DIS Environmental Economics — The Acid Rain Prevention Game

Suppose that there are **six** fossil-fuel power plants operating in the Upper Peninsula of Michigan and contributing to acid rain throughout the Eastern Seaboard of the U.S. and Canada.. You will be randomly assigned to one of six teams (Teams 1–6) representing the owners of the six plants: your role in the game is to act in your own company's best *financial* interests, given its MAC curve.

All six power plants emit lots of sulfur dioxide, but some emit more than others under BAU conditions: specifically, three of the six plants emit 2000 tons of SO_2 per year, while the other three emit 4000 tons/year. What is more, all six of the plants have distinct marginal abatement cost (MAC) curves. The MAC functions and BAU emission levels of the six plants are as follows:

Plant owners	BAU emissions level	MAC function (in thousands of dollars)
Team 1	2000 tons	MAC(E) = 4000 – 2E
Team 2	2000 tons	MAC(E) = 8000 – 4E
Team 3	2000 tons	MAC(E) = 10000 – 5E
Team 4	4000 tons	MAC(E) = 4000 – E
Team 5	4000 tons	MAC(E) = 8000 – 2E
Team 6	4000 tons	MAC(E) = 10000 – 2.5E
Total	*18000* tons	

Part 1: A Command-and-Control Scenario

Assume that the Michigan House of Representatives has introduced a uniform emissions standard of **1480 tons** of SO_2 per firm per year in order to reduce sulfur dioxide pollution and the acid rain it leads to.

Your first task is to figure out the amount of SO_2 your team needs to abate each year—and how much it will cost to do so. Once you've done that, please send a representative up to me at the computer at the front of the room. I will then generate a class-wide Excel file in order to calculate the total abatement amount and total abatement cost generated by this standard for the entire industry.

Part 2: A Simplified "ARP" Scenario

In this scenario, the Michigan House of Representatives (here played by me!) has granted each of the six firms 1480 "emission permits," each authorizing the emission of one (1) ton of SO_2. It then facilitates the buying and selling of these permits at zero transaction costs.

More specifically, I will make a series of announcements—each time announcing that permits may be bought and sold at a different price, and then keeping track of how each of the six firms react. My first two announcements are fixed: $1,000,000 per permit (way too low) and $4,000,000 per permit (way too high). After that, it's up to us as a group to try out other prices, until we arrive at the magical price at which the market "clears," i.e., the price at which there are buyers for every permit that is up for sale, and there are enough permits up for sale to satisfy all of the buyers.

Once the market has cleared, each firm will calculate the number of permits they have bought or sold, the amount they have abated, and the total cost of all of this activity (abatement + trading). Each firm will then send a representative up to me at the computer. I will then plug the numbers into our class-wide Excel file, in order to calculate the industry-wide abatement and net total cost.

Part 3: What the Heck Just Happened?

We will now, all together, analyze what this game reveals.

1. Together, we will graph all six MAC curves.
2. Then we will add a vertical line to the graph to illustrate the uniform standard used in Part 1, and ask about its cost-effectiveness.
3. We will then consider how the graph allows us to predict the six firms' behavior in Part 2: who bought permits, who sold them, and why.
4. We will then zero in on how abatement costs changed in Part 2 relative to Part 1, both for your individual firms and for the industry as a whole. How do you feel about your firm's fate during Part 2?