

1) Suppose that the  $MD = 5E$  and with its current technology, the firm's MS is given by  $MS_1 = 200 - 5E$ .

- a) Determine the socially optimal level of emissions  $E^*$ . If the government imposes a standard equal to  $E^*$ , what is the TOTAL private and social cost?
- b) Determine the emissions tax that would achieve the socially optimal level of emissions. What is the total PRIVATE costs to the Firm?

Now suppose the firm can adopt a new technology that changes its MS to

$$MS_2 = 160 - 4E$$

Assuming no change to standard or tax rate after the change in technology, Calculate change in costs for the firm from adopting the new technology when:

- c) The government uses an emissions standard equal to your answer in (a) above
- d) The government uses an emissions tax equal to your answer in (b)

Now suppose the government adjusts the standard and/or the tax such that  $MD = \text{New MS}$ . Calculate the change in total costs for the firm from adopting the new technology when:

- e) The government adjusts the standard, and
  - f) The government adjusts the tax rate
- 2) Suppose that there are three firms in a region that are producing a common emission. The marginal abatement cost (MS) for each firm is given by:

$$MS_1 = 120 - E_1 \quad MS_2 = 96 - 0.8E_2 \quad MS_3 = 160 - 1.33E_3$$

The marginal damage function for the region is given as

$$MD = (2/3)E^T \quad \{\text{where } E^T = E_1 + E_2 + E_3\}$$

- a) Find the aggregate MS for the region.
- b) Find the socially optimal level of Emissions for the region
- c) Suppose that the government imposes a *Uniform Standard* on the three firms that achieves the socially optimal level. What will be each firm's MS and TAC?
- d) Now, instead of a standard, the government uses an Emission Tax. Find the tax rate that achieves the socially optimal level of emissions. Determine each firm's emissions, TAC, and Tax Bill. Compare the total cost to each firm from a tax policy to your answer in (c).
- e) Suppose the government decides to use a Marketable Permit program. If permits are initially given to each firm in the amount equal to the uniform standard, then:
  - i) Determine the final allocation of permits (after trading)
  - ii) What is the net cost to each firm (TAC plus/minus permit revenues/costs)
  - iii) Compare each firm's total cost under permit system to that of the uniform standard and the emission tax.