Intermediate Microeconomic
Spring 2025

Part five: Market failures

Week 9(b): Externalities

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Approach 4. Market Making

- There is a sense in which the externalities problem is due to a "missing market."
- There is no market for the good "x's effect on C2."
- As a result, the market does not properly price this good.
- If the externality problem is caused by a missing market, then creating a market for the missing good could solve the problem.
- Suppose we do that. In order for C1 to consume x, he must buy one unit of x, and one unit of "x's effect on C2."
  - In other words, he must buy one "right" for each unit of x he imposes on C2.
- (Market making is quite math-heavy, but I'll give you a flavor)

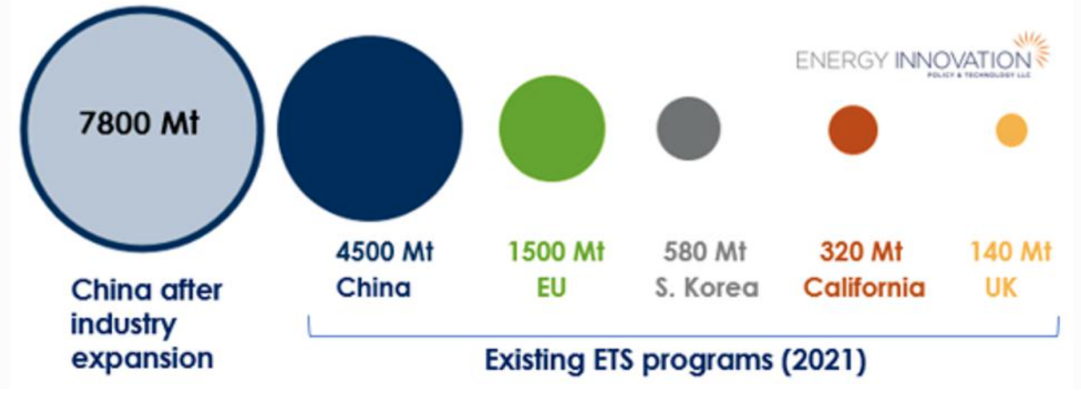
Market Making & Centralization

- The market-making approach is decentralized.
- The government creates the market (which is basically like creating a property right) and enforces the requirement that producers have permits.
- But, government does not have to know individuals actors' preferences.

China's national emission trading system (ETS) video

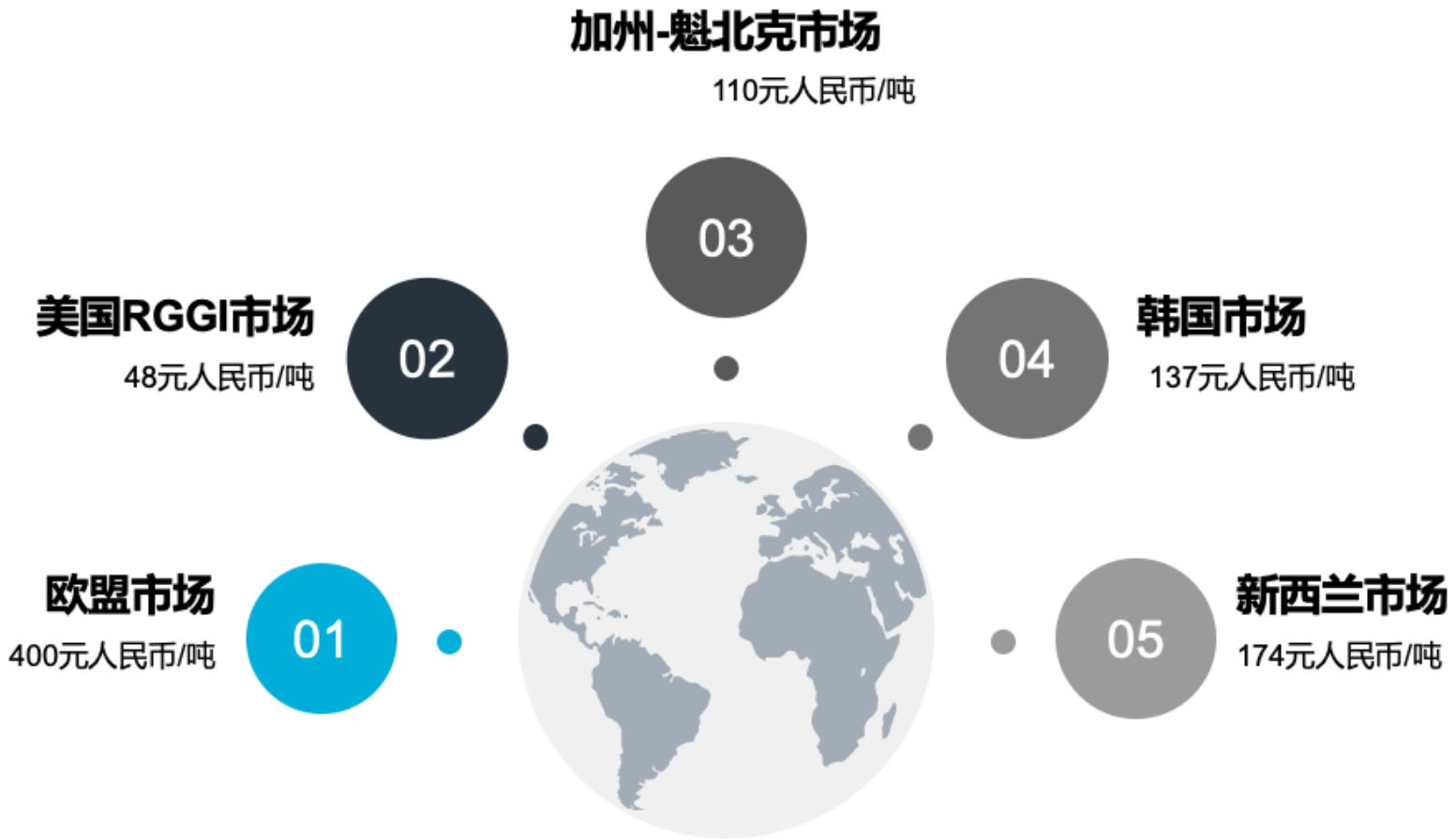
China’s new emissions trading system (ETS) is already the world’s largest carbon market, three times bigger than the EU’s.

China’s ETS is about to grow 70 percent under plans to add heavy industry and manufacturing, making it the single largest global climate policy, covering more emissions than the rest of the world’s carbon markets put together.

