14.23   Spring 2003   Problem Set 4   (Due Class #21)

1. Suppose there are two electricity-generating plants which emit sulfur dioxide emissions. The environmental goal is to reduce SO2 emissions by two tons from current levels. Plant 1 can reduce SO2 emissions at a cost of $60 per ton. Plant 2 can reduce SO2 emissions at a cost of $300 per ton.

(a) The.command and control. approach to achieving the environmental goal of a two ton reduction would be to mandate that each plant reduce emissions by one ton. What is the cost of the command and control. approach?

(b) A tradable permits approach to achieving the environmental goal of a two ton reduction is to issue to each plant permits equal to the plant's current emissions minus one. Suppose the price of a permit is equal to $75. What is the cost of the tradable permits approach? How much does Plant 1 reduce emissions by? How much does Plant 2 reduce emissions by?

(c) Under which approach is total abatement cost lower? Demonstrate under which approach Plant 1 is better off. Demonstrate under which approach Plant 2 is better off.

2. Suppose that a fossil fuel-generating plant discharges sulfur dioxide (SO2) into the atmosphere when it burns coal to generate electricity. SO2 emissions from fossil fuel-fired electric utilities are the main precursor of acid rain. In addition, high atmosphere concentrations of SO2 have long been thought to have adverse effects on human health. It would cost the plant $4 million to install a.scrubber. (a pollution abatement device) to completely eliminate the SO2 emissions. The harm caused by the emissions to the residents of the surrounding community is $10 million (i.e. that would be the maximum willingness to pay for the residents to prevent the emissions).

You can assume SO2 is the only harmful effect of coal-burning, that both parties have equal bargaining power, and that the firm's profits under status quo are $50 million.

(a) If the residents are assigned property rights to the air, what will be the predicted outcome and the dollar transfer between the parties?
(b) If the firm is assigned the right to pollute, what will be the predicted outcome and the dollar transfer between the two parties?

(c) Suppose we do not know precisely the dollar value of the health benefits from eliminating SO2 pollution from electric utilities. How would you estimate it? Would you err on the side of over-estimation or under-estimation? Why?

(d) The Clean Air Act forbids the EPA from considering cost considerations when setting air pollution standards. What are some reasons why this is this a reasonable mandate? What are some reasons why this is an unreasonable mandate?

(e) Now assume that instead of completely eliminating SO2 emissions, the scrubber can only eliminate "almost all" of it, causing the residents harm equivalent to $0.1 million. How, if at all, does this modification in technology affect the answers to part a) and b)?

3. Suppose a two-stage cool world in which global warming may happen at stage 2 with probability q. In a cool world, the value of undeveloped land is 5, and the value of developed land is 10. In a warm world, the value of developed land is still 10, but the value of undeveloped land is 50. People may develop land at stage 1 or stage 2, but once developed, land cannot be undeveloped. Development is .all or nothing., there cannot be development on only part of the land. The total payoff is the sum of the payoff in stage 1 (5 or 10), and the payoff in stage 2 (5, 10, or 50), so there is no discounting. People (acting as one) maximize the expected total payoff.

(a) If the people choose development now, what are the payoffs at stage 1, in a warm world, and in a cool future (stage 2) world? What is the total expected payoff at stage 1?

(b) If there is no development now, what is the payoff at stage 1? What will happen in a warm world at stage 2, and what will the payoff be? In a cool world? What is the total expected payoff at stage 2?

(c) Under what circumstances will development occur now?

(d) Suppose now that, once land has not been developed, it never can be. Thus if the people choose not to develop at stage 1, then it cannot at stage 2 if the world turns out to be cool. What is the expected total payoff if both development and lack of development are irreversible decisions?

(e) What is the value to the human race of the option to develop at stage 2 if it doesn't at stage 1?

(f) Comment in a few sentences on what effect, if any, the irreversibility of development may have on environmental regulation decisions.