairs. November 1994. *International Environment Reporter Resource File: France*. 231:0101.

Bureau of National Affairs. November 1994. *International Environment Reporter Resource File: Hong Kong*. 247:0101.

Bureau of National Affairs. May 1994. *International Environment Reporter Resource File: Hungary*. 248:0101.

Burtraw, Dallas. 1995. "Cost Savings Sans Allowance Trades? Evaluating the SO_2 Emission Trading Program to Date," Washington D.C.: Resources for the Future, Discussion Paper 95-30.

Business Cycle Indicators Scrap Lead Spot Prices. www.mlinet.com/bci/pages/lsm023.htm

Button, Kenneth. 1994. "Road User Charging With Particular Reference to Urban Areas." OECD. *Applying Economic Instruments to Environmental Policies in OECD and Dynamic Non-Member Economies.*

Cadiou, Alain and Nguyen Tien Duc. 1994. "The Use of Pollution Charges in Water Management in France." OECD. *Applying Economic Instruments to Environmental Policies in OECD and Dynamic Non-Member Economies.*

California Air Resources Board. Undated. "Overview of the Air Toxics 'Hot Spots' Information and Assessment Act." arbis.arb.ca.gov/toxics/ab2588/2588summ.txt

California Attorney General's office. May 1, 1996. "Proposition 65 litigation." Unpublished document. Oakland.

California Department of Toxic Substances. "Hazardous Waste Fee Summary Effective January 1, 1996."

California LAO. "LAO Analysis of the 1995-96 Budget Bill, Resources, Part II." www.lao.ca.gov/a96b2.html

California Pollution Control Financing Authority. Various informational brochures.

California Water Resources Control Board. "Schedule of Fees for Bay Protection and Toxic Cleanup Program." www.swrcb.ca.gov/pub/FEES/feebptc.zip

Cameron, Michael. March 1991. *Transportation Efficiency: Tackling Southern California's Air*

Pollution and Congestion. Environmental Defense Fund and Regional Institute of Southern California.

Canadian Department of Environment internet site. Documents on environmental labels in various countries. www.ns.doe.ca/g7.

Carraway, Candace. Environmental Protection Agency. Personal communication. 1996.

Cason, Timothy. 1995. "An Experimental Investigation of the Seller Incentives in the EPA's Emission Trading Auction," *American Economic Review*, 905-922.

Chance, Clifford. Summer 1995. "Economic and Fiscal Instruments and the Environment: the Example of ECO-taxes." www.cliffordchance.com/eer_f02.htm

Charles River Associates. 1991. "Policy Alternatives for Reducing Petroleum Use and Green-house Gas Emissions," Boston.

Chia, Ngee-Choon and Sock-Yong Phang. November 9, 1994. "Motor Vehicle Taxes: Their Role in the Singapore Revenue System and Implications for the Environment." Paper presented at 3rd biannual Economy and Environment Program for Southeast Asia Workshop.

Clarke, Stephen F. March 1992. "International Comparison of the Tax Treatment of Pollution-Control Investment." American Council for Capital Formation. Center for Policy Research. *U.S. Environmental Policy and Economic Growth: How Do We Fare?*

Coase, Ronald H. 1960. "The Problem of Social Cost," *Journal of Law and Economics*, Vol. 3: 1-44.

Cody, Betsy A. December 1994. "Grazing Fees: A Primer." Congressional Research Service. www.cnie.org/nle/ag-5.html.

Congressional Research Service. March 1994. *Market-Based Environmental Management: Issues in Implementation*.

Consumer Reports, various issues.

Container Recycling Institute. April 1994. *Beverage Container Reuse and Recycling in Europe: A Survey of Nine Countries*.

Cook, Elizabeth. January 1996. "Making a Milestone in Ozone Protection." World Resources Institute.

Cooney, John F. et al. 1996. "Criminal Enforcement of Environmental Laws," in *Environmental Crimes Deskbook*, Washington D.C.: Environmental Law Institute.

Council of Economic Advisors. 1996. *Economic Report of the President*.

Crandall, Robert W., H.K. Gruenspecht, T.E. Keeler, and L.B. Lave. 1986. *Regulating the Automobile.* Washington D.C.: The Brookings Institution.

Criner, George K., Steven L. Jacobs, and Stephanie R. Peavey. April 1991. "An Economic and Waste Management Analysis of Maine's Bottle Deposit Legislation." Maine Agricultural Experiment Station Miscellaneous Report 358.

Criner, George, Stephanie Seguino, Margarita Suarez, Jeff Young, Robert McKay, and Christopher Spruce. June 1995. "Solid Waste Management (SWM) Options: The Economics of Variable Cost and Conventional Pricing Systems in Maine."

Crookshank, Steven. 1994. *Air Emissions Banking and Trading: Analysis and Implications for Wetland Mitigation Banking,* American Petroleum Institute, Discussion Paper #074.

Crookshank, Steven. *1995. Alternative Wetland Mitigation Programs.* American Petroleum Insti-tute, Discussion Paper #077. www.api.org/cat/SEC12.htm#10

Cropper, Maureen, and Wallace Oates. 1992. "Environmental Economics: A Survey," *Journal of Economic Literature*, Vol.30: 675-740.

Daily Environment News (DEN), various issues.

David, Martin, Wayland Eheart, Erhard Joeres, and Elizabeth David. 1977. "Marketable Permits for the Control of Phosphorus Effluent in Lake Michigan," Social Science Research Institute Working Paper, University of Wisconsin.

Arrêté du 27 octobre 1995 relatif aux modalités de gestion de l'aide à la reprise des véhicules automobiles de plus de huit ans instituée par le décret no. 95-1119 du 19 octobre 1995. (Rule concerning implementation of French Decree on subsidies to retire older vehicles.)

Décret no. 95-1119 du 19 octobre 1995 instituant une aide à la reprise des véhicules automobiles de plus de huit ans. (French Decree on subsidies to retire older vehicles.)

Department of Energy. "Clean Cities Guide to Alternative Fuel Vehicle Incentives & Laws." www.ccities.doe.gov/documents/funding/toc.html.

"DNR Sets New Rules for Wetlands Mitigation," *Baton Rouge Advocate*, August 27, 1995.

Dittman and Sander. Bundesverband der Deutschen Industrien e.V. (German Industries Association). Personal communication. 1996.

Dower, Roger C. July 1995. "The Right Economic Instrument for the Right Task: The Case of Pollution Fees and Information Programs." World Resources Institute. Draft report prepared for the Comision Nacional del Medio Ambiente.