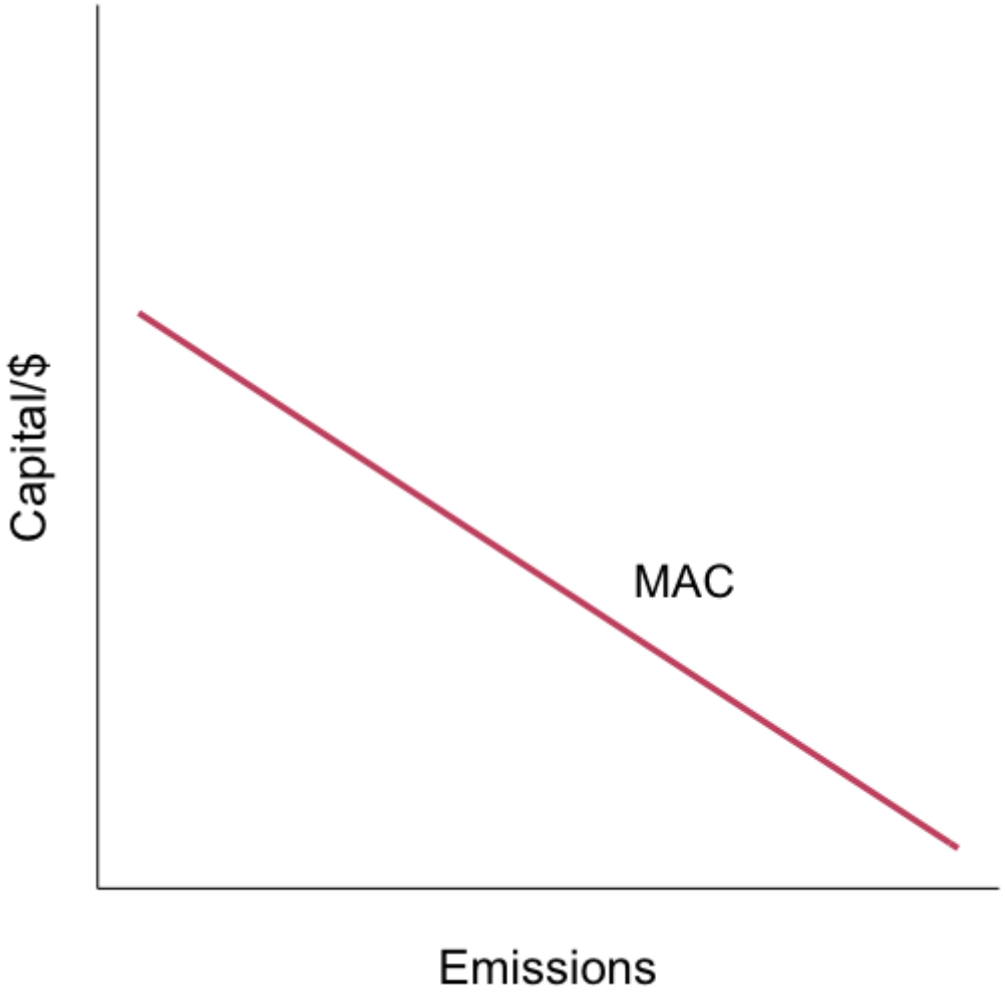


National system in 2021

全球碳市场体系现状



Setting up our model

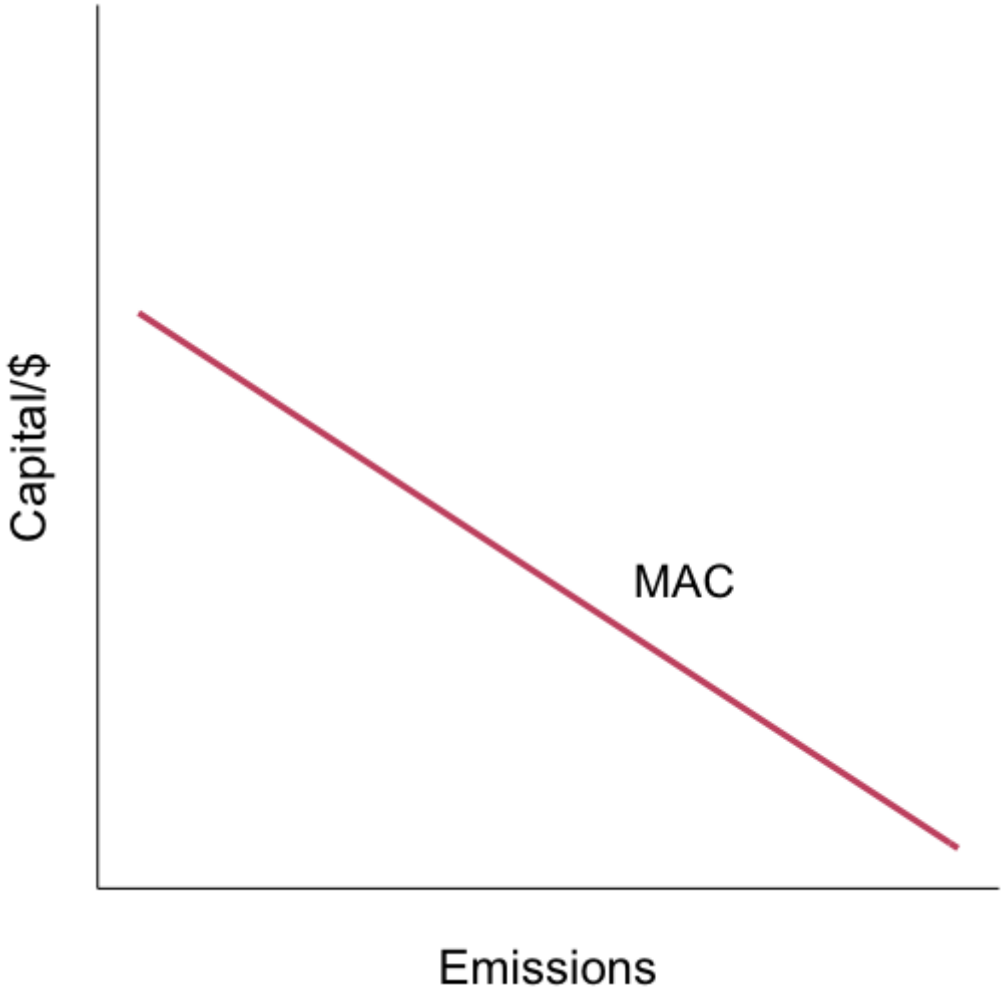


We will be working with graphs where we have cost as a function of emissions

First we have the **marginal abatement cost (MAC)** curve

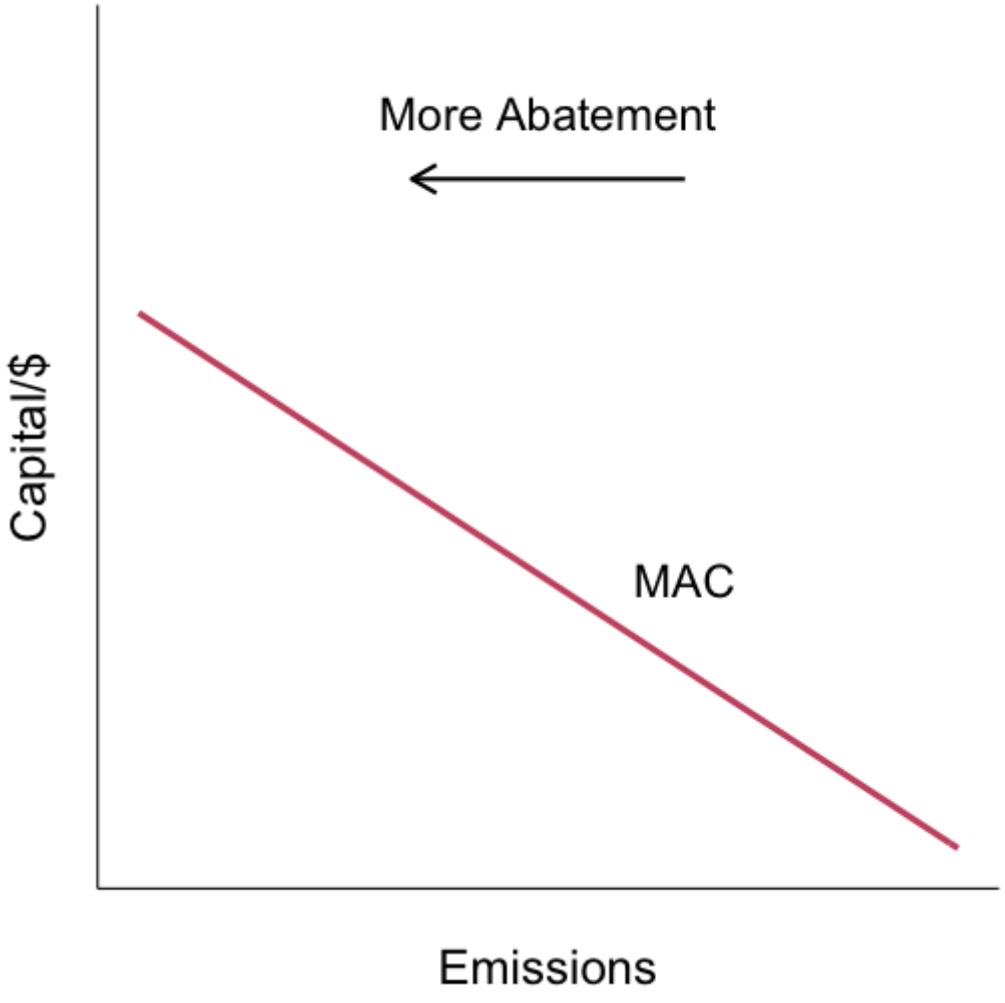
This tells us the cost of abating the next unit of emissions

