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Chapter 18

Comparative Environmental Policies

We begin by looking at some of the experiences of other industrialized countries of the East and the West. In the United States we have seen that there was a great burst of political energy in the early 1970s that launched many of the environmental initiatives at the federal level. Much of the same took place in other countries; their primary environmental policies date from around the same time.

International Comparisons of Environmental Quality

Perhaps the best place to start is to look at several comparisons among countries in terms of environmental achievements. Good comparative data are not easy to obtain because the monitoring efforts of the countries have not been established with the primary goal of facilitating international comparisons. Each country collects and publishes its own data, using whatever bases, indices, and systems it finds most useful for its purposes. Thus, comparability is a problem. Efforts are slowly under way, especially among the European countries, to achieve some degree of uniformity in monitoring and data reporting.

Another thing making comparisons difficult is that within any country, environmental quality can vary substantially among regions. In the United States, southern California and other urban areas have severe air problems. In Germany there is the heavily industrial pollution in the Ruhr Valley. Japan has the Tokyo–Osaka corridor. This means that international comparisons have to be made with care and confined to situations that are reasonably similar.

The most cogent comparisons are in terms of ambient conditions in different countries or locations. These are very difficult to come by, because different countries, or municipalities, will usually use different procedures for collecting, analyzing, and publishing data. Table 18.1 shows some air quality data

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TABLE 18.1 Ambient Levels of Ozone and Fine Particulate Matter for Six Major Cities, 2009

City	Ground-Level Ozone (parts per billion)	Particulate Matter (PM) Less Than 2.5 micrograms (micrograms per cubic meter)
Athens	27.66	20.12
Boston	36.31	9.77
Chicago	37.21	11.47
Paris	30.45	21.84
Rome	33.69	19.95
Sydney	NA	6.98

Source: Environment Canada, http://www.ec.gc.ca/indicateurs-indicators.

for six major cities of the world. Note that for ground-level ozone, all the cities are quite close to one another, whereas for fine particulate matter they are very diverse. In the latter case they range from about 7 milligrams per cubic meter in Sydney to over three times this level in Paris.

Table 18.2 also shows some comparative data on various environmental measures for selected countries, to show the diversity of these factors among them. The first three rows show air pollutant emissions. Sulfur dioxide (SO_2) emissions vary from 3.3 kg per capita in Sweden to 123.5 kg per capita in Australia. Nitrogen oxide (NO_x) emissions are also quite variable, and carbon dioxide (CO_2) emissions go from 4.4 tons per capita in Mexico to 19.7 tons per capita in the United States. The next row shows the proportion of the population served by public wastewater collection facilities, and varies from 45 percent in China to essentially all in the U.K. The next two rows show data on municipal solid waste, first kg of MSW produced per capita and then the percentage of MSW recycled. Again, note the variability among the countries. The next to last row shows renewable energy production as a percentage of all energy produced; data vary from 0.8 percent in Hungary to 58.1 percent in Canada (because of hydroelectric facilities in this country). The last row partially explains the variations in airborne emissions just noted. Some countries have adopted nuclear power much more widely than others; Canada, France, and Sweden, for example, produce relatively large amounts of high-level nuclear waste from electric power plants.

Interpreting Differences in Environmental Performance

One has to be careful in interpreting these comparative environmental data.[1] The first reaction might be to interpret different environmental indices as indicating the effort each country has put into pollution control, but a moment's reflection shows that this is not necessarily the case. Differences in ambient

[1] The same might be said about comparisons among different regions of the same country.

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TABLE 18.2 Environmental Indicators for Selected Countries in Recent Years

	Australia	Canada	France	Hungary	China	Japan
Emissions:						
SO_2 (kg/capita)	123.5	—	6.4	10.7	—	6.1
NO_x (kg/capita)	127.1	1.4	21.1	16.8	—	14.7
CO_2 (tons/capita)	19.0	17.9	6.5	5.7	4.9	10.2
Population connected to wastewater collection (%)	87.0	74.3	82.0	65.0	45.7	67.0
Municipal solid waste produced (kg/ capita)	—	—	536	430	—	428
recycled (%)	30.3	26.8	18.2	13.4	—	16.8
Renewable energy (% of total produced)	6.9	58.1	12.0	0.8	15.1	15.6
Nuclear waste*	—	1,340	1,130	55	—	964

	Korea	Mexico	Sweden	United Kingdom	United States
Emissions:					
SO_2 (kg/capita)	—	25.6	3.3	8.4	33.3
NO_x (kg/capita)	19.8	14.1	17.0	23.1	45.1
CO_2 (tons/capita)	10.5	4.4	5.6	9.0	19.7
Population connected to waste-water collection (%)	78.8	67.6	86.0	97.7	71.4
Municipal solid waste produced (kg/capita)	—	377	485	529	736
recycled (%)	49.2	3.3	35.4	26.9	23.8
Renewable energy (% of total produced)	1.3	13.6	45.5	3.6	7.6
Nuclear waste*	364	42	238	820	2,100

*Waste from spent fuel arising in nuclear power plants, in tons of heavy metal per million tons of oil equivalent of total primary energy supply.
—: negligible.

