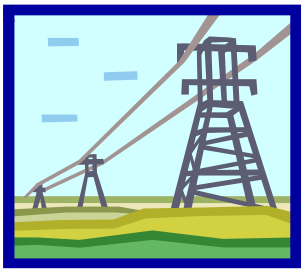
Auction of Pollution Permits

Game Rules

- **You will be a firm owner and see how to react to your government pollution restriction policy.**
- **You class will be divided into 10 groups.**
- **Each group represents an electricity company.**



- Many industries produce pollution. In order to have a better environment, governments usually make laws to restrict the amount of pollution. How should governments distribute the right to pollute? How firms will react to the restriction?

Game Rules

- **Initially, every company has a right to produce 5 Megawatts of electricity every year.**

- **The market value of 1 Megawatt of electricity is $1,000,000.**

Produce 1 Megawatts of electricity

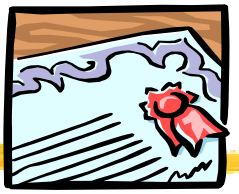
↓

Emits 100 tons of sulfur dioxide (SO_2)

Game Rules

- Now, government wants to cut down the emission of pollution to 60%.
- In other words, these 10 companies can only produce 30 Megawatts of electricity each year in total.

Game Rules



- **Government will issue 30 permits. Each permit for 1 Megawatt of electricity production.**
- **Firstly, government will allocate 2 permits to each company.**
- **Government will auction off 10 permits left. All companies can bid for them.**

Game Rules

- Even without permits, firms can still produce electricity if firms use pollution abatement equipment to reduce SO2.

- Besides, government allows firms to resell their permits, which is forbidden in the past.

Game Rules

- **You will have 5 minutes to study your firm's information & decide what you should do after getting 2 free permits.**
- **Then you will have an auction held by the government. You can bid for more permits to produce electricity if you find it is worthy to do so.**
- **After the official auction, all firms can buy and sell your permits among yourselves.**
- **After all, calculate the profit earned.**

- I will randomly give you some information of a company which will be your group's firm. The information includes your firm's marginal cost and marginal revenue of producing electricity (in Megawatt) and the marginal cost of using pollution abatement equipment. (Table 1 shows Companies' information. There are five sets of information. Each set will be distributed to two firms.)
- Give 5 minutes for students to study their firm's information. Calculating MR – MC can help them to know how to make decision in order to earn as high profit as they can. The first two MR – MC are the first two marginal profits earned by having two free permits to produce the first two Megawatts of electricity. Hence, the value of the first two permits for a firm is at least equal to the corresponding MR – MC. In order to decide how much firms should bid for the third permit, firms should firstly compare the MR – MC and the marginal cost of pollution abatement equipment. If marginal cost of pollution abatement equipment is lower, use this as the maximum value (the highest bidding price) of the third permit for the firm; if MR – MC is higher, use this as the maximum value (the highest bidding price) of the third permit for the firm. Some firms may find that they would like to bid for more than one permit in the official auction. However, some firms (Company D1 and D2) may find that it is more profitable to sell their free permits to others rather than producing the first two Megawatts of electricity themselves. Thus, they may sell their permits in the private market. The minimum price should be the marginal profit of the first two Megawatts of electricity.
- I will give you a worksheet to record your profit. Make record on your

Official Auction Rules

- **Permits will be sold 1 by 1.**
- **The upset price of each permit is 5 million dollars. Each time you raise your hand, the price will be 1 million higher.**
- **Each firm should find 1 person as a representative to raise hand.**
- **The auction will last for at most 15 minutes even not all permits can be sold off.**

Let’s get start !

Market Transaction

- **You have 10 minutes to resell or buy permits among yourselves.**

- **If your transaction succeeds, buyer should come out and tell teacher your Company name, the Company name of your seller and your buying price.**

- (After the auction) You can resell or buy permits among yourselves. I will give you some blank A4 papers and makers. If you want to sell your permits, please write down your selling price on the A4 paper and then hold it up to let all other firms read it. Buyers can go to the sellers and bargain with them if you want. If your transaction succeeds, buyer should come out and tell me your Company name, the Company name of your seller and your buying price, so I can record it on Table 3. You will have at most 10 minutes to resell or buy permits among yourselves.
- (After 10 minutes) T: Before discussion, let's finish by calculating your total profits. See which firm can earn the highest profit.

Discussion

- **Which firms bought permits in the official auction? Why did you do so?**
- **Which firms bought permits from other electricity companies? Why did you do so?**
- **Which firms sold permits to other electricity companies? Why did you do so?**
- **Did any firms go out of business, and if so, why?**

- Did any firms go out of business, and if so, why?
  - Companies go out of business if they find that they earn more by selling all the permits to others than running the businesses themselves. Company D1 and D2 are more likely to do this.

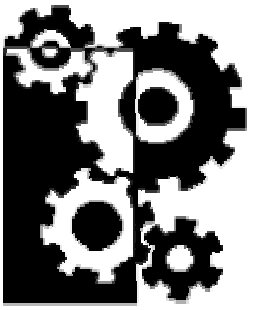
Discussion

- **If government had not used market-based approach to get the 40% pollution reduction, but only had given every company 3 permits without allowing private market for permits, what different results would have been?**
- **In term of social efficiency, which method is better? For companies themselves, which method is better?**

- If government had not used market-based approach to get the 40% pollution reduction, but only had given every company three permits without allowing private market for permits, what different results would have been? In term of social efficiency, which method is better? For companies themselves, which method is better?
  - Market-based approach is better for both companies and society. It allocates permits more efficiently. Those firms with lower production costs, that means they can produce more efficiently, and produce more under market-based approach.

Discussion

- **Do market-based pollution control methods give any incentive for firms to develop lower cost methods for pollution abatement? Do command-and-control methods provide the same incentives?**



- Do market-based pollution control methods give any incentive for firms to develop lower cost methods for pollution abatement? Do command-and-control methods provide the same incentives?
  - Only market-based pollution control methods can give incentive.

Example

- **Give examples of some events that would:**

1. **Lower the price of emission permits.**
   - ✓ **Such as an improvement in technology which reduces emissions.**

2. **Raise the price of emission permits.**
   - ✓ **Such as an increase in demand for the product being produced by the polluting firms or there is entry of new demanders, e.g. private environmental groups who wish to buy permits to reduce the total amount of pollution generated.**