Setting up our model



The MAC curve is **decreasing** in emissions

Setting up our model



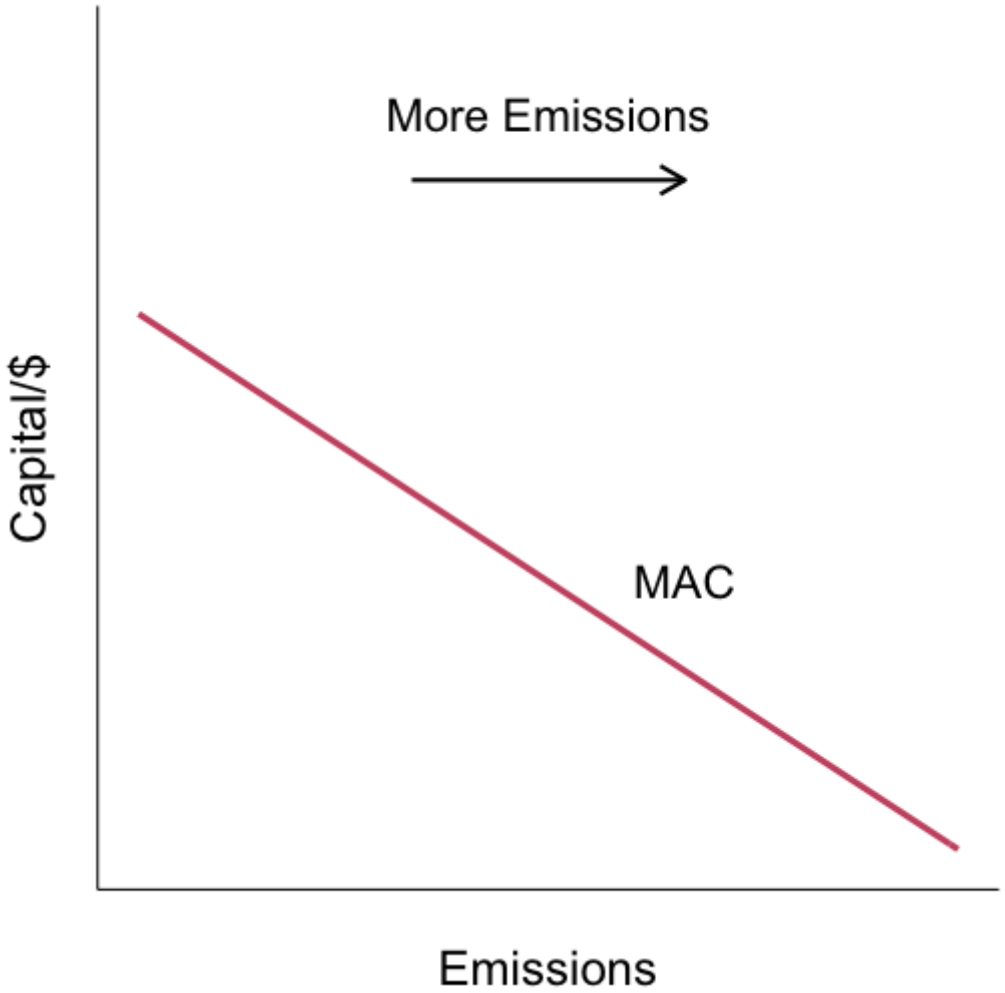
The MAC curve is **decreasing** in emissions

Abatement **increases** as you move to the left on the graph:

This raises marginal abatement cost

This means that it is more costly to reduce emissions as the level of emissions goes down