Sources: UNSD Environmental Indicators: http://unstats.un.org/unsd/environment/qindicators.htm.
Nuclear waste data: OECD, Environmental Data Compendium.

environmental quality between different countries can be explained in essentially two ways: (1) as differences in the efficient, or desired, levels of ambient quality and/or (2) as differences in the extent to which each country, through policy and its enforcement, has achieved these efficient levels.

These are depicted in Figure 18.1, which shows three familiar marginal damage/marginal abatement cost diagrams, with ambient quality indexed on

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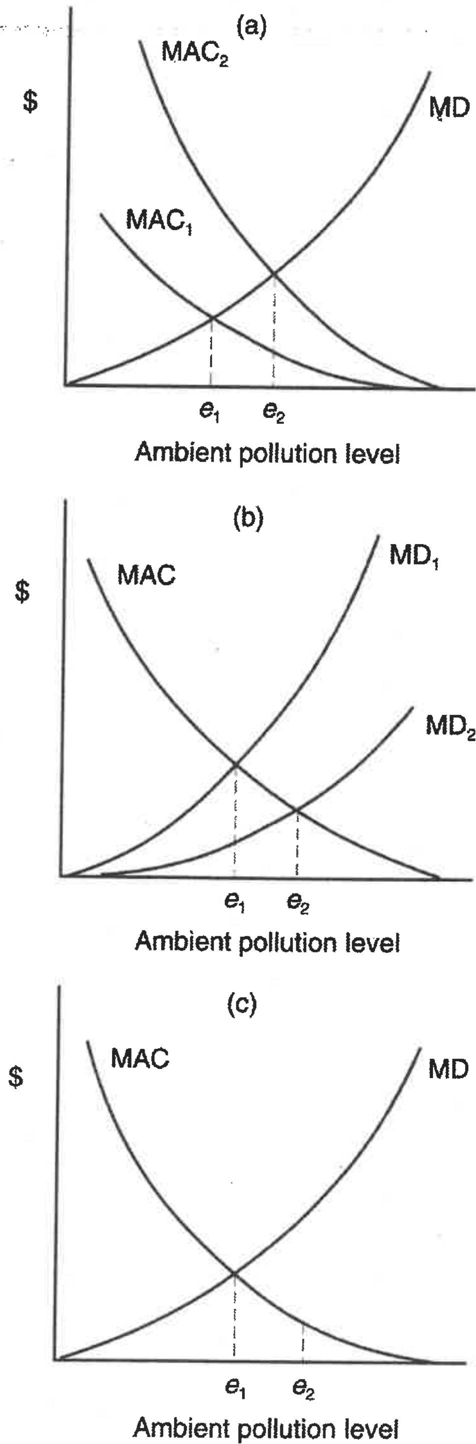
FIGURE 18.1 Interpreting International Differences in Ambient Pollution Levels



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the horizontal axes. Suppose that e_1 and e_2, indicated on each figure, refer to ambient levels in two countries. Panel (a) shows that this policy could be the result of differences between the two countries in terms of their marginal abatement costs, given the same preferences for environmental quality in the two countries. In the short run this could be the result of **different technological means for pollution control** available in the two countries. But in the long run this factor would be less important because pollution-control technology is mobile; whatever is available in one country can be made available in the other. Of course, the difference in marginal abatement cost functions could arise also because one country has adopted more **cost-effective environmental control policies** than the other.

Other factors also may be at work. As we have stated many times, ambient conditions are the result of **emissions** *and* the **assimilative capacity** of the environment. So a country that has achieved low emissions still may suffer relatively high ambient concentrations because of the way its environment works: Similar emissions in Mexico City and New York will produce much dirtier air in the former because of its prevailing meteorological patterns. By the same token, similar ambient levels do not imply that countries have made similar efforts to control emissions, because in one the assimilative capacity of the environment may be greater. Another real possibility is that there are differences in economic circumstances of the two countries—one relatively rich and the other relatively poor—so that the **opportunity cost** of pollution control in terms of forgone conventional income is higher in one than in the other. Note that the country with the highest ambient concentration actually may have spent more in total on abatement costs than the country with the lower concentration. We will have more to say on this point in Chapter 19, which discusses the relationship of environmental quality to economic development.

Panel (b) depicts the case where the difference between e_1 and e_2 is explained by differences in the damages flowing from ambient pollution loads in the two countries. This could stem, for example, from real differences in willingness to pay for pollution control by people in similar economic and social circumstances, that is, environmental quality as a matter of tastes and preferences, or from the fact that the two countries give a different priority to environmental quality. We should recognize here also that what we are calling social preferences are normally the result of a great deal of political strife and contention, in some countries more than in others. It is seldom that there is anything close to unanimity on environmental preferences across individuals, so what comes out as "social" preferences very much depends on how political/policy struggles mix the various viewpoints and produce environmental outcomes.