Dudra, Paul. Rhode Island Department of Environmental Management. Personal communication. 1996.

Duhl, Joshua. December 1993. *Effluent Fees: Present Practice and Future Potential*. American Petroleum Institute Discussion Paper #075. www.api.org/cat/SEC12.htm#12

Eheart, Wayland, E. Downey Brill, Jr., and Randolph M. Lyon. 1983. "Transferable Discharge Permits for Control of BOD: An Overview," in Erhard F. Joeres and Martin H. David, eds., *Buying a Better Environment: Cost-Effective Regulation through Permit Trading*. Madison: University of Wisconsin Press.

Environmental Defense Fund press release. December 7, 1995. "New Highway Uses Economic Incentives to Stem Air Pollution." internet: www.edf.org/pubs/NewsReleases/1995/Dec/catoll.html

Environmental Law Institute. 1993. *Wetland Mitigation Banking*.

Environmental Law Institute. June 1993. *Information Access Mechanisms: Collecting and Disseminating the Information Necessary for Environmental Protection*.

Environmental Law Institute. August 1993. "New State and Local Approaches to Environmental Protection."

Environmental Law Institute. 1995. "An Analysis of State Superfund Programs: 50-State Study, 1995 Update."

EPA. Office of Solid Waste and Emergency Response. "Answers to Frequently Asked Questions." Brownfields internet site: earth1.epa.gov/swerosps/bf/answers.htm#5

EPA. "EPA's Voluntary Programs: A Summary List Prepared by the 33/50 Program." Undated internet document: es.inel.gov/partners/3350/epavol1.html.

EPA. "Effluent Trading in Watersheds Policy Statement." http://www.epa.gov/ow/watershed/tradetbl.html

EPA. Office of Air Noise and Radiation. 1980. *Emissions Reductions Banking and Trading Update 2*, Washington, D.C.

EPA. 1988. *CFC Regulatory Impact Analysis, Vol 2*.

EPA. Office of Policy, Planning and Evaluation. March 1991. *Economic Incentives: Options for Environmental Protection*. Office of Policy, Planning, and Evaluation. http://206.29.48.66/EPA/eerm.nsf/a7a2ee5c6158cedd852563970080ee30/e01fdfc3022f913a852564ab00772bf7?OpenDocument

EPA. Office of Policy, Planning and Evaluation. July 1992. *The United States Experience with Economic Incentives to Control Environmental Pollution*. http://206.29.48.66/epa/eerm.nsf/a7a2ee5c6158cedd852563970080ee30/5585381D29D5359E8525643C007E4084?OpenDocument

EPA. 1992. “Guidelines for Oxygenated Credit Programs and Guidelines on Establishement of Control Periods Under Section (m) of the Clean Air Act As Amended,” *Federal Register* 57 47853.

EPA. Office of Pollution Prevention and Toxics. September 1993. *Status Report on the Use of Environmental Labels Worldwide.*

EPA. Office of Solid Waste and Emergency Response. October 1993. "WasteWi$e: EPA's Voluntary Program for Reducing Business Solid Waste."

EPA. Office of Pollution Prevention and Toxics. April 1994a. *Determinants of Effectiveness for Environmental Certification and Labeling Programs.*

EPA. Office of Air and Radiation. April 1994b. "Landfill Methane Outreach Program."

EPA. Office of Air and Radiation. August 1994a. *The Climate Is Right for Action: Voluntary Programs to Prevent Atmospheric Pollution*.

EPA. Office of Policy, Planning, and Evaluation. August 1994b. *Federal Disincentives: A Study of Federal Tax Subsidies and Other Programs Affecting Virgin Industries and Recycling.*

EPA. Office of Water. September 1994. "Introducing WAVE - Water Alliances for Voluntary Efficiency: Hotel Water Management for the 21st Century."

EPA. Office of Air and Radiation. November 1994. "Introducing...The Energy Star Buildings Program."

EPA. Office of Water. January 1995. "The Clean Water State Revolving Fund: Financing America's Environmental Infrastructure--A Report of Progress."

EPA. Office of Air and Radiation. November, 1995. *Human Health Benefits From Sulfate Reductions Under Title IV Of The 1990 Clean Air Act Amendments.*

EPA. Office of Pollution Prevention and Toxics. March 1995. "Expanding Community Right-to-Know: Recent Changes in the Toxics Release Inventory."

EPA. Office of Enforcement and Compliance Assurance. May 1995. *Enforcement and Compliance Assurance Accomplishments Report: FY 1994.*

EPA. Office of Air and Radiation. June 1995. *Green Lights Fourth Annual Report*.

EPA. June 15, 1995. "Summary Report to the President: The Presidential Regulatory Reform Initiative." Reprinted in *Daily Environment News*. June 23, 1995.

EPA. Office of Pollution Prevention and Toxics. September 1995.
Pollution Prevention Incentives for States: Grant Summaries 1989-1995.

EPA. Office of Pollution Prevention and Toxics. "Issue Paper on Expansion of Toxic Release Inventory, TRI Phase 3." Reprinted in *Daily Environment News.* October 10, 1995.

EPA. Office of the Administrator. Spring 1996. *Partnerships in Preventing Pollution: A Catalogue of the Agency's Partnership Programs.*

EPA. Office of Pollution Prevention and Toxics. June 1996. *1994 Toxics Release Inventory: Public Data Release*.

Environment Reporter, various issues.

Ernst & Young. "1994 National Water & Wastewater Rate Survey."

European Communities. March 23, 1992. *Council of European Communities Regulation on a Community Eco-Label Award Scheme.*

European Communities. June 29, 1993. *Council Regulation (EEC) No 1836/93 of 29 June 1993 Allowing Voluntary Participation by Companies in the Industrial Sector in a Community Eco-Management and Audit Scheme.*

European Communities. May 13, 1993. *Commission Decision of 13 May 1993 Establishing Indicative Guidelines for the Fixing of Costs and Fees in Connection with the Community Eco-Label.*

European Communities. June 28, 1993. *Commission Decision of 28 June 1993 Establishing the Ecological Criteria for the Award of the Community Eco-Label to Washing Machines.*

Executive Office of the President. 1993. *Environmental Quality: The Twenty-Fourth Annual Report of the Council on Environmental Quality*.

"Executive Order 12291 of February 17, 1981." February 19, 1981. *Federal Register.* Vol. 46, No. 33.

"Executive Order 12866 of September 30, 1993." October 4, 1993. *Federal Register.* Vol. 58, No. 190.