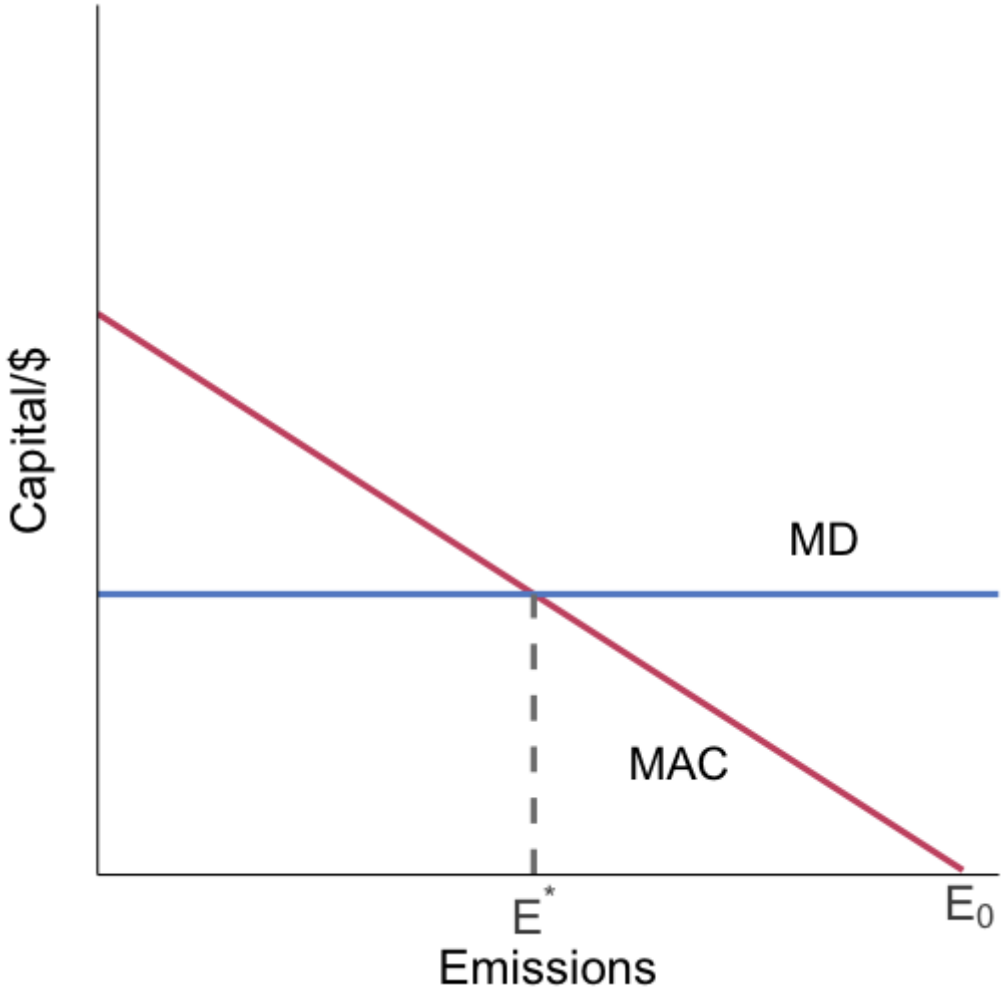
Setting up our model



Abatement decreases (emissions increase) as you move to the right on the graph

This decreases marginal abatement cost

Setting up our model

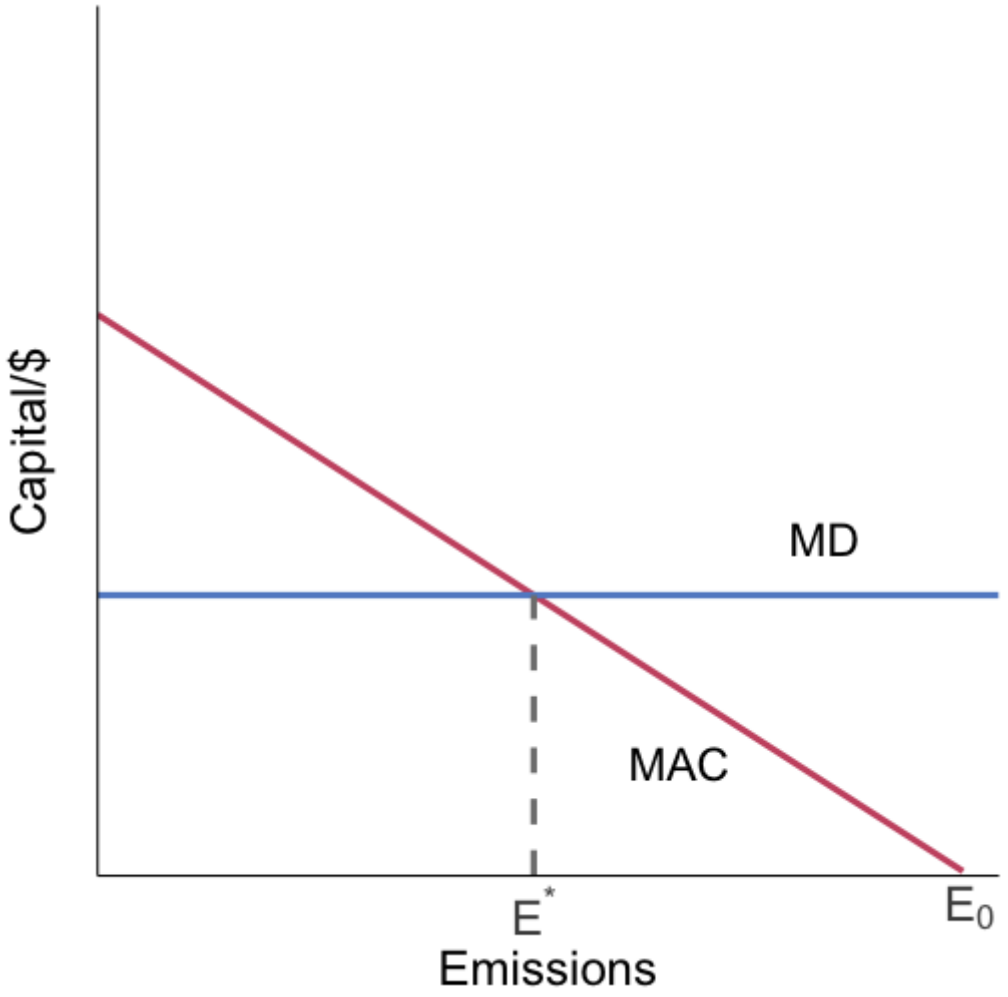


Next we have the **marginal damage (MD)** curve

This gives us the external cost of the next unit of emissions

It is also the social cost since we assume the private cost of emitting is zero

Setting up our model



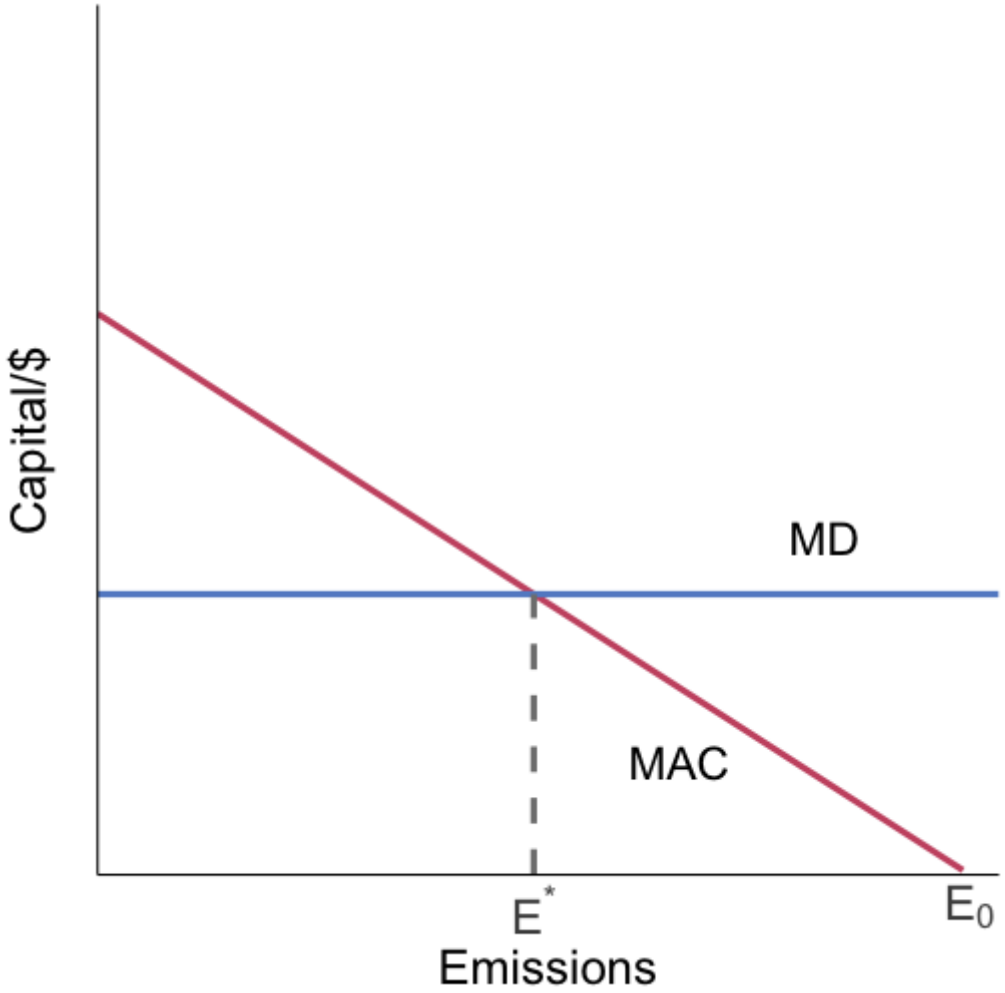
How do we think about this? One of two ways

1. MAC is the social marginal benefit of emissions, MD is the social marginal cost of emissions

2. MAC is the social marginal cost of abatement, MD is the social marginal benefit of abatement

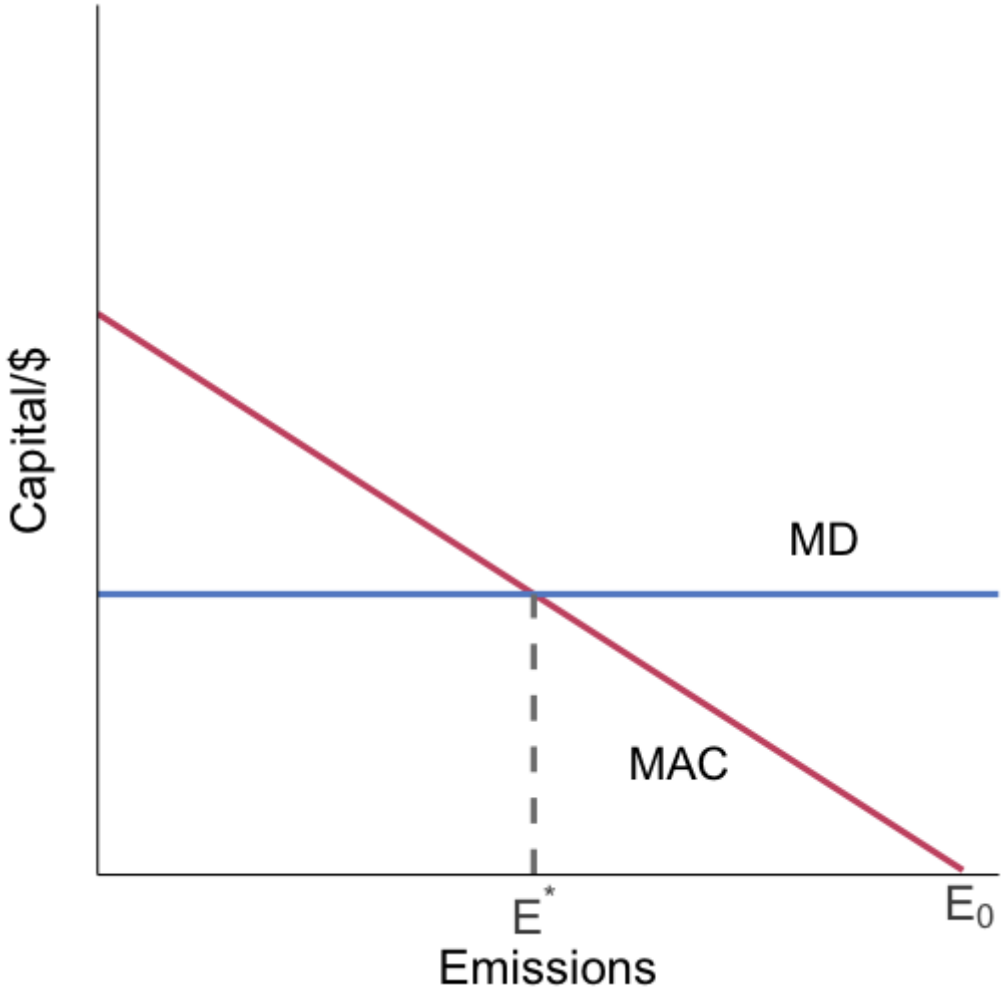
These are identical

The unregulated/free market



What is the unregulated / free market outcome?

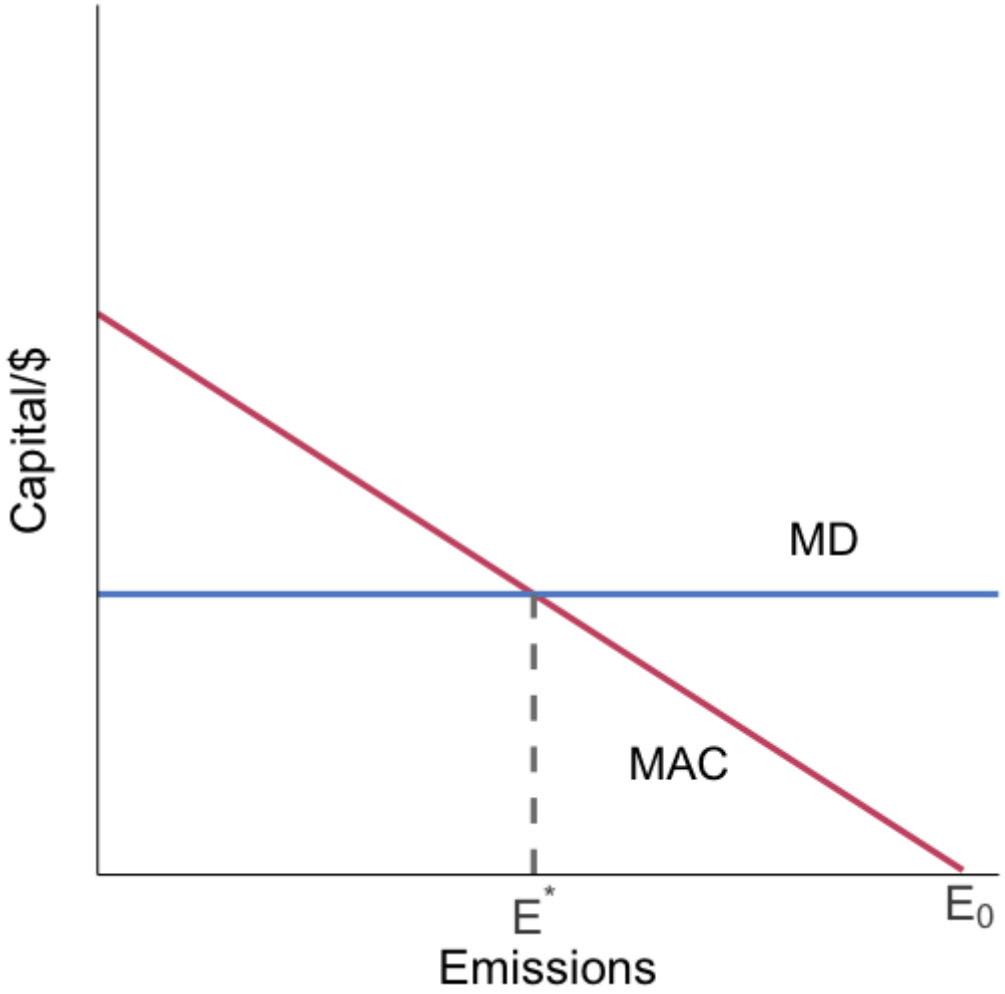
The unregulated/free market



What is the unregulated / free market outcome?