Finally, panel (c) depicts the situation of different enforcement efforts. Although both have the same desired level of ambient quality, one country has devoted more resources to enforcement, and thus its actual level is lower. Throughout this book we have talked about the importance of enforcement. Nothing is more common in the world of environmental pollution control

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than laws and regulations that are put in the books but then enforced inadequately in practice.

Of course, when making comparisons among countries all three factors will normally come into play: abatement costs, damages, and enforcement efforts.

Environmental Policy in Other Countries

Regardless of where one lives, there is much to learn through comparing one's own experience with that of others. The rest of this chapter examines some of the distinguishing environmental policy efforts of developed countries other than the United States. It is not intended to offer a catalog of events in each country; this would be impossible in the space we have, and also because environmental issues and responses are changing so rapidly that a catalog of this type would quickly be out of date. Instead, we will try to single out particularly noteworthy policies or trends that characterize environmental policy in particular countries or groups of countries.

National Styles in Environmental Policy

The United States was not the only national government to address environmental quality issues in the 1970s. Many other developed countries undertook at the time to do the same thing. It is not surprising that these efforts were not just technical exercises in selecting the right policy for the problem. In fact, environmental policies in different countries were a reflection of their unique political cultures and institutions. In one study of air-pollution policy in Sweden and the United States, the author characterized the differences between the two countries as the difference between the hare and the tortoise.[2] The United States was the hare, with bursts of speed followed by pauses and rests, while Sweden was the tortoise, with slower but steadier progress. This side-by-side comparison of U.S. and Swedish policy approaches is the following:

United States	Sweden
1. Statutory ambient standards	1. Nonstatutory emission guidelines
2. Strict timetables for compliance	2. Compliance timetables set on basis of economic feasibility
3. Technology-forcing emission developments	3. Adjustments of standards to technological standards

In general, the U.S. style, at least during the 1970s covered in this study, emphasized formal and sharply defined objectives written into public laws, after much political wrangling, with later administrative compromises and delays

[2] Lennart J. Lundquist, *The Hare and the Tortoise: Clean Air Policies in the United States and Sweden*, University of Michigan Press, Ann Arbor, 1980.

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to accommodate reality. The Swedish approach was to set policy with far less public fanfare, negotiating voluntary agreements that were based on technical and economic feasibility.

Many other studies around this time highlighted the difference between the conflictual, litigious style of policymaking (and implementing) in the United States, and the apparently more cooperative, collaborative styles in other countries.[3] Despite these differences, however, the authors of these studies conclude that for the most part there was little significant difference among the countries in terms of results, that is, in terms of the extent to which environmental pollution was in fact being reduced.

These differences in style continue to exist to some extent, because differences in political cultures and institutions still exist. But there has also been substantial evolution in the environmental programs of countries in the developed world. In keeping with the economic integration that has occurred in a globalizing world, environmental policy has also become, as one author has indicated, more hybrid. This means simply that, with the international free flow of ideas about different approaches to pollution control, the mix of policies in any one country becomes a complex amalgam of plans developed locally and plans imported from elsewhere. Speaking of the United States and Europe, this author states:

> Examples of such borrowing in environmental policy abound. From the U.S., Europe has borrowed approaches to emissions trading; cost-benefit analysis, and executive oversight of the regulatory system; product liability and the proposed liability directive; increasing "federal" oversight of environmental policy; information disclosure instruments, including environmental impact assessment (EIA) and toxics release registries; and other measures.
>
> Meanwhile, from Europe, the U.S. has borrowed the Dutch method of environmental covenants and related approaches to voluntary negotiated agreements, and the concept of precaution itself (which originated as *Vorsorgeprinzip* in German law and was later adopted in the noted U.S. case *Ethyl Corp*).[4]

Guiding Principles of Pollution Control

In some countries, political authorities have attempted to develop **guiding principles** to identify appropriate pollution-control policies. A guiding principle is simply an overarching policy criterion that supposedly sets guidelines for determining acceptable policies. In Japan, for example, pollution-control efforts

[3] Joseph L. Badaracco Jr., *Loading the Dice: A Five-Country Study of Vinyl Chloride Regulation*, Harvard Business School Press, Boston, 1985; David Vogel, *National Styles of Regulation, Environmental Policy in Great Britain and the United States*, Cornell University Press, Ithaca, NY, 1986; Julian Gresser, Koichiro Fujikura, and Akio Morishima, *Environmental Law in Japan*, MIT Press, Cambridge, MA, 1981, p. 248. See also: Helmut Weidner and Martin Janiuce (eds.), *Capacity Building in National Environmental Policy. A Comparative Study of 17 Countries*, Springer, 2002; Paul F. Steinberg and Stacy D. Van Deveer, *Comparative Environmental Policies*, MIT Press 2012.

