Cost-Benefit Analysis of Climate Policy

EES 3310/5310

Global Climate Change

Jonathan Gilligan

Class #29: Friday, April 1 2022

Announcements

Project presentations (Monday April 4)

- I have created Brightspace assignments for uploading the slides for your presentations and your reports.
  - Use Powerpoint or PDF, please
- Structure for Presentations
  - Your presentation should be 5 minutes per person.
  - Structure:
    1. Briefly describe the problem you decided to investigate and why you were interested in it.
    2. Describe what you did to investigate the question or problem
    3. Show your results (graphs or charts of your results)
    4. Briefly describe what you learned about your problem or the answer to your question.

Guidelines for presentations:

- A few guidelines:
  - Don’t put a lot of words on a slide.
  - Try to use figures (charts, illustrations, drawings, etc.) instead of words as much as you can.
  - This presentation is a brief overview.
    - You can’t tell everything you did, so focus on highlights.

Climate Casino

Considerations in Economic Policy Analysis

1. Compliance & Participation

   If you make a policy, how many people/organizations/nations will follow it?

2. Discounting

   If you have to pay the costs now, and don't get the benefits for a long time, the effective benefits are smaller.

   Imagine you're a musician and you're buying a guitar.

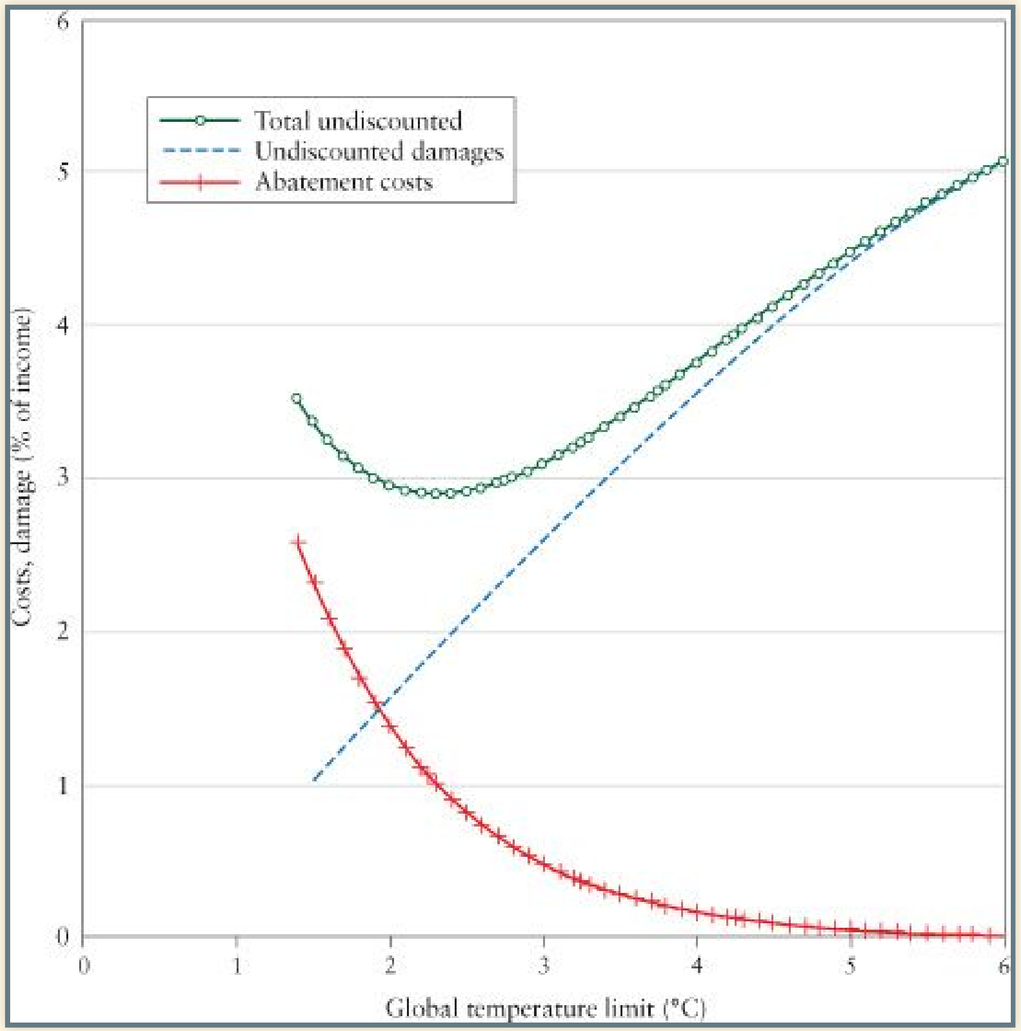
   - How much would you pay today for a guitar that you can have right away?
   - How much would you pay today for a guitar that will be delivered in six months?