Think about the firm's problem in terms of the marginal benefits and costs of emissions

The unregulated/free market



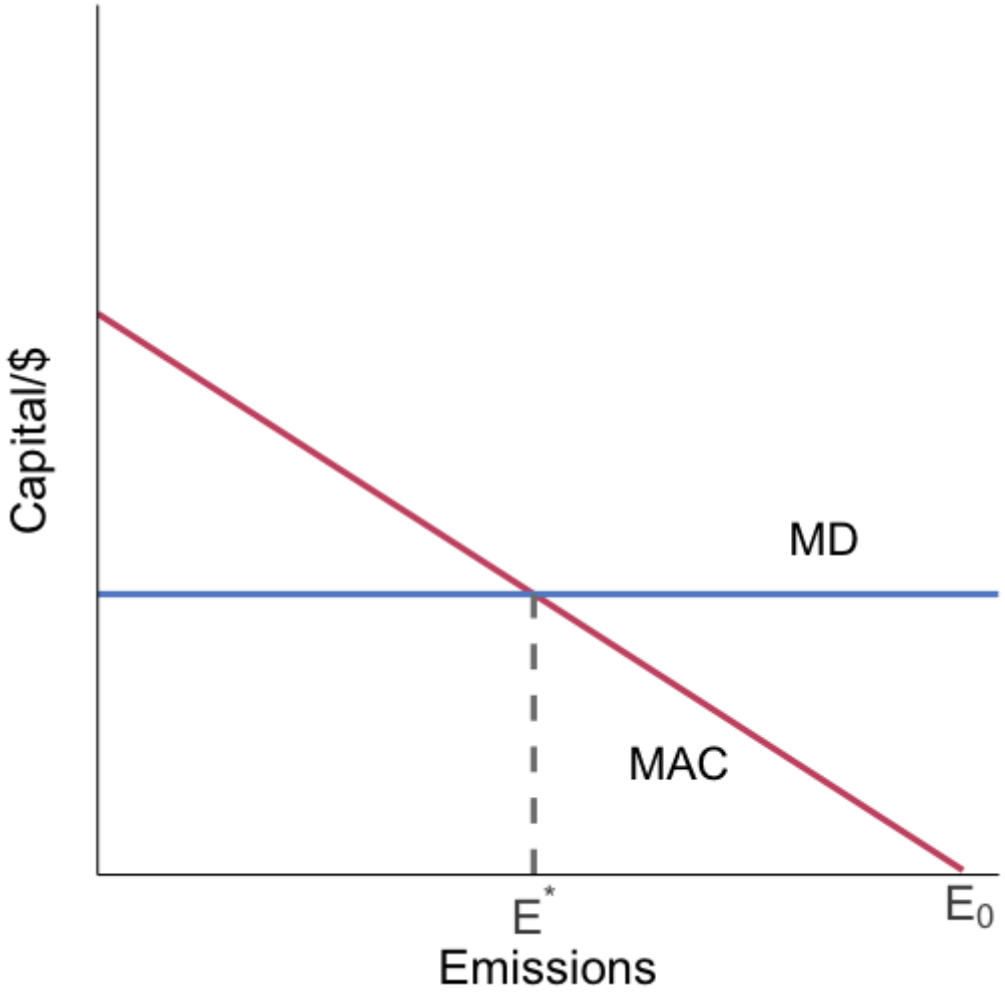
The PMB of emissions is given by the MAC (avoided abatement cost, an opportunity cost)

The PMC of emissions without regulation is....zero

So firms set emissions where: PMB=PMC $\rightarrow$ MAC = 0

Free market outcome is $E = E_0$

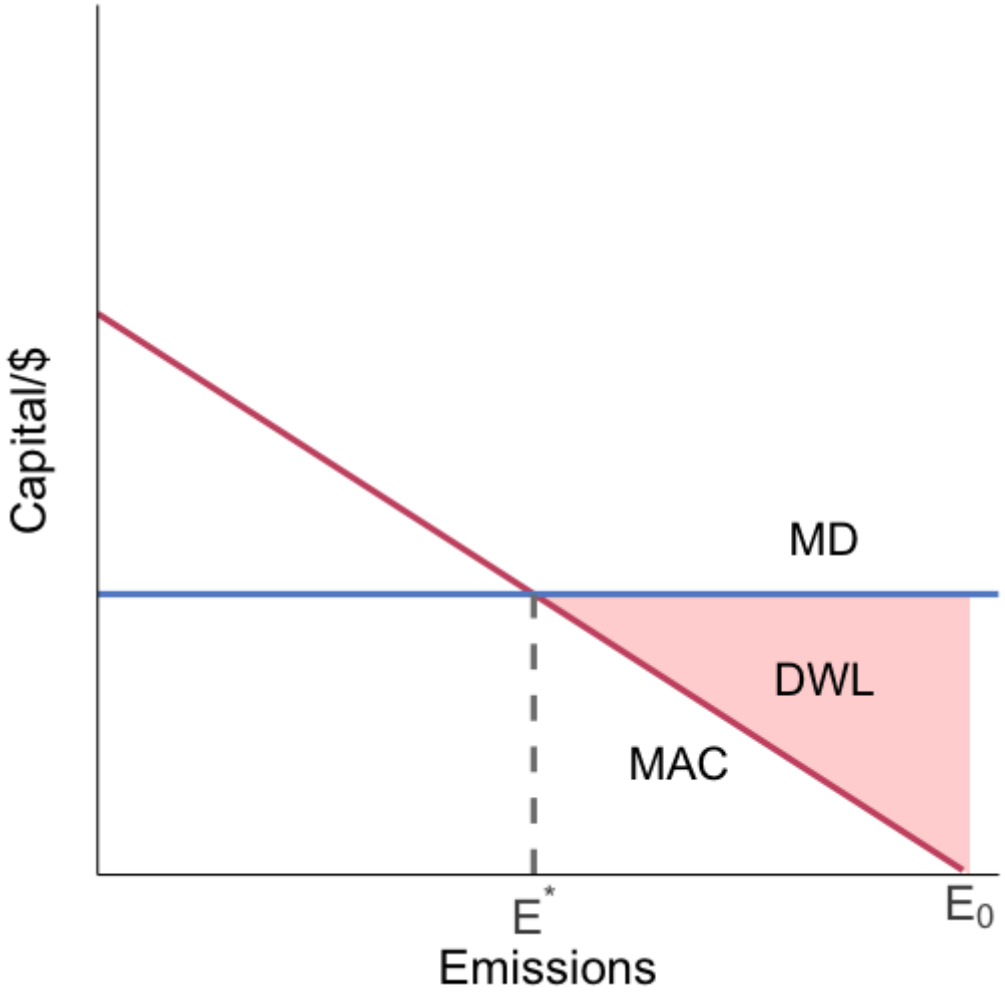
The unregulated/free market



But, if we could get all the victims of pollution together, they are willing to pay up to MD in order to get the firm to abate the pollution