[4] Jonathan B. Wiener, "Convergence, Divergence, and Complexity in U.S. and European Regulation," in Normal J. Vig and Michael G. Faure (eds.), *Green Giants? Environmental Policies of the United States and the European Union*, MIT Press, Cambridge, MA, 2004, p. 98.

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were initially developed under the principle of "harmonization," which was essentially a requirement that pollution-control laws be "harmonized" with the requirements of economic growth. In China, new industrial construction is supposed to be pursued within the principle of "three at the same time." Each new construction plan is supposed to contain a special section on environmental protection showing how pollution-control methods will be designed, installed, and operated.[5]

Countries of the Organization for Economic Cooperation and Development (OECD) have sought to pledge their allegiance to what is called the **polluter pays principle** (PPP). This principle states that it is the polluters themselves who should bear the cost of measures to reduce pollution to levels specified by public authorities. Although this may sound like a rule based on ethical considerations, it is really grounded in political economics. It is meant to rule out situations where governments subsidize pollution-control expenditures of firms or industries in order to give them an economic advantage over competitors who must pay their own compliance costs. This is regarded as especially important among the closely competing firms and industries of the countries of Europe. There are exceptions allowed to the PPP in certain cases of undue economic hardship, short-term transition periods, and cases that have no significant impacts on international trade and investment. Because most countries, in OECD as elsewhere, subsidize pollution reduction to a greater or lesser degree, it has been necessary for political diplomats to find ways of reconciling principle and reality. In general, this has been done by defining the PPP abstractly enough that it can be held compatible with a wide number of arrangements.

Another idea that environmental policymakers have increasingly referred to is the **precautionary principle,** which is intended to introduce greater caution into public decisions in cases where there could be substantial future costs (damages) that are currently unknown. It stems from well-known cases in the recent past of many industrial countries where the introduction of a product or material that had substantial up-front benefits turned out in the end to have some very high costs that were not foreseen. Asbestos is an example, as are chlorofluorocarbons (CFCs). The precautionary principle essentially states that if there is a perceptible threat of serious and/or irreversible damage in undertaking some action, these future costs should not be overlooked or discounted simply because they are scientifically uncertain. In a sense, the principle emphasizes the burden-of-proof issue in environmental decision making: Should the burden of demonstrating that a new product or practice is safe be put on those who introduce it, or on those who might question its safety?

Instrument Choices

Environmental regulation in most industrial countries has historically been based on a command-and-control standard setting, as it has in the United

[5] Rui Lin Jin and Wen Liu, "Environmental Policy and Legislation in China," in *Proceedings of the Sino-American Conference on Environmental Law*, Natural Resource Law Center, University of Colorado School of Law, Boulder, CO, 1989, p. 173.

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States. This means, as we have seen in earlier chapters, such things as political and administrative determination of, for example, the pollution-control technologies that are going to be acceptable, what emissions levels will be, where firms may locate, how buildings and equipment should be designed, what fuels and inputs may be used, how certain substances are to be handled, and so on.

In most countries, some basic criterion has been adopted to establish the technological level(s) on which to base command-and-control decisions. In Great Britain authorities have required "best practicable means," which refers to "reasonably practicable and technically possible to prevent the emission of gases and render these discharges harmless." Germany has relied on the basic idea that pollution-control programs must involve "state-of-the-art" technology. In Sweden the underlying decision criterion has been to choose "what is technically feasible using the most effective technical devices and methods that are available in the area in question."Italy has had a standard calling for emissions reductions to "the lowest level possible through available technologies." As we have mentioned several times in previous chapters, this approach actually allows regulators to make implicit trade-offs between damage reduction and technical and economic feasibility.

Although basic policies continue to be grounded in concepts of command and control, there has been a clear evolution in many countries toward the use of incentive-based policies.[6] Emission charges have been introduced extensively in many of the countries of Europe. In air pollution–control policy, numerous European countries have taxes on SO_2 and NO_x emissions. Some have also introduced a charge on CO_2 emissions, as well as on various types of waterborne emissions. Our discussion of emission charges in Chapter 12 focused on charges as a means of bringing about cost-effective emission reductions. These might be called "incentive" charges or, as they are sometimes called in Europe, "balancing" charges. The emission charges employed in Europe are not incentive charges of this type. Rather, they are employed primarily to raise money that then can be used to subsidize pollution-control activities of public and private organizations. Among European countries a major problem has been to move toward harmonizing the many national programs with directives established by officials of the European Union (EU).