Federal Highway Administration. Spring 1996. *BUYLINE$: Congestion Pricing Updates.*

Federal Highway Administration. Spring 1996. *Congestion Pricing Notes.*

Federal Trade Commission. May 24, 1994. "FTC Updates Energy-Usage Disclosures for Home Appliances." News release.

Ferguson, Amanda. Environmental Protection Agency. Personal communication. 1996.

Fertilizer Institute. Unpublished list of state fertilizer taxes.

Field, Barry C. 1994. *Environmental Economics: An Introduction*, New York: McGraw Hill.

Financial Times, various issues.

Finnish National Commission of Sustainable Development. December 1993. *The National Report of Finland on the Implementation of Agenda 21*.

Florida Department of Environmental Protection. October 1995. "Waste Tires in Florida: State of the State."

Flowers, John. EPA. April 25, 1996. Memorandum on WAVE program to Michelle Price.

Flowers, John. EPA. Personal communication. 1996.

Fortney, Catherine S. Bay Area Air Quality Management District. Personal communication. 1996.

Foster, Vivien and Robert Hahn. 1995. "Designing More Efficient Markets: Lessons from Los Angeles Smog Control," *The Journal of Law and Economics*, XXXVIII: 19-31.

Francis, Patrick. 1995. "National Environmental Protection Funds in Central and Eastern Europe." OECD Centre for Co-Operation with the Economies in Transition. *Environmental Funds in Economies in Transition*.

Franklin, Pat. Container Recycling Institute. Personal communication. April 1996.

Freedgood, Julia. 1991. "PDR programs take root in the Northeast." *Journal of Soil and Water Conservation*. September / October 1991. Volume 46. Number 5.

Freeman III, A. Myrick. 1990. "Water Pollution Policy." Portney, Paul, ed. *Public Policies for Environmental Protection*. Resources for the Future.

French Ministry of Foreign Affairs. 1995. "Environnement."
www.diplomatie.fr / france / societe / environ.html

Frisvold, George B. and Peter Condon. July 1994. "Biodiversity Conservation and Biotechnology Development Agreements." *Contemporary Economic Policy*. Vol. XII.

Fullerton, Don. December 1995. "Why Have Separate Environmental Taxes?" National Bureau of Economic Research Working Paper 5380.

Fullerton, Don and Thomas C. Kinnaman. July 1995. "Garbage, Recycling, and Illicit Burning or Dumping." *Journal of Environmental Economics and Management*. Volume 29. Number 1.

General Accounting Office (GAO). September 1994. *Toxic Substances: EPA Needs More Reliable Source Reduction Data and Progress Measures*. GAO / RCED-94-93.

GAO. December 1994. *Electric Vehicles: Likely Consequences of U.S. and Other Nations' Programs and Policies.* GAO/PEMD-95-7.

GAO. February 1995. *Conservation Reserve Program: Alternatives Are Available for Managing Environmentally Sensitive Cropland.* GAO/RCED-95-42.

GAO. February 1995. *Solid Waste: State and Federal Efforts to Manage Nonhazardous Waste.* GAO/RCED-95-3.

GAO. April 1995. *Agricultural Conservation: Status of Programs That Provide Financial Incentives.* GAO/RCED-95-169.

GAO. June 1995. *Animal Agriculture: Information on Waste Management and Water Quality Issues.* GAO/RCED-95-200BR.

GAO. 1996. *An Integrated Approach Could Reduce Pollution and Increase Regulatory Efficiency*, GAO/RCED-96-41.

GAO. 1996. *Water Pollution: Differences Among the States in Issuing Permits Limiting the Discharge of Pollutants.* GAO/RCED-96-42.

GAO. April 16, 1996. *Clean Water Act: Use of State Revolving Funds Varies.* GAO/T-RCED-96-140.

German Information Center. June 1995. "Focus On...Environmental Protection." www.germany-info.org/close-up/environ.htm.

Girasole, Rich. Rhode Island Department of Environmental Management. Personal communication. 1996.

Goldhammer, Earl, Jerry O. Allen, Mark G. Ancel, Mark A. Engel, Duane T. Phillips, and Raymond P. Reichert. American Bar Association State and Local Taxes Subcommittee. August 1995. "State Tax Treatment of Pollution Control Equipment -- A Survey and Commentary."

Goldstene, James. California Pollution Control Financing Authority. Personal communication. 1996.

Government Pricing Tribunal of New South Wales. October 1993. *Inquiry into Water and Related Services.*

Green Scissors Campaign of Citizens United to Terminate Subsidies (CUT$). January 1995. "Sacred Cows: Grazing Fees -- Fair Market Value."
www.essential.org/orgs/FOE/scissors95/greenpart22.html

Green Seal. Various documents.

Grocery Manufacturers of America. May 12, 1995. "GMA Praises Florida Legislature for Killing Two-Cent 'Container' Tax." Internet press release: www.gmabrands.com/news/may95/5_12_95.htm.

Guerrero, Peter F. June 20, 1995. "Status of Natural Resource Damage Claims," testimony (for GAO) before the Subcommittee on Commerce, Trade, and Hazardous Materials, Committee on Commerce, House of Representatives.

Hahn, Robert, and Gordon Hester. 1989. "Where Did All the Markets GO? An Analysis of EPA's Emissions Trading Program." *Yale Journal on Regulation*. Vol.6: 109-153.

Hahn, Robert, and Roger Noll. 1982. "Designing a Market for Tradable Emissions Permits," in Wesley Magat, ed., *Reform of Environmental Regulation*. Cambridge: Ballinger, 132-133.

Hahn, Robert. 1989. "Economic Prescriptions for Environmental Problems: How the Patient Followed the Doctor's Orders," *Economic Perspectives*, Vol.3: 95-114.

Hahn, Robert. 1995. "Choosing Among Fuels and Technologies for Cleaning Up the Air," *Journal of Policy Analysis*, 533-551.

Halkos, George E. 1994. "Optimal Abatement of Sulphur Emissions in Europe," *Environmental and Resource Economics*, Vol.4: 127-150.

Hamilton, Randy. Texas Natural Resource Conservation Commission. Personal communication. June 1996.

Harris, Jeffrey P. and Nancy Casey-McCabe. Undated. "Energy-Efficient Product Labeling: Market Impacts on Buyers and Sellers." Lawrence Berkeley National Laboratory. Energy and Environment Division.

Harvard Institute for International Development. Winter/Spring 1996. "Highlights in Environmental Economics & Policy."

Hau, T.D. 1990. "Electronic Road Pricing Developments in Hong Kong." *Journal of Transport Economics and Policy*.