The MAC for eliminating the first unit of emissions is ≈ 0

The cost of no regulation

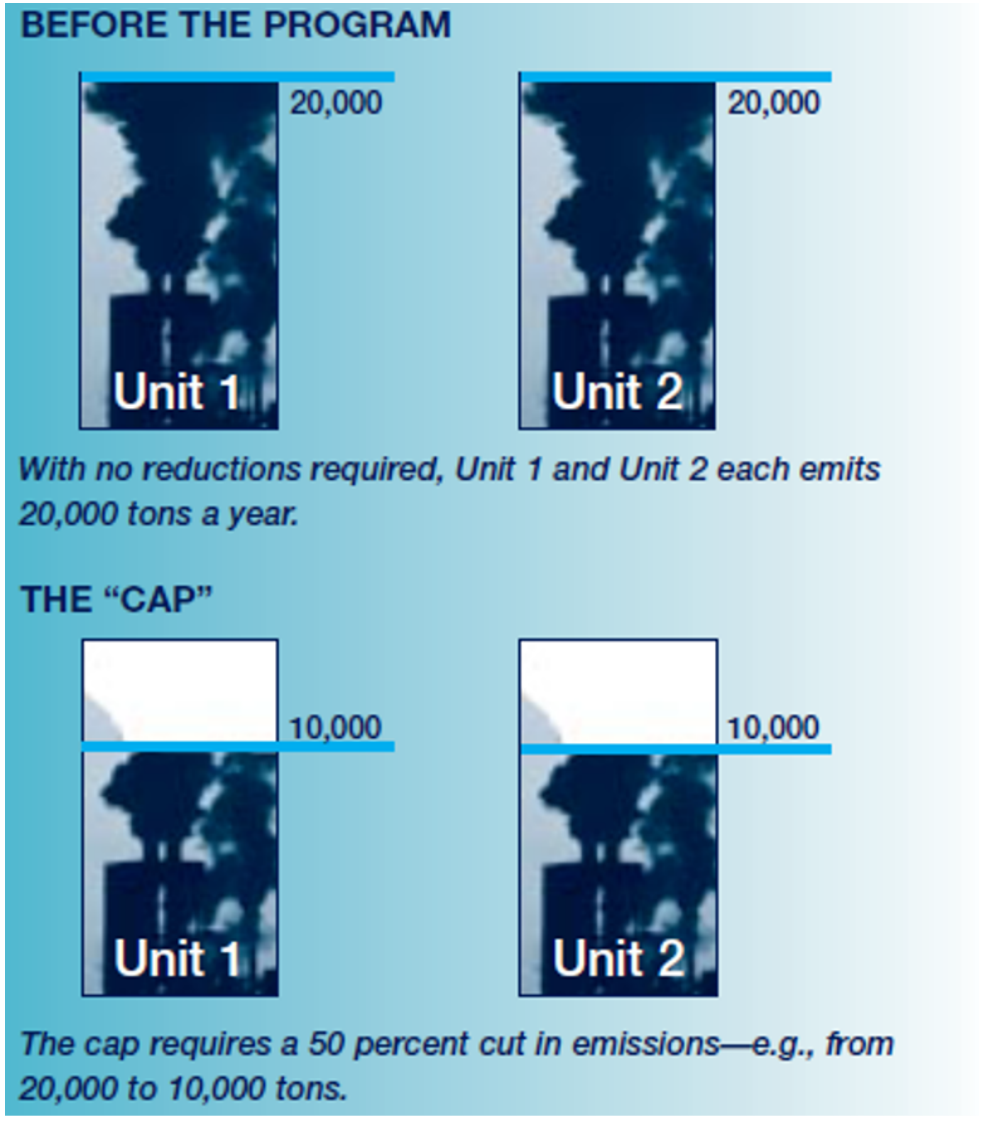


People are willing to pay to eliminate emissions until $E = E^*$

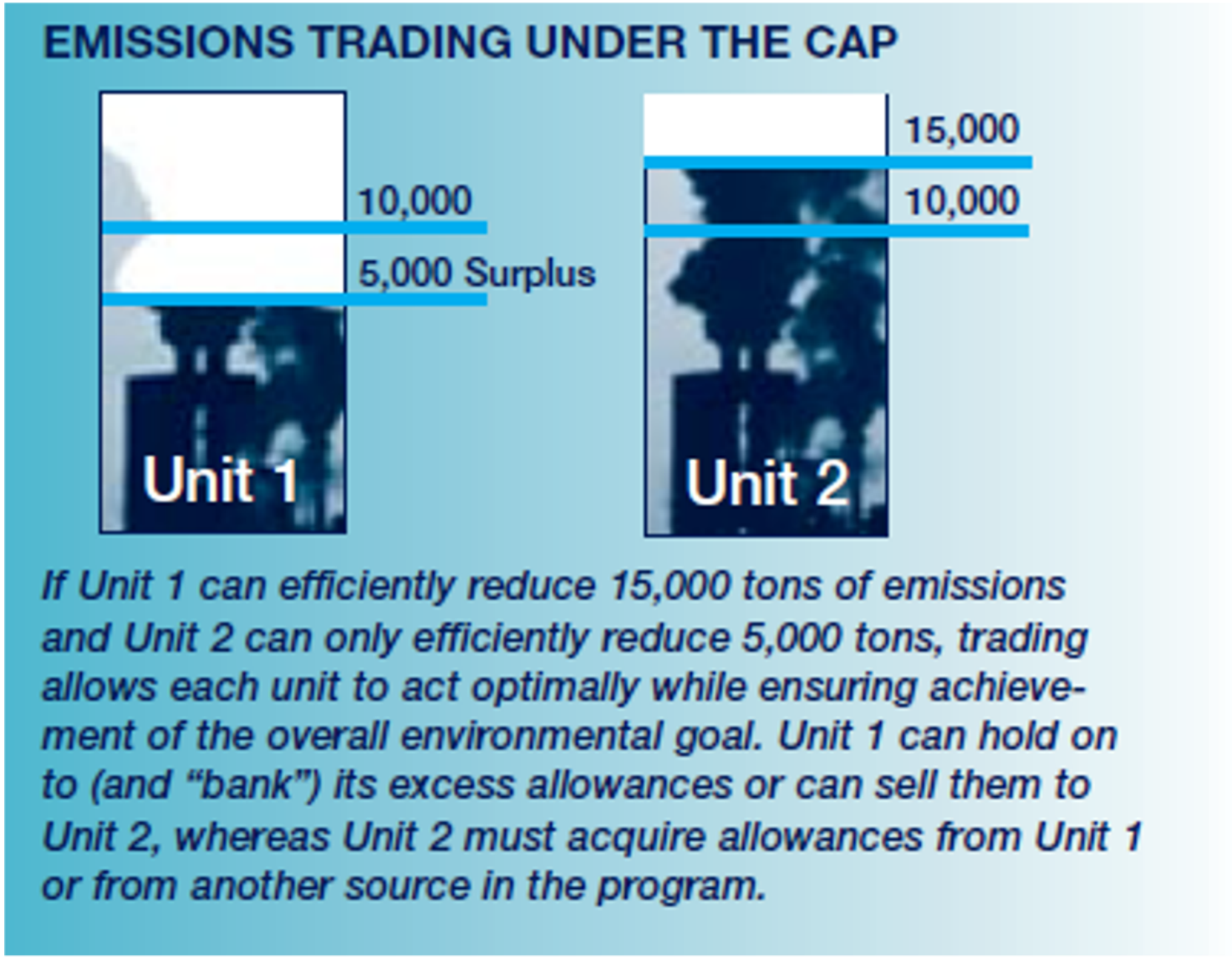
If we add up all of these potential surpluses from Pareto improving trades, we get our DWL from the externality

Tradable permits (Cap-and-Trade Program)

