

Problem Set 2, part 4

Introduction to Environmental and Resource Economics, October 18, 2006

Due Nov. 1

1. You are the head of the pollution control agency in charge of regulating emissions of coal-fired electric generating plants in a small town in Southern Indiana along the Ohio River. There are two plants. The two plants have the following marginal abatement cost functions (MAC), where costs are in millions of dollars, and A represents the level of pollution abated in a given time period.

$$MAC_1 = 0.05A_1 \text{ (maximum abatement 250 units)} \quad (1)$$

$$MAC_2 = 0.2A_2 \text{ (maximum abatement 1000 units)} \quad (2)$$

The social costs of emissions, which include acid rain damage and mercury contamination, are given by:

$$MDC = 187.50 - 0.15A$$

where A refers to the aggregate level of abatement.

- (a) Verify that the aggregate marginal abatement cost function is $MAC = 0.04A$ (Hint: Use the same approach that you would use to construct a market supply curve.)
- (b) If you do nothing to regulate the firms, what will be the level of emissions released by each firm? (Hint: Is the firm likely to spend any money on abatement costs if it doesn't have to?) What would be the total level of emissions?
- (c) What is the efficient level of total abatement? Graphically illustrate this solution.
- (d) How much abatement should be achieved by each firm, given your answer for total abatement from above?
- (e) What value of a tax on emissions would achieve the efficient level of abatement by each firm? Explain using one of the firm's marginal abatement costs how this tax would operate. Explain how the tax could achieve both allocative and cost efficiency.
- (f) A typical problem when regulating pollution is that the individual firms' marginal abatement costs are not known. Assuming now that you don't know these costs, you decide to allow each firm to emit half of the level of pollution found above. Would this be an efficient allocation of pollution? Explain and illustrate graphically. (Hint: Focus on the equimarginal principle of optimality.)
- (g) If there were a uniform emissions allocation, what is the potential for bargaining or emissions trades between the two firms? Explain, using a numerical example to demonstrate the gain from trade.

- (h) Briefly discuss the difference between allocative efficiency and cost efficiency. Need they occur together in general? If we want to achieve maximum social welfare, what implication must hold for both allocative and cost efficiency?
2. Suppose that there are two firms that each emit 20 units of pollution, and that the regulating authorities want to reduce this level to a total of 20 units between the two firms. They decide to initially allocate 10 permits to each firm, which allow 1 unit of emissions per permit. Firm 1's cost functions are given by:

$$TAC_1 = 10 + \frac{3}{4}A_1^2 \quad (3)$$

$$MAC_1 = \frac{3}{2}A_1 \quad (4)$$

Firm 2's costs are given by:

$$TAC_2 = 5 + \frac{1}{2}A_2^2 \quad (5)$$

$$MAC_2 = A_2 \quad (6)$$

- (a) Find the equilibrium level of abatement for each firm after trading and a permit price which will achieve this solution. Note that a unique permit price cannot be determined, but there is a range of possible prices.
- (b) Calculate the total cost savings from the trading program, relative to the equal permit allocation.
3. 20 points.

Read the three recent articles on carbon markets and Kyoto posted on webCT. Answer the following two questions (and add any other thoughts that you might have):

The new agreement signed between CA and the NE will allow trading between different geographic regions. To what extent might this lead to the potential for "hot spots" (see Hackett), or to the potential to otherwise increase spatial inequality, as mentioned by the Sierra Club? *This one for the creative geographers:* Can you think of ways to refine the rules of the market to address these potential problems?

OK, three questions: The NYT editorial argues that there is a need for increased "value for carbon" in order to create economic opportunities for developing countries and industry. How might the new agreement help create that value? Explain in terms of standards (the cap) and trading opportunities.