Hearne, Robert R. and K. William Easter. 1995. *Water Allocation and Water Markets: An Analysis of Gains-from-Trade in Chile.* World Bank Technical Paper Number 315.

Helfand, Gloria E. 1994. "The Role of Information as an Incentive for Environmental Control." *New Partnerships: Economic Incentives for Environmental Management*. Air and Waste Management Association.

Henriques, Irene and Perry Sadorski. May 1996. "The Determinants of an Environmentally Responsible Firm." *Journal of Environmental Economics and Management*. Volume 30. Number 3.

Hodge, Ian. 1995. *Environmental Economics*. St. Francis Press. New York.

Hoerner, J. Andrew. Summer 1995. "Life and Taxes." *The Amicus Journal.*

ICF Resources. 1989. *Economic, Environmental, and Coal Market Impacts of SO_2 Emissions Trading under Alternative Acid Rain Control Proposals.* Prepared for the Regulatory Innovations Staff, Office of Policy, Planning and Evaluation, U.S. EPA.

ICF Resources Inc. 1989a. "Economic Analysis of Title V of the Administration's Proposed Clean Air Act Amendments."

Illinois EPA, 1995. *Design for VOC Emissions Trading System*.

Illinois Department of Nuclear Safety. "Radon Program Strives to Increase Public Awareness." www.state.il.us/idns/radon/prgdescr/radonprg.htm

Independent Pricing and Regulatory Tribunal of New South Wales. April 1996. *Pricing Policies of the Waste Recycling and Processing Service of NSW*.

International Energy Agency (IEA). *Energy Prices and Taxes*, 3rd Quarter 1995.

International Environment Reporter (IER), various issues.

Investor Responsibility Research Center. *1993 Corporate Environmental Profiles Directory: Executive Summary and Appendices.* Vol. 1.

Jenkins, Glenn P. and Ranjit Lamech. November 1992. *Fiscal Policies to Control Pollution: International Experience.* Harvard Institute for International Development Discussion Paper No. 439. Taxation Research Series No. 5. www.hiid.harvard.edu/pub

Johnson, Edwin, 1967. "A Study in the Economics of Water Quality Management," *Water Resources Research*, Vol.3.

Kalmbach, Siegfried and Andreas Troge. November 1989. "TA Luft - Kompensationslösung bewährt." *UmweltMagazin*.

Kanazawa, Mark T. April 1994. "Water Subsidies, Water Transfers, and Economic Efficiency." *Contemporary Economic Policy*. Vol. XII.

Katz, Ricardo A., Jose Miguel Sanchez, and Rosa Ana Balcazar. April 1994. "Analysis of an Emission Offset System for Particulate Matter in Santiago, Chile." Unpublished report.

Katzen, Sally. Office of Management and Budget. January 1996. Unpublished memorandum for members of the Regulatory Working Group with an Economic Analysis of Federal Regulations Under Executive Order No. 12866.

Keller, Richard. Northeast Maryland Waste Disposal Authority. February 19, 1993.

Unpublished memorandum on state and local procurement of recycled products.

Kennedy, Victoria S., Stuart I. Bretschneider, John E. Petersen, Myung-Jae Moon, Todd A. Nash, and Jason Gross. April 1995. *Fee-Based Models for Funding Water Quality Infrastructure.* Draft Final Report prepared by the Environmental Finance Center, Syracuse University Maxwell School of Citizenship and Public Affairs for the Office of Water, US EPA.

Kerr, Suzi C., 1993. "The Operation of Tradable Rights Markets: Empirical Evidence from the United States Lead Phasedown," in Anderson and Marshall, eds., *New Partenerships: Economic Incentives for Environmental Management*, Air and Waste Management Association, SP-90, Pittsburgh, PA.

Kerr, Suzi, and David Mare. 1995. "Market Efficiency in Tradable Permit Markets with Transactions Costs: Empirical Evidence from the United States Lead Phasedown," draft manuscript (Cambridge, Harvard University).

Khazzoom, Daniel. 1995. "An Econometric Model of the Regulated Emissions for Fuel-Efficient New Vehicles," *Journal of Environmental Economics and Management*, Vol. 28: 190-204.

Konar, Shameer, and Mark A. Cohen. 1996. "Information as Regulation: The Effect of Community Right to Know Laws on Toxic Emissions," *Journal of Environmental Economics and Management*, Vol. 32: 109-124.

Kohn, Robert E. 1978. *A Linear Programming Model for Air Pollution Control*, Cambridge, MIT Press.
Korea Ministry of Environment. 1993. *Environmental Protection in Korea.*

Krupnick, Alan. 1986. "Costs of Alternative Policies for the Control of Nitrogen Dioxide in Baltimore, *Journal of Environmental Economics and Management*. Vol. 13: 189-197.

Landesabfallabgabengesetz (Austrian Waste Charge Law).

Langford, John. 1995. "An Australian Approach to the Sustainable Use of Water." Unpublished document presented at Policy Measures for Changing Consumption Patterns conference. Seoul. (www.ksdn.or.kr/consumption/langford.txt)

Lentz, James M. and Patricia Leyden, 1996. "RECLAIM: Los Angeles' New Market-Based Smog Cleanup Program," *Journal of the Air & Waste Management Association*, 195-206.

Limouze, Richard. Maine Air Quality Bureau. Personal Communication. 1996.

Linsenbigler, Michael. USDA Economic Research Service. Personal communication. July 1996.

Loeb, Alan P., Sept. 1, 1996 draft. "A Short History and Analysis of the Lead Phasedown Lead Credit Market," Argonne National Laboratories, Washington, D.C.

Louisiana Department of Environmental Quality. January 25, 1995. "DEQ Announces Programs to Aid Tire Dealers and Tire Processors." Internet press release: www.deq.state.la.us/osec/n950124.htm

Lovei, Magda. 1995. "Environmental Financing: The Experience of OECD Countries and Implications for Transition Economies." OECD Centre for Co-Operation with the Economies in Transition. *Environmental Funds in Economies in Transition.*

Lucas, Tom. New Jersey Taxation Division's Special Audit Section. Personal communication. 1996.

Lust, Noël. "The Forest Incentive System in Belgium." Internet report abstract. www.metla.fi/conf/iufro95abs/d6pap129.htm

Maabs-Zeno, Carl C. 1981. "Design of Programs Using Transferable Development Rights to Preserve Farmland in the Northeast," *Journal of the Northeastern Agricultural Economics Council*, Vol 10: 57-62.

Maine Legislature Office of Policy and Legal Analysis. January 1996. *Final Report of the Task Force to Review the Beverage Container Deposit Laws*.