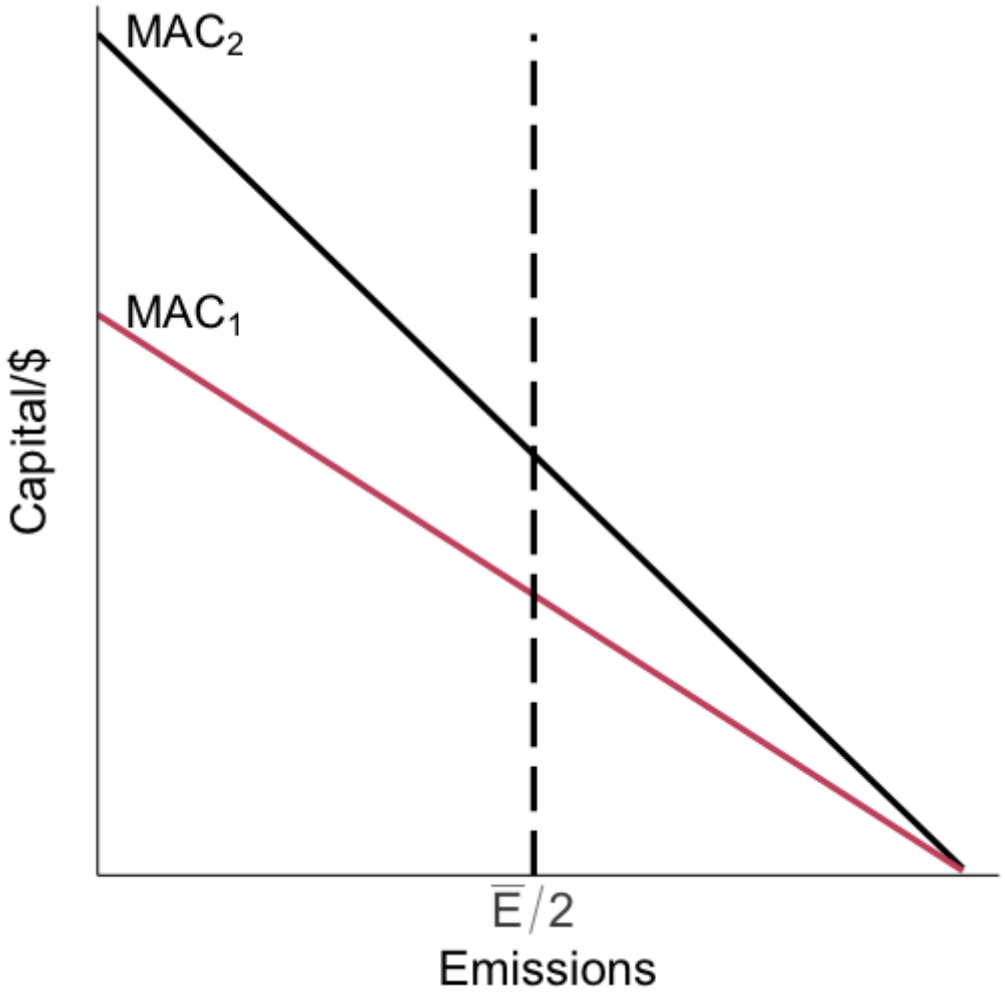
Tradable permit systems: example



Tradable permit systems: example



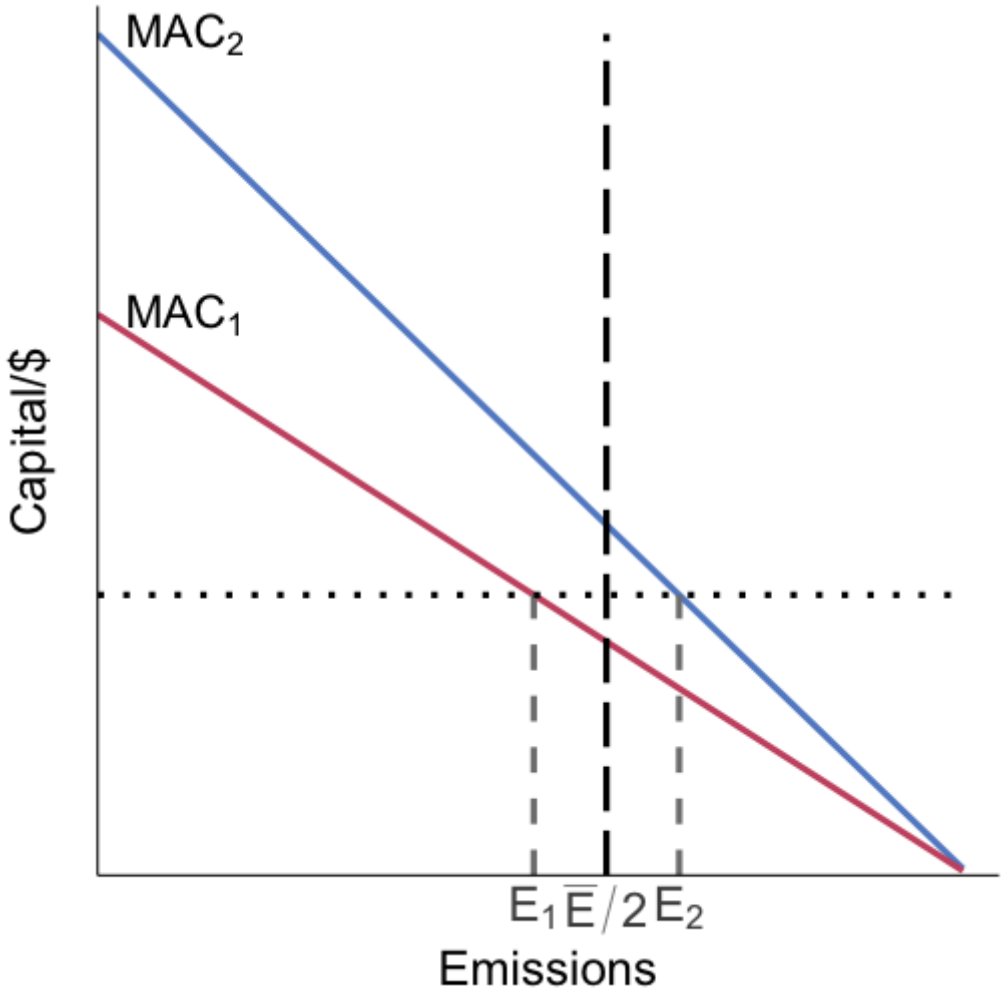
Tradable permits: graphical



Suppose we want to limit to $\bar{E}$ total emissions so each firm gets $\bar{E}/2$ permits