   Much more detail on this next week (Fri. Apr. 8)

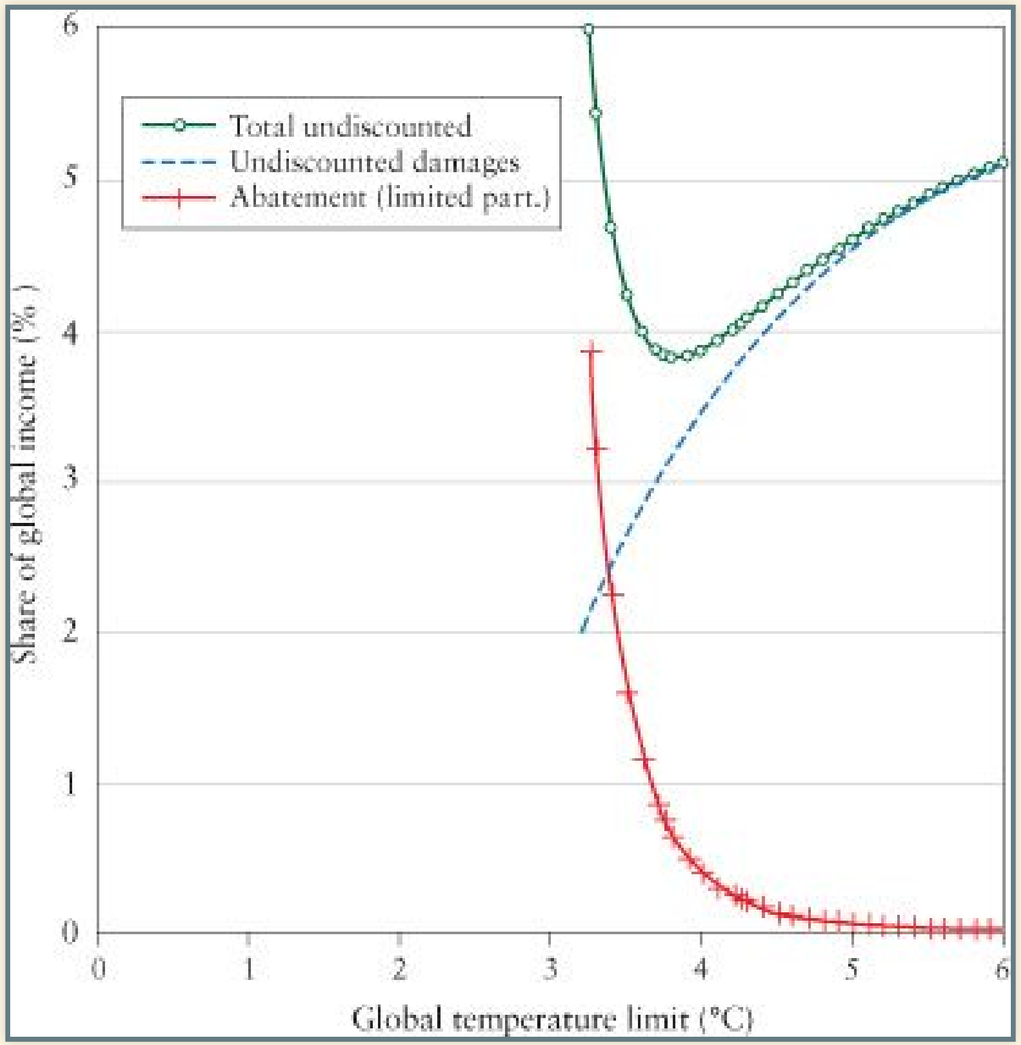
3. Tipping points

Climate Casino