Maloney, Michael T., and Bruce Yandell. 1984. "Estimation of the Cost of Air Pollution Control Regulation," *Journal of Environmental Economics and Management*. Vol 11.

Margulis, Sergio. 1994. "The Use of Economic Instruments in Environmental Policies: the Experiences of Brazil, Mexico, Chile and Argentina." OECD. *Applying Economic Instruments to Environmental Policies in OECD and Dynamic Non-Member Economies.*

Martin, Russ. October 1994. "Avoiding the Stick: Improving Recycling Through Market Forces." *BioCycle*.

Massachusetts Department of Environmental Protection. "Massachusetts Toxics Use Reduction Program: 1994 Data Release."

Mayes, Donna Purcell. Virginia Department of Transportation. Personal communication. May 1996.

McCarthy, James E. January 1993. *Bottle Bills and Curbside Recycling: Are They Compatible?* Congressional Research Service.

McDougall, Richard D. 1994. "Air, Water, and Land Discharge Fees in British Columbia." *New Partnerships: Economic Incentives for Environmental Management*. Air and Waste Management Association.

McGartland, Albert M. 1984. *Marketable Permit Systems for Air Pollution Control: An Empirical Study*. PhD Dissertation, University of Maryland.

Menell, Peter S. 1995. "The Uneasy Case for Ecolabelling." *RECIEL*. Volume 4. Issue 4.

Micozzi, Martine. Transportation Specialist. Federal Highway Administration. Personal communication. May 1996.

Mikrut, Joe. U.S. Congress Joint Committee on Taxation. Personal communication. July 1996.

Miller, Edgar M. National Recycling Coalition. "Economic Policy Options to Achieve Sustainable Resource Utilization and Environmental Quality Goals Relative to Resource Management and Waste Reduction." Undated report submitted to Economic Policy Cluster, Eco-Efficiency Task Force, President's Council on Sustainable Development.

Miranda, Marie Lynn, Scott D. Bauer, and Joseph E. Aldy. August 1995. "Unit Pricing Programs for Residential Municipal Solid Waste: An Assessment of the Literature." Report prepared for Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency.
http://206.29.48.66/epa/eerm.nsf/a7a2ee5c6158cedd852563970080ee30/9F66384145F6801D8525643C007E4080?OpenDocument

Miranda, Marie Lynn and Joseph E. Aldy. March 1996. "Unit Pricing of Residential Municipal Solid Waste: Lessons from Nine Case Study Communities." Report prepared for Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency. http://206.29.48.66/epa/eerm.nsf/a7a2ee5c6158cedd852563970080ee30/08EF01299D2DBD588525643C007E4082?OpenDocument

Mooney, Saskia. Weinberg, Bergeson & Neuman. Personal communication. April 1996.

Morandi, Larry, Deb Starkey, and Addie Romero. March 1995. "Alternative Funding Mechanisms for State Drinking Water Programs, 1994-1995." National Conference of State Legislatures.

Morgenstern, Richard. October 1995. *Environmental Taxes: Dead or Alive?* Resources for the Future Discussion Paper 96-03. www.rff.org/dpapers/abstract/9603.htm

Muller, Frank. March 1996. "Mitigating Climate Change: The Case for Energy Taxes." *Environment*. Vol. 38. Number 2.

Musgrave, Warren. 1995. "Interstate Water Management: The Case of the Murray-Darling Basin in Australia." Dinar, Ariel and Edna Tusak Loehman, eds. *Water Quantity/Quality Management and Conflict Resolution: Institutions, Processes, and Economic Analyses.* Prager. Westport, Connecticut and London.

National Oceanic and Atmospheric Administration. 1996. “The Damage Assessment and Restoration Program.”

National Oceanic and Atmospheric Administration. 1966. “Natural Resource Damage

Assessments: Final Rule," *61 Federal Register* 440-510.

Netherlands Ministry of Housing, Spatial Planning and Environment. Undated. "The Netherlands' Environmental Tax on Groundwater: Questions and Answers."

Netherlands Ministry of Housing, Spatial Planning and Environment. Undated. "The Netherlands' Environmental Tax on Fuels: Questions and Answers."

Netherlands Ministry of Housing, Spatial Planning and Environment. Undated. "The Netherlands' Environmental Tax on Waste: Questions and Answers."

Netherlands Ministry of Housing, Spatial Planning and Environment. Undated. "The Netherlands' Regulatory Tax on Energy: Questions and Answers."

New Jersey Department of Transportation. January 1996. "Adopt-A-Highway National Survey."

New Zealand Ministry for the Environment. Undated. "New Zealand Resource Management Act - Resource Consents." www.mfe.govt.nz/consents.htm

Nichols, Albert L. 1983. "The Regulation of Airborne Benzene," in Thomas C. Schelling, ed. *Incentives for Environmental Protection*. Cambridge, MIT Press.

North Carolina Department of Environment, Health, and Natural Resources. Undated document on white goods and scrap tires. wastenot.ehnr.state.nc.us/SWHOME/grants.txt

Novello, Daniel, and Robert Martineau Jr. 1993. "Better Earlier Than Later: EPA's Air Toxics 'Early Reductions' Program," *Environment Reporter*, 401.

Oates, Wallace. 1994. "Environment and Taxation: The Case of the United States," in *Environment and Taxation: The Cases of the Netherlands, Sweden and the United States*, Paris: OECD.

Ocampo, Emilio. 1994. "Atmospheric Pollution for Transport Sources in Mexico City." OECD. *Applying Economic Instruments to Environmental Policies in OECD and Dynamic Non-Member Economies.*

O'Connor, David. 1994. *Managing the Environment with Rapid Industrialisation: Lessons from the East Asian Experience.* OECD Development Center.

O'Neil, William B. 1980. *Pollution Permits and Markets for Water Quality*, PhD Dissertation, University of Wisconsin-Madison.

O'Neil, William B. 1983. "Transferable Discharge Permits Trading Under Varying Stream Conditions: A Simulation of Multiperiod Permit Market Performance on the Fox River, Wisconsin," *Water Resources Research*, Vol. 19: 608-612.

O'Ryan, Raul. 1996. "Cost Effective Policies to Improve Urban Air Quality in Santiago, Chile," *Journal of Environmental Economics and Management*, Vol. 31: 302-313.

Oklahoma Department of Transportation. "1994 Adopt-A-Highway National Survey."

Opaluch, James J. and Richard Kashmanian. 1985. "Assessing the Viability of Marketable Permit Systems: An Application in Hazardous Waste Management." *Land Economics*, Vol. 61: 441-47.