Countries of the European Union have started the European Trading Scheme (ETS) for meeting its obligations under the Kyoto Convention. In that agreement, the EU collectively agreed to reduce its CO_2 emissions to a level 7 percent below its 1990 emissions. Individual country goals vary around this, depending on their own circumstances. In their national plans, each country is to allocate a portion of its total cutback requirement to the firms of four sectors: energy, iron and steel, minerals (cement, glass), and pulp and paper. These firms may then trade emission allowances among themselves and with sources in other EU countries. Some of the details of the program are shown in Exhibit 18.1.

[6] For a good summary, see Organization for Economic Cooperation and Development, "Environmental Taxes in OECD Countries," OECD, Paris, 1995.

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Details of the European Trading Scheme

EXHIBIT 18.1

The EU-ETS officially began on January 1, 2005, and consisted of a "warm-up" phase from 2005–2007 and then successive five-year periods, with the second phase from 2008–2012 set to coincide with the Kyoto compliance period. The first phase was focused only on CO_2. The overall cap (and hence the stringency of the program and the resulting cost of emissions reductions) in the emissions trading scheme is made up of individual country caps set by each nation's national allocation plan (NAP). The second phase on the EU-ETS will run for five years from January 1, 2008, will involve tighter overall caps (in line with the economy-wide emissions target under the Kyoto Protocol), and may be expanded to other greenhouse gases (depending on available verification) and additional sources and sectors (e.g., aluminum and aviation).

Six key industrial sectors are covered, notably electricity and heat production plants greater than 20-MW capacity.[1] Other included sectors (with specific facility size thresholds) are oil refineries, coke ovens, metal ore and steel installations, cement kilns, glass manufacturing, ceramics manufacturing, and paper, pulp, and board mills. These sectors accounted for around 12,000 installations (depending on the final details of the specification process), and represent close to half of the total CO_2 emissions from the EU-25 countries. A current very controversial issue is extending the program to include emissions from aircraft.

The EU-ETS is a cap-and-trade program where fixed amounts of emissions allowances are allocated (via the individual country NAPs). From 2005–2007 most permits were given away free (either grandfathered to a base year or on an updating basis). Five percent were to be auctioned in the first phase;[2] from 2008 onwards, 10 percent auctioning is allowed.

Banking of excess reductions (i.e., allowances) for future years is allowed within the first compliance period (phase of the EU-ETS).

Hefty fines exist for noncompliance (40 Euro/TCO_2 from 2005–2007, then 100 Euro/TCO_2 from 2008 onwards[3]), levels that are considerably higher than most predictions of allowance prices.

In terms of project mechanisms, or credits generated from specific reduction efforts, credits from developing countries via the clean development mechanism (CDM) and from other nations via the joint implementation (JI) mechanism were allowed from the first (2005–2007) and second (2008–2012) phases of the EU-ETS, respectively.

[1] To put a 20-MW plant in context: 20-MW coal steam turbine operating 8,000 hrs/annum = 158,000 tons of CO_2 or 43,200 tons of carbon; 20-MW natural gas combined cycle plant operating 5,000 hrs/annum = 45,000 tons of CO_2 or 12,300 tons of carbon.

[2] Hungary, Denmark, and Lithuania have decided to auction some allowances.

[3] Note, as of January 2005; 1 Euro ~ \$1.30; 10Euro TCO_2 \$13 TCO_2 37Euro TC \$48/TC.

Source: PEW Center on Global Climate Change, "The European Union Emissions Trading Scheme: Insights and Opportunities," **http://www.pewclimate.org/docUploads.**

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The program has been controversial, and the EU has instituted changes that promise to make it more effective. Some of these are: reducing the caps, reflecting the fact that too many permits were distributed at first; a shift toward a more centralized system of permit allocations, taking some of the initiative away from the individual countries; a shift to auctioning permits instead of distributing them free of charge; and an extension to other sectors, such as aviation.

Other countries have recently installed trading programs, or are planning to in the near future. These include Canada, Australia, Korea, and Japan. Emission-trading programs have also been adopted at the state and regional levels (in the United States and elsewhere), as well as voluntarily by groups of firms in the private sector.

Environmental Analysis

By **environmental analysis** we refer to the attempts to measure such things as the cost-effectiveness of particular policy actions, the **benefits** of environmental improvements, and the **benefits and costs** of alternative environmental policies and regulations. Significant progress is being made in other countries to develop techniques for measuring the social benefits of environmental improvements. Environmental economists are very active, for example, in Europe. The control of air and water pollution there is complicated by the presence of many international boundaries in a relatively small geographical area. Efforts at harmonizing environmental laws, spearheaded by the European Community, can be helped along by the accumulation of results of benefit-measurement studies. Table 18.3 shows just a few of the many studies done in other countries to estimate the benefits of environmental policies.

Environmental Policy in Transition Countries

It may be tempting to think that command economic systems would have been better than market economies in managing environmental quality issues because they involved pervasive central direction over all economic decisions. Administrative agencies, apparently with control over all the important variables, could make sure that all "externalities" were properly accounted for in production planning, and plant managers would be directed to pursue courses of action that ensured efficient levels of emissions and ambient environmental quality.