Optimal Policy: 100% efficient



Inefficient: Limited Participation



Climate Casino

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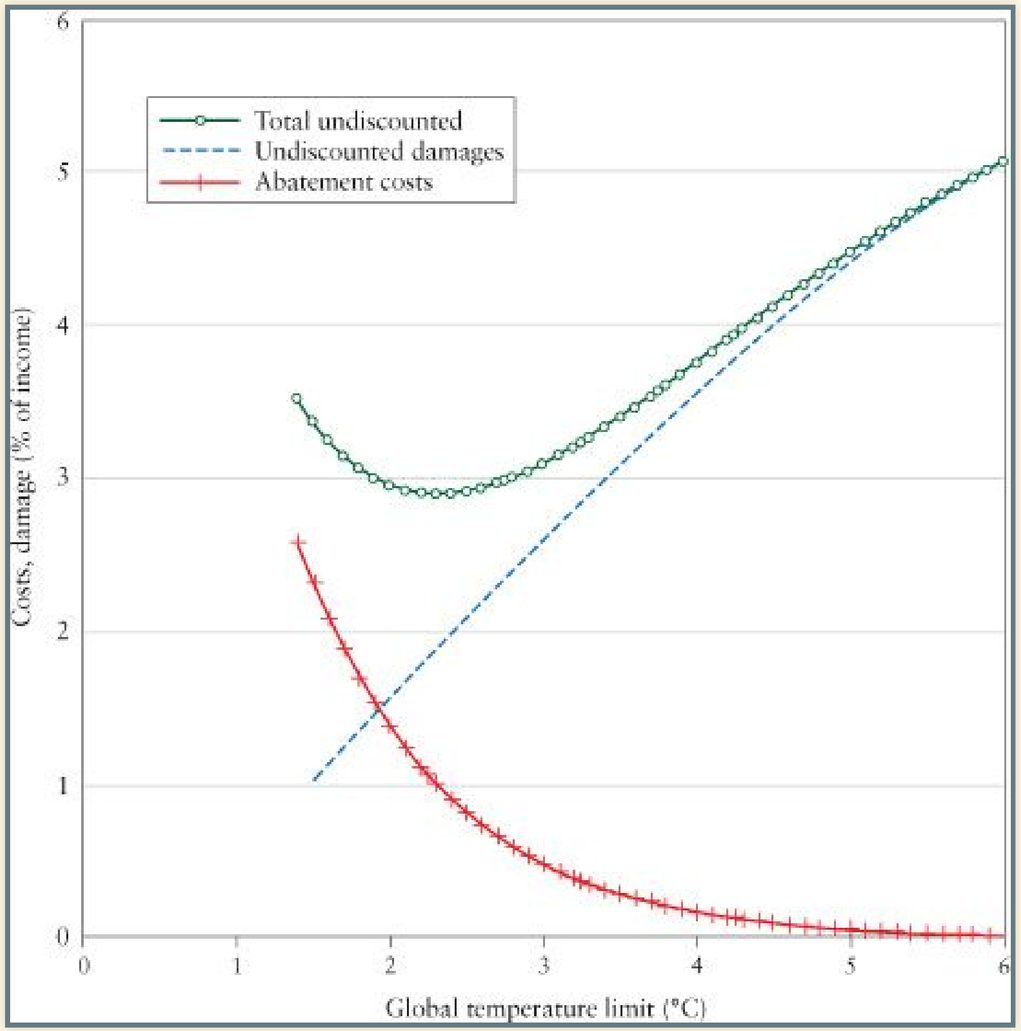
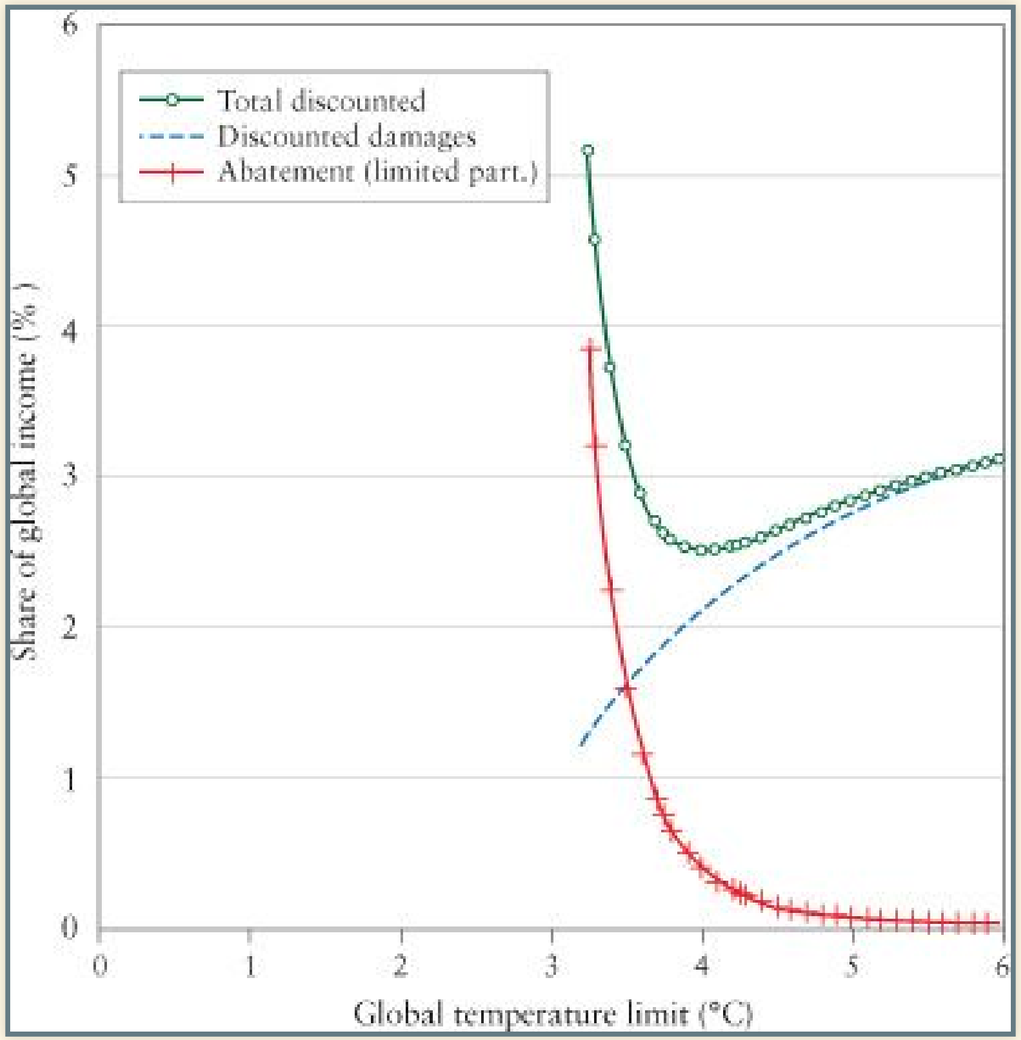
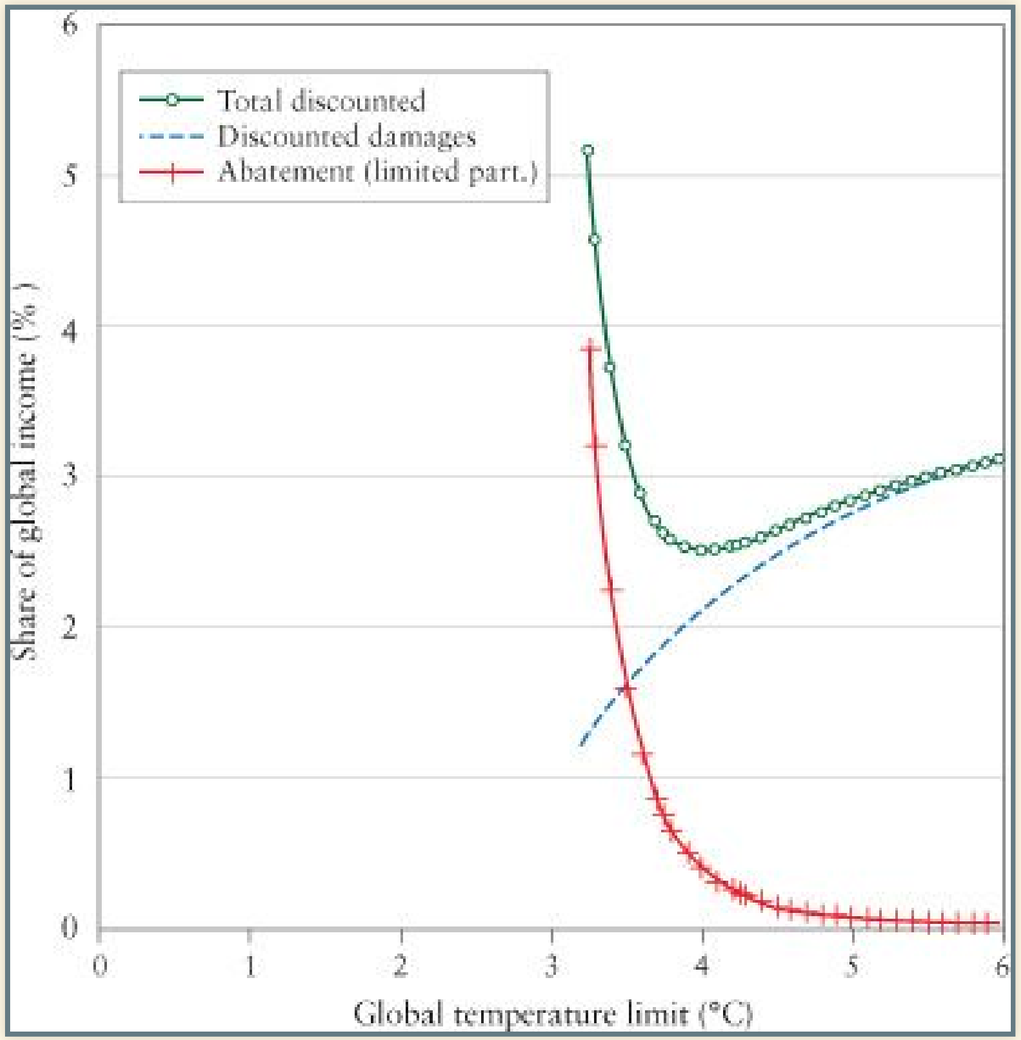