Organization for Economic Cooperation and Development (OECD). 1989. *Economic Instruments for Environmental Protection.*

OECD. 1994a. *Managing the Environment: The Role of Economic Instruments.*

OECD. 1994b. *Public Policies for the Protection of Soil Resources.* Environment Monograph No. 89.

OECD. 1995a. *Environmental Performance Reviews: The Netherlands.*

OECD. 1995b. *Environmental Taxes in OECD Countries.*

OECD. 1996a. *Implementation Strategies for Environmental Taxes.*

OECD. 1996b. "Agricultural Policies, Markets and Trade in OECD Countries: Monitoring and Evaluation 1996."

OECD Environment Policy Committee Meeting Communiqué. February 19-20, 1996.

Orr, Joanne S. Oklahoma Department of Transportation. Personal communication. May 1996.

Osborn, C. Tim, Daniel Hellerstein, C. Matthew Rendleman, Marc Ribaudo, and Russ Keim. February 1994. *A Preliminary Assessment of the Integrated Crop Management Practice.* USDA Economic Research Service.

Osborn, C. Tim, Felix Llacuna, and Michael Linsenbigler. November 1995. *The Conservation Reserve Program: Enrollment Statistics for Signup Periods 1-12 and Fiscal Years 1986-93.* USDA Economic Research Service. Statistical Bulletin Number 925.

Osborn, C. Tim. USDA Economic Research Service. Personal communication. 1996.

Palmer, Karen L, Hilary Sigman, Margaret A. Walls, Ken Harrison, and Steve Palmer. July 1995. *The Cost of Reducing Municipal Solid Waste: Comparing Deposit-Refunds, Advance Disposal Fees, Recycling Subsidies, and Recycling Rate Standards.* Resources for the Future Discussion Paper 95-33. www.rff.org/dpapers/abstract/9533.htm

Palmisano, John. 1994. "Environmental Fees in Russia." *New Partnerships: Economic*

Incentives for Environmental Management. Air and Waste Management Association.

Pan, Tin-Bai. 1994. "The Use of Economic Instruments in Environmental Protection: The Experience of Taiwan." OECD. *Applying Economic Instruments to Environmental Policies in OECD and Dynamic Non-Member Economies.*

Parker, Bill. Florida Department of Environmental Protection. Personal communication. May 1996.

Pennsylvania Department of Environmental Protection. "Land Recycling Fact Sheet 8: Financial Assistance (Grants and Loans)." Undated.
www.dep.state.pa.us/dep/deputate/airwaste/wm/landrecy/facts/fs8.htm

Pennsylvania Department of Environmental Protection. "Pennsylvania's Land Recycling Program: Six-Month Progress Report." Undated.
www.dep.state.pa.us/dep/deputate/airwaste/wm/landrecy/facts/6monrpt.htm

Perkins, Jody. September 1995. *Subsidies to Alternative Transportation Fuels and Alternative Fuel Vehicles in Twelve Eastern States and the District of Columbia.* American Petroleum Institute Research Study #080. www.api.org/cat/SEC12a.htm#52

Portney, Paul. Fall 1990. Economics and the Clean Air Act," *Journal of Economic Perspectives*, Vol. 4, No. 4, pp. 173-181.

Potier, Michel. February/March 1995. "China Charges for Pollution." *The OECD Observer*. No. 192.

President Bill Clinton and Vice-President Al Gore. March 1995. "Reinventing Environmental Regulation." Reprinted in *DEN*. March 17, 1995.

President's Council on Sustainable Development. March 1996. Report.
www.whitehouse.gov/WH/EOP/pcsd/#council_report

Project 88: Harnessing Market Forces to Protect Our Environment: Initiatives for the New President. Study sponsored by Senators Timothy E. Wirth and John Heinz.

Project 88 -- Round II: Incentives for Action: Designing Market-Based Environmental Strategies. Study sponsored by Senators Timothy E. Wirth and John Heinz.

Putnam Hayes & Baaartlett, Inc. 1981. "Evaluation of the Potential Cost Impact of Plantwide Effluent Limitations (The Water Bubble Concept)," prepared for the Office of Policy, Planning and Evaluation, U.S.EPA.

Quinn, Barbara. March 1996. "Ten Years Later, The Awards, and Rewards, Keep Coming." *Pollution Engineering.*

Quinn, James J. March 1992. *Water Quality Management: Policy and Practice in Selected*

Countries. American Petroleum Institute Discussion Paper #072. www.api.org/cat/SEC12.htm#15

Raffle, Bradley I., and Debra F. Mitchell, 1993. *Effective Environmental Strategies: Opportunities for Innovation and Flexibility under Federal Environmental Law,* Chicago, AMOCO.

Rahim, Khalid Abdul. 1994. "The Standard-cum-Charge Approach in Environmental Policy: The Malaysian Experience." OECD. *Applying Economic Instruments to Environmental Policies in OECD and Dynamic Non-Member Economies.*

Reese, Andrew J. January/February 1996. "Storm-Water Utility User Fee Credits." *Journal of Water Resources Planning and Management.* Vol. 122. No. 1. pp. 49-56.

Regional Environmental Center for Central and Eastern Europe. 1994. *National Environmental Protection Funds in Central and Eastern Europe: Case Studies of Bulgaria, the Czech Republic, Hungary, Poland, and the Slovak Republic.*

Regional Environmental Center for Central and Eastern Europe. 1995. *Use of Economic Instruments in Environmental Policy in Central and Eastern Europe: Case Studies of Bulgaria, the Czech Republic, Hungary, Poland, Romania, the Slovak Republic, and Slovenia.*

"Reinventing Enviro Protection." November/December 1993. *The Environmental Forum.* Volume 10. Number 6.

Rendleman, C. Matthew, Kenneth A. Reinert, and James A. Tobey. 1995. "Market-based Systems for Reducing Chemical Use in Agriculture in the United States," *Environmental and Resource Economics,* Vol 5: 51-70.

Repetto, Robert, Roger C. Dower, Robin Jenkins, and Jacqueline Geoghegan. November 1992. *Green Fees: How a Tax Shift Can Work for the Environment and the Economy.* World Resources Institute.

Rhee, Ho-Saeng. 1994. "The Use of Economic Instruments in Environmental Protection in Korea." OECD. *Applying Economic Instruments to Environmental Policies in OECD and Dynamic Non-Member Economies.*

Rhee, Jeong-Jean. 1995. "Waste-Collection Fee and Sustainable Consumption." Unpublished document presented at Policy Measures for Changing Consumption Patterns. Seoul.
conference.www.ksdn.or.kr/consumption/rhee.txt

Roach, Frederick, Charles Kolstad, Alan V. Kneese, Richard Tobin, and Michael Williams, 1981. "Alternative Air Quality Policy Options in the Four Corners Region," *Southwest Review,* Vol.1: 44-45.

