

**Air Pollution**

1. Suppose you're a state official charged with reducing sulfur dioxide (SO<sub>2</sub>) emissions from a group of three electric power plants. You have the following facts:
  - \* The marginal damage caused by a ton of SO<sub>2</sub> is \$60,000.
  - \* The three plants differ in the amount they are emitting now and in their marginal cost of abatement, as shown in the table below. None of the plants are abating emissions now.

Plant	Current Emissions	Marginal Abatement Cost
1	100	$MAC_1 = 100,000 - 1000E_1$
2	200	$MAC_2 = 300,000 - 1500E_2$
3	50	$MAC_3 = 400,000 - 3400E_3$

- a) Compute the efficient amount of abatement for each plant. What is the total cost of abatement under this scenario?
  - b) How much would it cost to get the same overall reduction by requiring the plants to cut their emissions by an equal percentage? (For example, how much would it cost if each plant cut its emissions by 40%?)
  - c) Suppose you were deciding between the policy in (b) and an emissions tax designed to achieve the outcome in (a). If you approached the three plants, which policy would they prefer? Explain. Which policy do you, as an economist, prefer? Why? If you and the plants differ on which policy is better, what might you do? (That is, could you use a different policy or modify the tax in some way to make it more appealing to the firms?)
2. In the 1990 Clean Air Act Amendments, Congress and the EPA rely on the automobile industry to develop a "cleaner" automobile. At the same time, the government imposes a relatively minor federal tax on gasoline.
    - a) Do you see any problem with the implicit signals the federal government is sending to the American auto manufacturer and to American car drivers through these policies? Briefly comment.
    - b) Formulate a hypothetical economic policy to motivate auto manufacturers to advance the technology of cleaner motor vehicles.
  3. New source bias may exist for either stationary or mobile sources. Select one of these, and briefly discuss why this bias leads to a solution that is *not* cost-effective. What policies would you implement to eliminate this bias?
  4. Some EPA officials began wondering aloud in 1989 whether it was really worthwhile to control ozone as stringently as the Clean Air Act requires. The ozone standard was set at a level that would prevent any adverse health effects on people who exercise in an area with high ozone concentrations.
    - a) Is there any scientific way to decide whether the benefits from a stringent ozone standard are greater than its costs?
    - b) According to a *New York Times* article of April 3, 1989, 51 percent of the annual emissions of volatile organic compounds that produce ozone at ground level come from the operation of motor vehicles. So we could protect our health either by prohibiting so much driving or by exercising less in those urban areas where, on a few days in the year, ozone levels exceed the standard. Which is the more efficient way to protect our health?
    - c) Industrial solvents create 4 percent of the emissions and household solvents create 5 percent of them. If we pass legislation to reduce the use of solvents, is the legislation more likely to restrict industrial or household use? Would a restriction on industrial use show that people are more important than profits?
  5. Suppose that engineers invented an accurate and reliable means of monitoring and measuring the emissions from individual automobiles throughout the year. What possibilities would this open up for new types of mobile-source emission control programs?

## Global Environment

6. What are the major greenhouse gases, and what are their sources of emissions?
7. What are the costs and benefits of global warming? What controversy surrounds the Stern Report's calculation of the net present value of the social costs of global warming?
8. Rather than placing a tax on fuels or the carbon content of fuels, taxes might be put on fuel-using items, such as "gas-guzzling" cars, less efficient appliances, or houses with poor insulation. Which type of tax would be more efficient?
9. Global warming is predicted to affect countries differently, which is one reason it is difficult to get all countries to agree on a global CO<sub>2</sub> treaty. Do you think it will be easier to get agreement *after* the results start showing up in different countries?
10. What are the economic forces that lead to extinction? What are the costs and benefits of preserving biodiversity?
11. The Pacific yew tree has a chemical that can be used to treat cancer, but there are a limited number of trees, and the tree must grow for many decades before it produces the chemical. How would you allocate the trees between current cancer patients, future cancer patients, and leaving the trees in their natural state?
12. Imagine you're responsible for managing the number of species of large mammals (wolves, bears, elk, etc.) in a national park and you have collected the following information:
  - Each visitor's benefit from  $Q$  species is given by  $B = 100Q - 2Q^2$ . (Note: this is each visitor's *benefit*, not marginal benefit. To find the marginal benefit, take the first derivative of  $B$  with respect to  $Q$ .)
  - There are exactly 1 million visitors to the park and their use of the park is non-rival.
  - The marginal cost of protecting species is zero for the first 15 species. After 15 species the cost rises by 4 million dollars with each species. In other words, the marginal cost is zero until  $Q$  hits 15, after which it is given by  $MC = \$4M (Q - 15)$ .
  - There are initially 30 species.
  - a) Find the efficient number of species to preserve. Show all your work and explain the key steps as clearly as you can.
  - b) Now suppose that this biodiversity provides external benefits to a large group of people who never visit the park. How large would the external benefit *per species* have to be in order to make it worthwhile to preserve all of the species?