It did not work out this way, however. With the fall of the command societies and economies, it became apparent that they had been responsible for extreme environmental damages in many regions. In many places ambient air and water quality were deteriorated sufficiently to have severe impacts on human health, and some major environmental assets were seriously degraded. Exhibit 18.2 discusses a particularly egregious case, the destruction of the Aral Sea in Kazakhstan, which was formerly a part of the Soviet Union. Its source rivers were diverted during those days to irrigate cotton fields, leading to a vast drying

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TABLE 18.3 Examples of Benefit Estimation Studies Carried Out by Environmental Economists in Other Countries

Country and Study	Results
Australia[a]	
Contingent valuation (CV) study to measure willingness of people to pay (WTP) to develop biological means of fly control	$13.40/person/yr
Finland[b]	
WTP for grouse hunting, as a function of the grouse population (CV method)	
Grouse population at current level	604 FIM/person/yr
Grouse population half of current level	462 FIM/person/yr
Grouse population two times current level	786 FIM/person/yr
France[c]	
WTP to maintain more nearly constant water level in a flood control reservoir to benefit recreationists (CV method)	47 FF/person/yr
Germany[d]	
WTP to have an improvement in air quality (CV method)	75–190 DM/person/month
Israel[e]	
WTP for a 50 percent reduction in air pollution in Haifa	
Indirect means (hedonic)	$66.2/household/yr
Direct means (CV)	$25.1/household/yr
Netherlands[f]	
WTP to prevent further deterioration of the Dutch forests and heath (CV method)	22.83 DFL/person/month
Norway[g]	
WTP for improved water quality in the inner Oslo fjord (CV method)	
Users	942 NOK/household/yr
Nonusers	522 NOK/household/yr
Sweden[h]	
WTP for a reduction in the risk of getting lung cancer from radon exposure (CV method)	4300 SEK/household
United Kingdom[i]	
WTP for an improvement in river water quality (CV method)	£12.08/person/year

[a] B. Johnston, "External Benefits in Rural Research and the Question of Who Should Pay," presented to 26th Annual Conference of the Australian Agricultural Economic Society, February 9–11, 1982, University of Melbourne.
[b] V. Owaskainen, H. Savolainen, and T. Sievanen, "The Benefits of Managing Forests for Grouse Habitat: A Contingent Valuation Experiment," paper presented at Biennien Meeting of the Scandinavian Society of Forest Economics, April 10–13, 1991, Gausdal, Norway.
[c] B. Desaigues and V. Lesgards, *La Valorisation des Actifs Naturels un Example d'Application de la Method d'Evaluation Contin-gente*, Université de Bordeaux, working paper, 1991.
[d] K. Holm-Müller, H. Hansen, M. Klockman, and P. Luther, "Die Nachfrage nach Umweltqualität in der Bundesrepublik Deutschland" (The Demand for Environmental Quality in the Federal Republic of Germany), *Berichte des Umweltbunde-samtes* 4/91, Erich Schmidt Verlag, Berlin, 1991, p. 346.
[e] M. Shechter and M. Kim, "Valuation of Pollution Abatement Benefits: Direct and Indirect Measurement," *Journal of Urban Economics*, Vol. 30, 1991, pp. 133–151.
[f] J. W. van der Linden and F. H. Oosterhuis, *De maatschappelijke waardering voor de vitaliteit van bos en heide* (The Social Valuation of the Vitality of Forests and Heath), in Dutch, English summary, Publication by the Ministry of Public Housing, Physical Planning and Environmental Management, VROM 80115/3, Leidschendam, 1987, p. 46.
[g] A. Heiberg and K.-G. Him, "Use of Formal Methods in Evaluating Countermeasures of Coastal Water Pollution," In H. M. Seip and A Heiberg (eds.), *Risk Management of Chemicals in the Environment*, Plenum Press, London, 1989.
[h] J. Aakerman, *Economic Valuation of Risk Reduction: The Case of Indoor Radiation*, Stockholm School of Economics, Stockholm, Sweden, 1988, p. 65.
[i] C. H. Green and S. Tunstall, "The Evaluation of River Water Quality Improvements by the Contingent Valuation Method," *Applied Economics*, 1991, p. 23.

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The Aral Sea: Destruction and (Partial Recovery)

EXHIBIT 18.2

The Aral Sea, in central Asia, is a world famous case of ecological murder, followed recently by at least partial resurrection. It was once the world's fourth largest inland body of water, but over the last half century has been largely wiped out by human desires for rapid economic development.