Rolfe, Christopher J. B. December 1993. *Using Subsidies to Promote Environmental Protection in Agriculture: A Review of Programs in North America and Europe.* West Coast Environmental

Law Association. yvrww1.pwc.bc.doe.ca/ec/frap/fr-pof.html

Rubin, Jonathan, and Catherine Kling, 1993. "An Emission Saved is an Emission Earned: As Empirical Study of Emission Banking for Light-Duty Vehicle Manufacturers," *Journal of Environmental Economics and Management*, November, 257-274.

Ruffing, Kenneth G. 1995. "Setting Consumption as a Global Agenda." Unpublished document presented at Policy Measures for Changing Consumption Patterns conference. Seoul.
(www.ksdn.or.kr/consumption/ruffing.txt)

Rusin, Michael, Robert C. Anderson, Thomas J. Lareau, G. Prasad Rao, and Arthur Wiese. June 1996. *Analysis of the Costs and Benefits of Regulations: A Review of Historical Experience*. American Petroleum Institute Discussion Paper #084.

Schärer, Bernd. 1995. "Ökonomische Instrumente-zur Rolle von Abgaben, Kompensationen und Subventionen in der deutschen Luftreinhaltepolitik." *Staub-Reinhaltung der Luft*. Nr. 55. pp. 253-258.

Schiff, Stanley D., undated. "Real World Experience with TDRs - An Update," Piedmont Environmental Council, Warrenton VA.

Schmutzler, Armin, and Lawrence Goulder, 1977. "The Choice between Emission Taxes and Output Taxes Under Imperfect Modeling," *Journal of Environmental Economics and Management*, Vol. 32: 51-64.

Schoot Uiterkamp, J.F.J., F.P.M. Leek, and A.F. de Savornin Lohman. January 1995. *Waste Water Charge Schemes in the European Union*. Two part series. Netherlands Ministry of Transport, Public Works and Water Management. www.minvenw.nl/rws/riza/publ.htm

Scientific Certification Systems. Various documents.

Scrap Tire News Legislative Report. January 1996. "Scrap Tire Laws and Regulations."

Selmi, Daniel P. 1994. "Transforming Economic Incentives From Theory to Reality: The Marketable Permit Program of the South Coast Air Quality Management District," *Environmental Law Reporter*, 195-206.

Sendak, Paul E. August 1995. "The Role of Economic Incentives in Conserving Wildlife Habitat." Paper presented at IUFRO XX World Congress, Wildlife and its Habitats.

Seskin, Eugene, Robert J. Anderson, and R. Reid. 1983. "An Empirical Analysis of Economic Strategies for Controlling Air Pollution," *Journal of Environmental Economics and Management*, Vol. 10: 112-124.

Shapiro, Michael, and Ellen Warhit. 1983. "Marketable Permits: The Case of Chlorofluorocarbons," *Natural Resources Journal*, Vol. 23: 577-591.

Sidhu, Ranjit. November 1993. *Current Status of Watershed Management in the United States*. American Petroleum Institute Discussion Paper #074. www.api.org/cat/SEC12.htm#13

Sierra Research, Inc. April 1995. "Institutional Support Programs for Alternative Fuels and Alternative Fuel Vehicles in California."

Sigman, Hilary. 1994. "State Hazardous Waste Fees: An Assessment." *New Partnerships: Economic Incentives for Environmental Management*. Air and Waste Management Association.

Sigman, Hilary. Autumn 1995. "A Comparison of Public Policies for Lead Recycling." *RAND Journal of Economics*. Vol. 26. No. 3. pp. 452-478.

Sigman, Hilary. March 1996. "The Effects of Hazardous Waste Taxes on Waste Generation and Disposal." *Journal of Environmental Economics and Management*. Volume 30, Number 2.

Sims, William A. 1977. *Economics of Sewer Effluent Charges*. PhD. Thesis, Political Economy, University of Toronto.

Skelton, Eric P. 1994. "Small Scale Marketable Permits Programs: Grass Field Burning and Wood Stove Permits," in *New Partnerships: Economic Incentives for Environmental Management*, Pittsburgh: Air & Waste Management Association.

Skumatz, Lisa. 1994. "Pay as You Throw: Variable Rate Incentives in Solid Waste Management." *New Partnerships: Economic Incentives for Environmental Management*. Air and Waste Management Association.

Skumatz, Lisa A. November 1995. "Continued Growth for Variable Rates." *BioCycle*.

Skumatz, Lisa A. Skumatz Economic Research Associates. March 21, 1996. Unpublished memorandum to whom it may concern.

Smith, Bucklin and Associates, Inc. November 1995. *1994 National Recycling Rate Study*. Prepared for Battery Council International.

Smith, Stephen. November 1995. *"Green" Taxes and Charges: Policy and Practice in Britain and Germany*. The Institute for Fiscal Studies. www1.ifs.org.uk/ifsinfo/publist.htm

South Coast Air Quality Management District. 1992. Regional Clean Air Incentives Market. Diamond Bar, CA.

South Coast Air Quality Management District. Rule 301: Permit Fees, as amended May 10, 1996. www.aqmd.gov/rules/html/r301.html

South Coast Air Quality Management District. Rule 303: Hearing Board Fees, as amended May 10, 1996. www.aqmd.gov/rules/html/r303.html

Spofford, Walter O., Jr. 1984. "Efficiency Properties for Alternative Source Control Policies for Meeting Ambient Air Quality Standards: An Empirical Application to the Lower Delaware Valley, " Resources for the Future, Discussion Paper D-118.

"State Waste Board Lowers Interest Rate on Recycling Loan," March 1996. *CAL/EPA Report*. Vol. 5. No. 3. www.calepa.cahwnet.gov/epadocs/mar96.txt

Steele, Paul and Ece Ozdemiroglu. 1993. "Examples of Existing Market-Based Instruments and the Potential for Their Expansion in the Asian and Pacific Region." *Financing of Environmentally Sound Development*. Asian Development Bank.

Steele, Paul and David W. Pearce. 1993. "The Theory and Practice of Market-Based Instruments in the Asian and Pacific Region." *Financing of Environmentally Sound Development*. Asian Development Bank.

Stein, Rafael. Environmental Protection Agency. Personal communication. 1996.