Limited Participation with Discounting

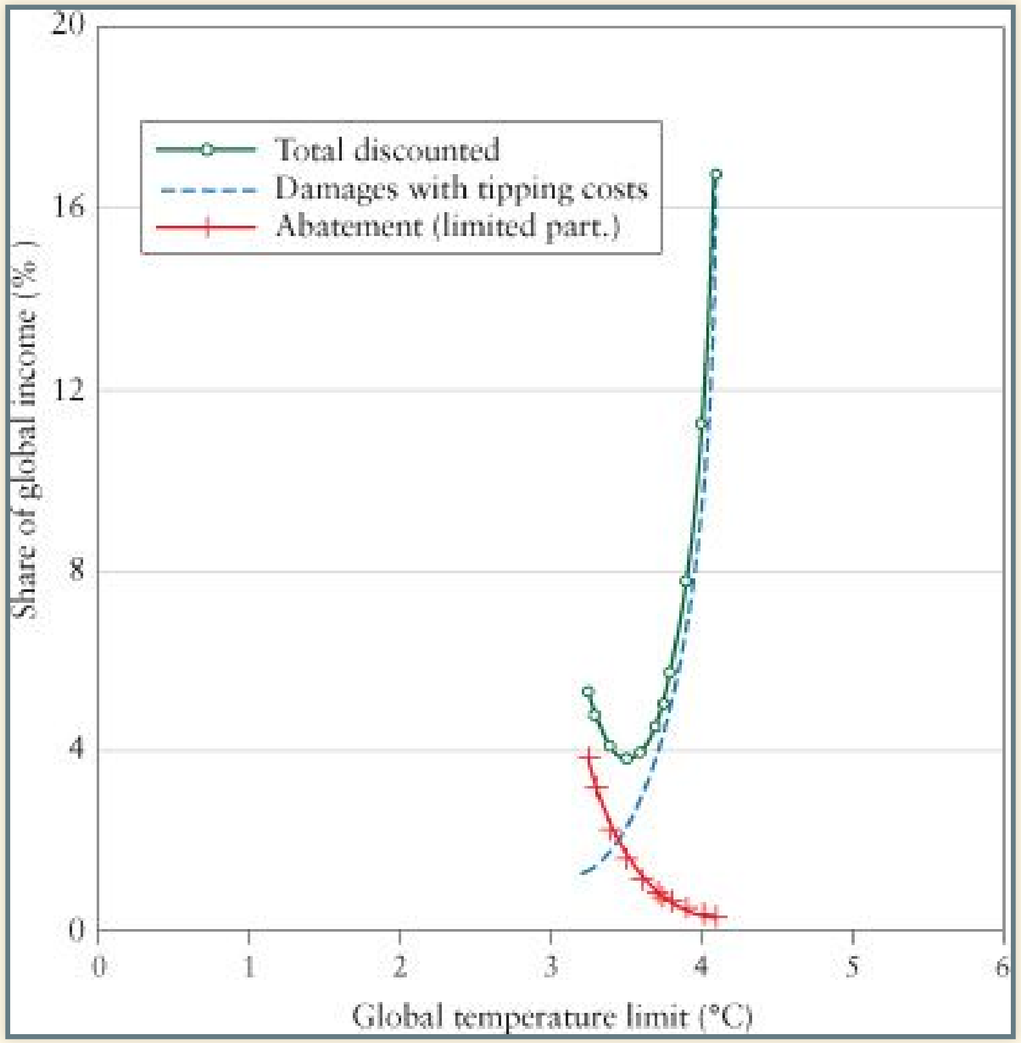


Climate Casino

Limited Participation with Discounting



Limited Participation with Discounting and Tipping Points



Summary of Principles:

- Higher damages with higher temperatures
- Higher costs of emissions abatement for lower temperature targets