In the years after the Russian Revolution, the Soviet government decided to divert the rivers feeding the Aral Sea to irrigate a vast new area of irrigated cotton production. Canal building started in earnest after WW II. As predicted, the diverted water led to the rapid drying up of the Aral. By the 1990s the surface of the Aral had shrunk by about 60 percent. The ecology of the sea and surrounding area were heavily impacted. Marine species disappeared as the sea became more salty. Fisheries were wiped out; communities that used to be on its shore were now sometimes hundreds of kilometers away; the hulls of old ships rusted on what was once the bed of the Aral Sea; exposed salt and sand beds produced dust storms and toxic winds. But cotton production boomed, and for some the death of the Aral was seen as a necessary price to pay for economic growth.

But the breakup of the Soviet Union changed things. Some of the new central Asian countries sought to undo a disaster that had been directed previously from authorities higher up.

The drying of the sea had actually split it into two sections: a northern part and a southern part. These were divided by a channel through which water ran from north to south. With the help of the World Bank, a dam was built across this channel, stopping the water from flowing from the northern part to the southern. Thus in the north the carp and sturgeon are returning, and the fishermen are back in their boats. The clouds and rain have returned. Even though only about 40 percent of the water has returned, the replenishment has restored the livelihoods of hundreds of people of Kazakhstan who historically relied on these waters for their economic support.

But in the southern part, now in Uzbekistan, the waters continue to recede, owing to irrigation water subtractions. And here the focus may be different. The Uzbek government and a consortium of international oil companies have signed a production sharing agreement to foster oil and gas development in their part of the Aral Sea. The ecology of the south is still in doubt.

Source: Based in part on Natalya Antelava, "Dam Project Aims to Save Aral Sea," BBC News, April 9, 2007, **http://news.bbc.co.uk/2/hi/asia-pacific/6538219.stm.**

of the lake. More recently, a dam has been built to replenish the northern part of the lake bed. The main reasons for this occurrence were the heavy priority given to industrial growth, the perverse incentives for managers in a command economy, and the inability of the citizenry to get information on environmental impacts and petition effectively for their amelioration.

For many of these countries environmental pollution actually improved somewhat as a result of the economic downturns experienced after the collapse of the socialist systems. As countries have tried to turn the corner in economic development, they have begun to address the need for more effective

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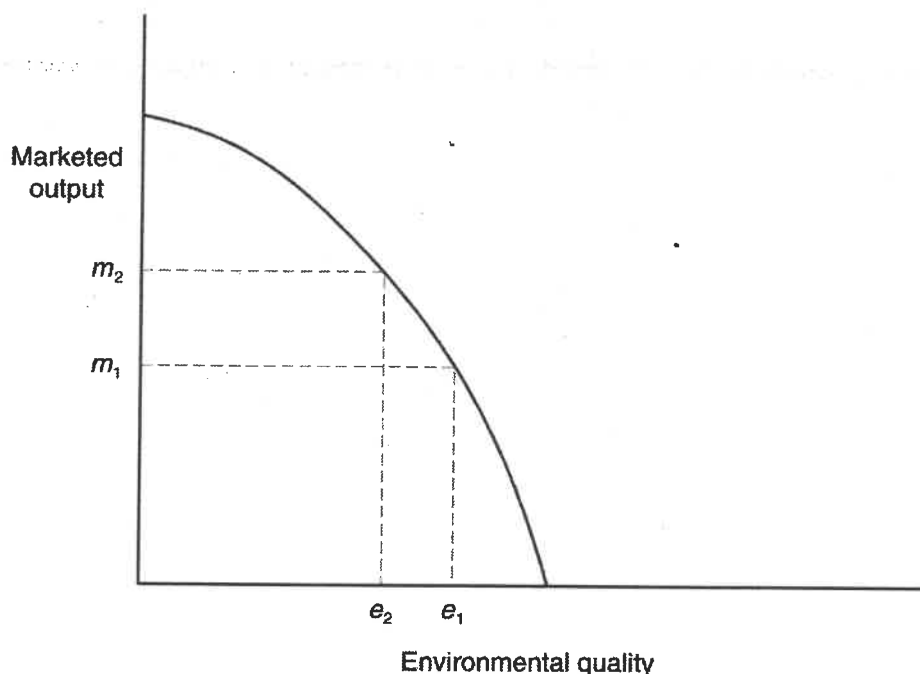
FIGURE 18.2 National Income Accounting and the Neglect of Environmental Quality



Researchers and public authorities in different countries are approaching this problem in several ways. The basic question is how to measure and treat the "quantity" $e_1 - e_2$ in Figure 18.2. Numerous countries, the United States included, have sought simply to measure annual total costs of pollution-control expenditures. The next logical step is perhaps to deduct these costs from measured output, on the grounds that they do not represent a true increase in economic welfare but expenditures necessary to protect ourselves from pollution. This procedure has been undertaken in France and Japan.