Steuteville, Robert. May 1995. "BioCycle Nationwide Survey: The State of Garbage in America." *BioCycle*.

Surface Mining Control and Reclamation Act. 1977. www.osmre.gov/smcra/smcra.html

Swedish Ministry of the Environment and Natural Resources. 1995. *Taxes and Charges in Environmental Policy: The Swedish Experience*. (Similar document: www.ksdn.or.kr/consumption/eloffson.txt)

Takemoto, Carla. California Air Resources Board. Personal communication. 1996.

Technische Anleitung zur Reinhaltung der Luft (TA-Luft). (German air pollution regulation.) 1986.

Temple Barker & Sloane. 1981. "The Effect of the Water Bubble Policy on Individual Iron and Steel Facilities," prepared for the U.S. EPA.

Texas Natural Resource Conservation Commission (TNRCC). 1994. *Marketable Permits: Final Report Grant Period 1993-1994*. Austin.

Texas Natural Resource Conservation Commission (TNRCC). March 1995. *A Report to the 74th Texas Legislature: Pollution Prevention and Waste Reduction in Texas*. www.tnrcc.state.tx.us/exec/oppr/ppc_pubs.html#5033

TNRCC. March 1995. *Clean Industries 2000: Community Environmental Programs*. www.tnrcc.state.tx.us/exec/oppr/ppc_pubs.html#5033

TNRCC. March 1995. *Clean Industries 2000: Directory*. www.tnrcc.state.tx.us/exec/oppr/ppc_pubs.html#5033

TNRCC. March 20, 1995. "Record Texas Pollution Reductions, New Clean Industries 2000 Members Announced in Houston." www.tnrcc.state.tx.us/pub/bbs1/press/clean.txt

TNRCC. March 27, 1995. "Texas Achieves Largest Pollution Reductions of Major Industrial States." www.tnrcc.state.tx.us/pub/bbs1/press/tri.txt

TNRCC. March 1996. *Clean Industries 2000: Citizen Communication Programs*. www.tnrcc.state.tx.us/exec/oppr/ppc_pubs.html#5033

TNRCC. March 1996. *Pollution Prevention Ideas from Texas Industries: A Case Study Compendium*. www.tnrcc.state.tx.us/exec/oppr/ppc_pubs.html#5033

TNRCC. March 25, 1996. "Clean Industries 2000 Fact Sheet."

TNRCC. March 25, 1996. "22 Metroplex Industries Cut Pollution Two Million Tons: Metroplex CLEAN INDUSTRIES 2000 Members Saluted Monday in Houston." www.tnrcc.state.tx.us/pub/bbs1/press/tri.txt

Thorning, Margo. February 1992. "International Comparison of the Tax Treatment of Pollution-Control Investment." American Council for Capital Formation. Center for Policy Research.

"305 State Businesses Win Awards for Reducing Waste." January/February 1996. *CAL/EPA Report*. Vol. 5. No. 1/2. www.calepa.cahwnet.gov/epadocs/janfeb96.txt

Tietenberg, Thomas H. 1985. *Emissions Trading: An Exercise in Reforming Pollution Policy*, Washington D.C.: Resources for the Future.

Tolman, Jonathan. August 1995. "Federal Agricultural Policy: A Harvest of Environmental Abuse." Competitive Enterprise Institute.

Trombly, Jeanne. June 1995. "Credit where credit is due: Targeted loan funds for recycling." *Resource Recycling*.

U.S. Department of Agriculture (USDA) Forest Service. September 1994. "Debt for Nature Swaps and Alternative Financial Instruments for Financing Environmental Programs." International Forestry Issue Brief No. 9. www.fs.fed.us/global/swap.html

USDA. December 1994. *Agricultural Resources and Environmental Indicators*. Economic Research Service Agricultural Handbook Number 705.

USDA. January 1996. "1996 Grazing Fees Announced." Internet press release: www.fs.fed.us/forum/graznews.htm

USDA. April 1996. "1996 Farm Bill Press Release."

Verordnung des Bundesministers für Umwelt, Jugend, und Familie über die Rucknahme,

Pfanderhebung, und umweltgerechte Behandlung von bestimmten Lampen. (Austrian regulation on light bulb deposit-refund requirements.)

Virginia Department of Environmental Quality. January 1996. "Waste Tire Program." www.deq.state.va.us/envprog/tires.html.

Virginia Department of Transportation. Various documents on adopt-a-highway program.

von Amsberg, Joachim. June 15, 1995. "Selected Experiences with the Use of Economic Instruments for Pollution Control in non-OECD Countries." Unpublished draft report.

Wagner, Helmut. Commercial Counselor. Austrian Embassy. Personal communication. 1996.

Wall Street Journal, various issues.

Ward, Kevin, and John Duffield. 1992. *Natural Resource Damages: Law and Economics*, New York: John Wiley & Sons.

Ward, Rebecca, Scientific Certification Systems, personal communication, May 1996.

Warmer Bulletin. February 1996. general access to bulletin: www.wrfound.org.uk/wrfjnl.html

Weil, Edward. California Deputy Attorney General. Personal communication. 1996.

Weinberg, Bergeson & Neuman. April 8, 1996. "Summary of State Lead-Acid Battery Recycling Law."

Weitzman, Martin. 1974. "Prices vs Quantities," *Review of Economic Studies*, Vol. 41, 477-491.

Wellman Inc. December 1994. *PET Recycling Supply/Demand Analysis.*

White, Lucinda. Maine Assistant Attorney General. Personal communication. 1996.

Whitehouse, Edward. 1996. "Tax Expenditures and Environmental Policy." OECD. *Subsidies and Environment: Exploring the Linkages.*

Wisconsin Department of Natural Resources. Undated. "Wisconsin's Newspaper Recycled Content Requirements: 1994 Update."

Wisconsin Department of Natural Resources. 1993. "Order of the State of Wisconsin Natural Resources Board Creating Rules in the Matter of Creating Ch. NR 546 of the Wisconsin Administrative Code Pertaining to Newspaper Recycling Fee."

World Bank. 1992. *World Development Report 1992: Development and the Environment.*

Young, C. Edwin, and C. Tim Osborn. February 1990. *The Conservation Reserve Program: An Economic Assessment*, USDA Economic Research Service AER-626.

Young, Terry F. and Chelsea H. Congdon, 1994. *Plowing New Ground: Using Economic Incentives to Control Water Pollution from Agriculture*, Oakland CA: Environmental Defense Fund.

Zylicz, Tomasz. Warsaw Ecological Economics Center. June 1994. "The Chorzow Project." August 8, 1997.