- Higher costs when participation is limited and abatement is inefficient
- Lower damages when you account for discounting
- Tipping points can change everything

Microeconomics and Emissions Reduction

Technical Microeconomics

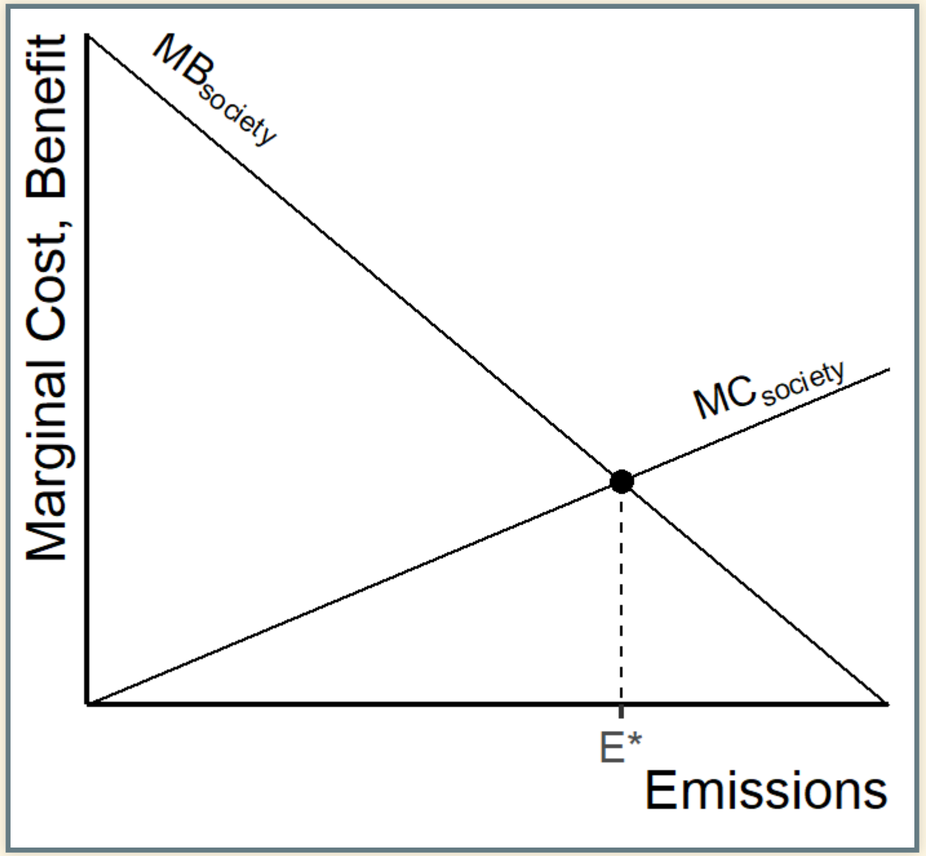
(More about this in reading for Wed. Apr. 6)