But the method of deducting pollution-control expenditures does not get directly at measuring the values of environmental quality change as represented by the distance $e_1 - e_2$ in the figure. The first step in doing this is to measure the *physical* quantities of environmental resources and changes in these quantities over time. Attempts to measure physical changes in the total resource endowments of a nation are being undertaken in several countries, notably France and Norway. The French are trying to develop a complete environmental accounting system: Les Comptes du Patrimoine Natural (natural endowment accounts), which can be used to measure physical changes in natural and environmental resources resulting from economic production and consumption. Exhibit 18.3 shows some results of a study of this type by economists at the World Bank.

To put the quantity $e_1 - e_2$ in value terms, however, requires taking the next step: to place values on the physical changes in environmental resources. Major work on this is being done in the Netherlands. The objective is to put monetary values on the various dimensions of environmental degradation, including

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Green Accounting

EXHIBIT 18.3

If a country, in the course of producing its conventional goods and services, despoils or depletes its natural resource endowment, the normal gross domestic product (GDP) accounts will give a distorted view of its economic welfare. To account for changes in **natural capital,** it's necessary to put a value on such things as agricultural and ecologically valuable land, forests, and mineral deposits. Then if these natural assets get degraded or used up, their reduced value can be deducted from normal income measures to find true, or sustainable, measures of income and wealth.

Economists at the World Bank are pursuing a major effort to measure the values of natural capital in countries of the world, and especially to compare natural capital and its changes with other forms of capital, including **human capital** and **produced capital.** Some recent results for selected countries are shown in the accompanying tabulation. Note that in all of these countries, the bulk of total wealth consists of human capital. This is true for all but a few countries of the world.

Estimates of National Wealth for Selected Countries, 2005 Dollars

	Total Wealth* per Capita	Wealth Components: Produced, Capital Plus Urban Land	Human Resources	Natural Resources
		($1,000, 2005)		
Australia	537.0	111.6	385.4	40.0
Bangladesh	7.2	1.0	4.8	1.4
Chile	103.8	19.3	65.7	18.8
China	18.9	6.0	8.9	4.0
Egypt	21.3	2.8	13.8	4.7
France	583.9	93.6	481.7	8.6
India	10.7	2.0	6.0	2.7
Mexico	134.4	21.3	106.5	6.6
Turkey	116.9	13.4	97.9	5.6
United States	741.0	100.0	627.2	13.8

*Excludes net foreign assets.
Source: World Bank, *The Changing Wealth of Nations, Measuring Sustainable Development in the New Millennium*, Washington, D.C., 2011, pp. 174–180.

the reduced value of resources and the damages from pollution. A valuation approach like this also is being undertaken by the United Nations.

We are just at the beginning of efforts to incorporate environmental values into national income accounts. The conceptual and measurement problems are very difficult, and it will be some time before acceptable procedures can be developed and believable numbers estimated. But if it is successful, this work could have a profound impact on public policy decisions.

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Summary

In many other industrialized countries, major pollution-control efforts started in the decade of the 1970s, as they did in the United States. Policy in different countries is pursued through means that are congenial to the political culture and institutional history of each one. For the most part, pollution-control efforts have relied on various command-and-control approaches involving standards of various types. In many European countries, emission charges have been widely used, but historically these have been primarily to raise revenues, which then can be used to subsidize pollution-control efforts. In the future, these could perhaps easily be transformed into incentive taxes with a primary pollution-control objective.

Environmental standards may be set at the national level (as in, e.g., Germany, Italy, and the United States) or at the local level (as in France and England). But their *enforcement* tends to be very local, involving "bargaining" between emitters and local officials—not bargaining in the formal sense, but give-and-take between these parties as to what courses of action are to be undertaken by different sources to control emissions.

The large-scale environmental degradation of the ex-socialist countries bears an instructive lesson for pollution control in all countries. The initial reaction to environmental pollution is to think that it comes about because authorities lack the necessary means of control to bring about emission reductions. But in the ex-socialist countries, authorities presumably had total control and environmental damages have still been massive. This points up the importance of having open political systems, readily available information on what the state of the environment really is, and incentive systems that lead polluters to internalize the damages their emissions produce.

Questions for Further Discussion

1. If two (or more) countries are shown to have the same (total) quantity of emissions, does this mean that they are equally close to the efficient level of emissions for each one?
2. Explain the polluter pays principle. How would this apply to the control of nonpoint-source emissions?
3. Consider the "European" approach to emission charges. For a single source, is it possible that a low emissions charge could produce enough revenues to pay for all of the abatement costs required to reduce this source's emissions to an efficient level? What factors affect this? (Hint: You will want to explore this with the help of our standard emission-control model.)
4. What factors determine whether it would be more effective to proceed against polluters by hammering them in court or by sitting down with them to try to work things out on a "reasonable" basis?
5. Explain what is meant by "greening the national income accounts."

For additional readings and Web sites pertaining to the material in this chapter, see **www.mhhe.com/field6e.**