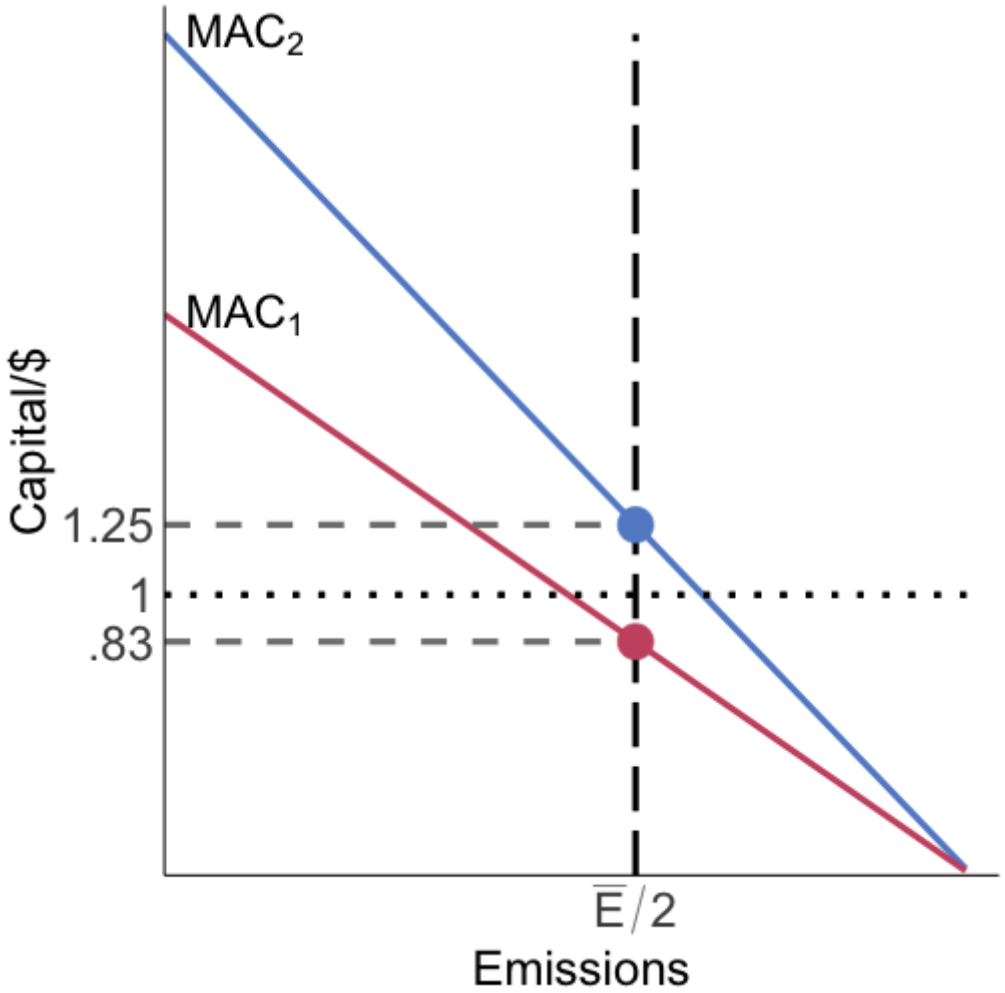
Uniform Emission Standard

Tradable permits: graphical



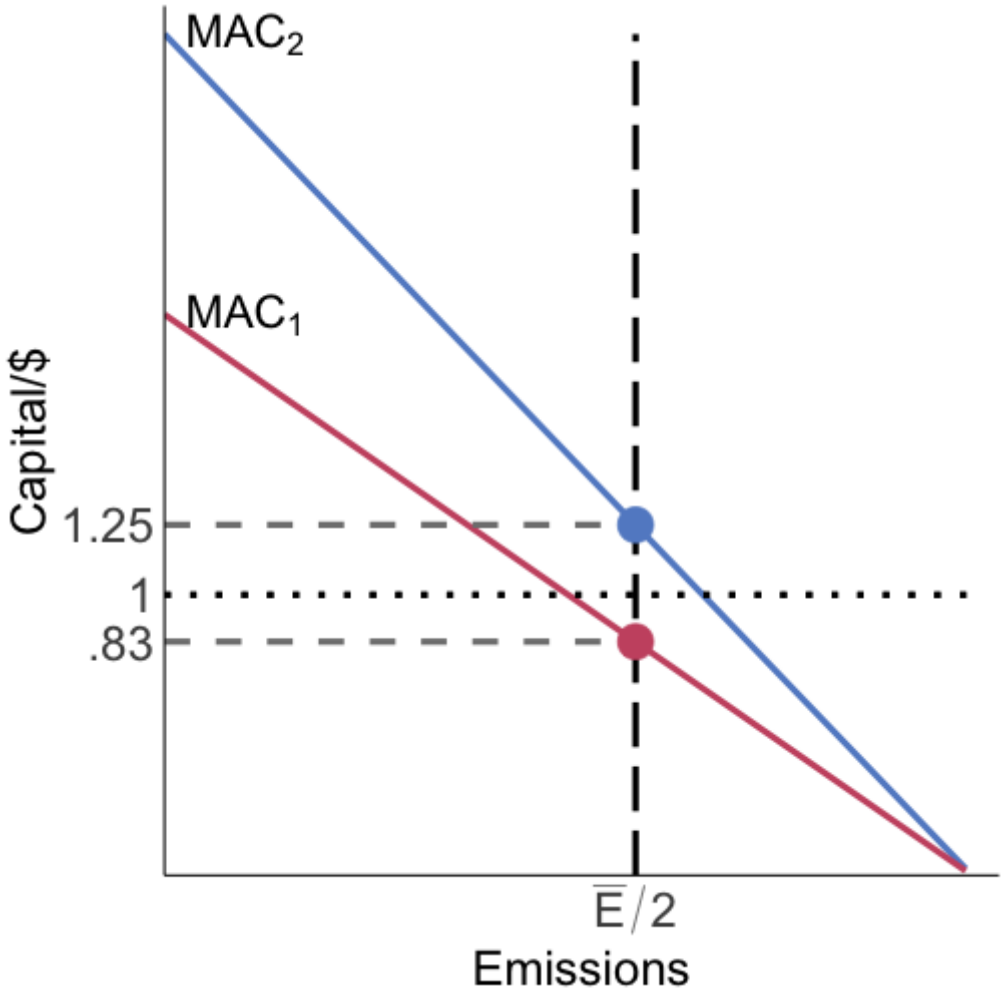
We can reduce costs by increasing emissions at high MAC firm 2 and decreasing emissions at low MAC firm 1 until they are equal

Tradable permits: graphical



We want to equalize MACs for cost-effectiveness, but does the permit market cause this to happen?

Tradable permits: graphical

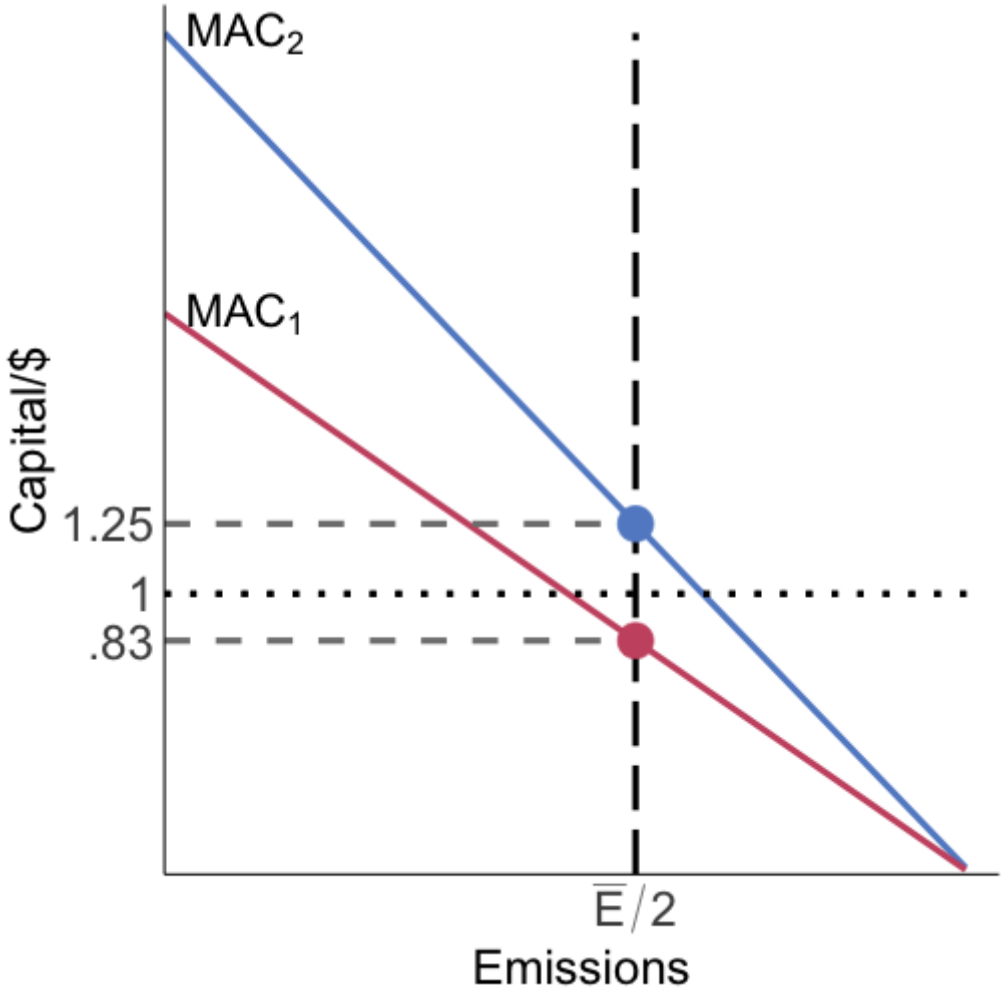


We want to equalize MACs for cost-effectiveness, but does the permit market cause this to happen?

Firm 2 is willing to pay a price up to the blue point (1.25) to be able to emit 1 more unit

Firm 1 can abate 1 more unit at cost equal to the red point (0.83)

Tradable permits: graphical



Firm 2 can buy the right to emit 1 unit of pollution from firm 1 for anywhere between 1.25 to 0.83 and **both will be better off**

These trades can be done until the MACs are equal at a value of 1

This would be the prevailing permit price in a tradable permit system

Cap-and-Trade Game

Cap-and-Trade Game

6 firms (6 groups, each representing a different firm with different cost structure)

We will conduct a series exercises

One student will come forward and report information about your firm's choices and expenditures by typing numbers into the class spread sheet on my Mac as soon as you are ready.

The first group to report gets six points toward an end-of-class prize, the second group gets five points and so on.

However, points will be deducted if your answer is wrong.

Emissions Trading Background

We describe firms only by their marginal abatement cost.

These MAC functions are given by the following equations.

The MAC for emissions greater than the initial level is always 0.

Firms differ both by amount of emissions they would choose to create in the absence of regulation, and in the marginal cost of cleaning up a unit of emissions.

Emissions Trading Background

Firm Type	MAC in Dollars	Initial Emissions Level
1	MAC = 4000 - 2E	2000
2	MAC = 8000 - 4E	2000
3	MAC = 10000 - 5E	2000
4	MAC = 4000 - E	4000
5	MAC = 8000 - 2E	4000
6	MAC = 10000 - 2.5E	4000

Scenario 1: Uniform emission standard

In this scenario, firms are subject to a uniform standard (1,480 tons emissions for each firm, in this example). You should calculate and record the abatement quantity and cost that this standard imposes on your firm.

On a piece of paper turn in the following to the professor/market facilitator:

- Your team name
- Your firm type
- Your total amount of emissions abated
- Your total cost of abatement

Scenario 2: Cap-and-Trade

Now your firm is given an initial permit allocation of 1,480 for free. The industry total is 1,480*6 permits.

For this exercise, a permit price will be called out. For that price, your firm must decide how many permits it wants to hold, and thus how many it wishes to buy or to sell. As soon as you have that figured out, n a piece of paper turn in the following to the professor/market facilitator:

- Your team name
- Your firm type
- How many permits you want to buy (negative numbers mean you want to sell)

Discussion of the tradable permit game

Scenario 1: Uniform Standard

- To calculate the total cost of abatement, you need to figure out what your final emissions are (here, E=1480 for everyone), the MAC at that level of emissions (MAC(E)), and the amount of abatement (A) associated with that level of emissions. Then calculate:

- Total cost = ½ (A)(MAC(E))

Scenario 2: Tradable Permits

- To calculate the number of permits you want to hold at a given price, set P=MAC(E) and solve for E.
- As the price moves towards equilibrium, some firms will switch between being sellers and being buyers.

More Questions

- Compare the costs under a uniform standard and under a TDP discuss what you observe.

  - Total industry abatement costs?

  - Each firm's emissions? abatement costs? permit revenue? net costs?

More questions, cont.

- What would happen to the equilibrium permit price of the initial allocation is reduced, say to 1430 permits?

- Compare the industry-wide cost of abatement and industry-wide net costs; discuss.