- Marginal costs:
  - The cost of the last unit produced
- Gross costs:
  - The total cost of *all* units produced
- Marginal costs and scale:
  - iPhones:
    - Billions of dollars to build the first iPhone
    - Less than $500 to build the millionth iPhone
- Production possibilities:
  - Economies of scale
    - Marginal costs fall as volume increases
  - Learning
    - The more you produce, the more you learn how to cut costs
  - Diminishing returns:
    - Marginal costs rise as volume increases
  - Takeaway: Whether costs go up or down depends on the details

Using Graphs to Avoid Math

- Costs vs. benefits for increasing CO_2 abatement
- MC = marginal cost to society of emissions (pollution)
- MB = marginal benefit of emissions (economic output)

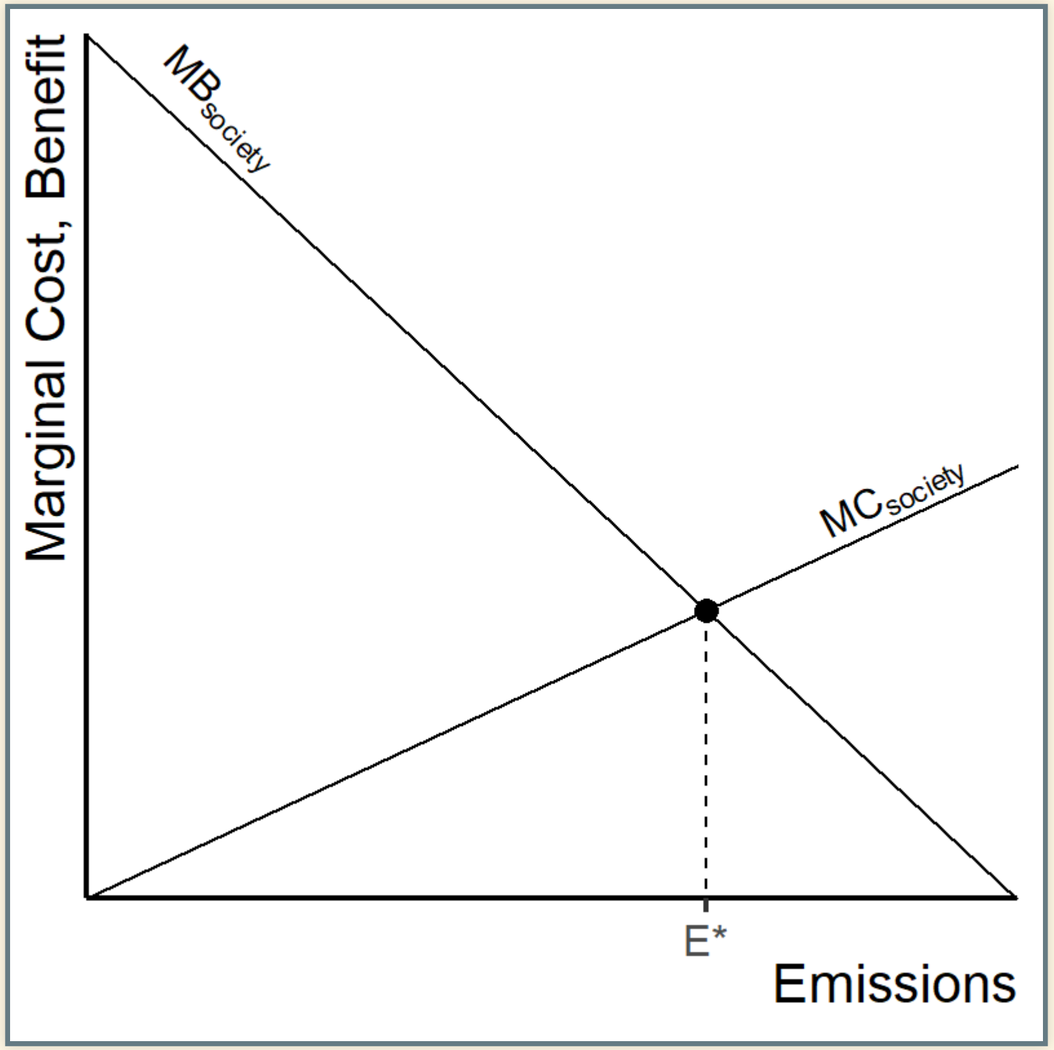
- When MC > MB, it's worth cutting emissions.
- When MC < MB, cutting emissions costs more than it's worth.
- When MC = MB: equilibrium, optimal amount of emissions.



Slope of MB

- Costs vs. Benefits of Emissions

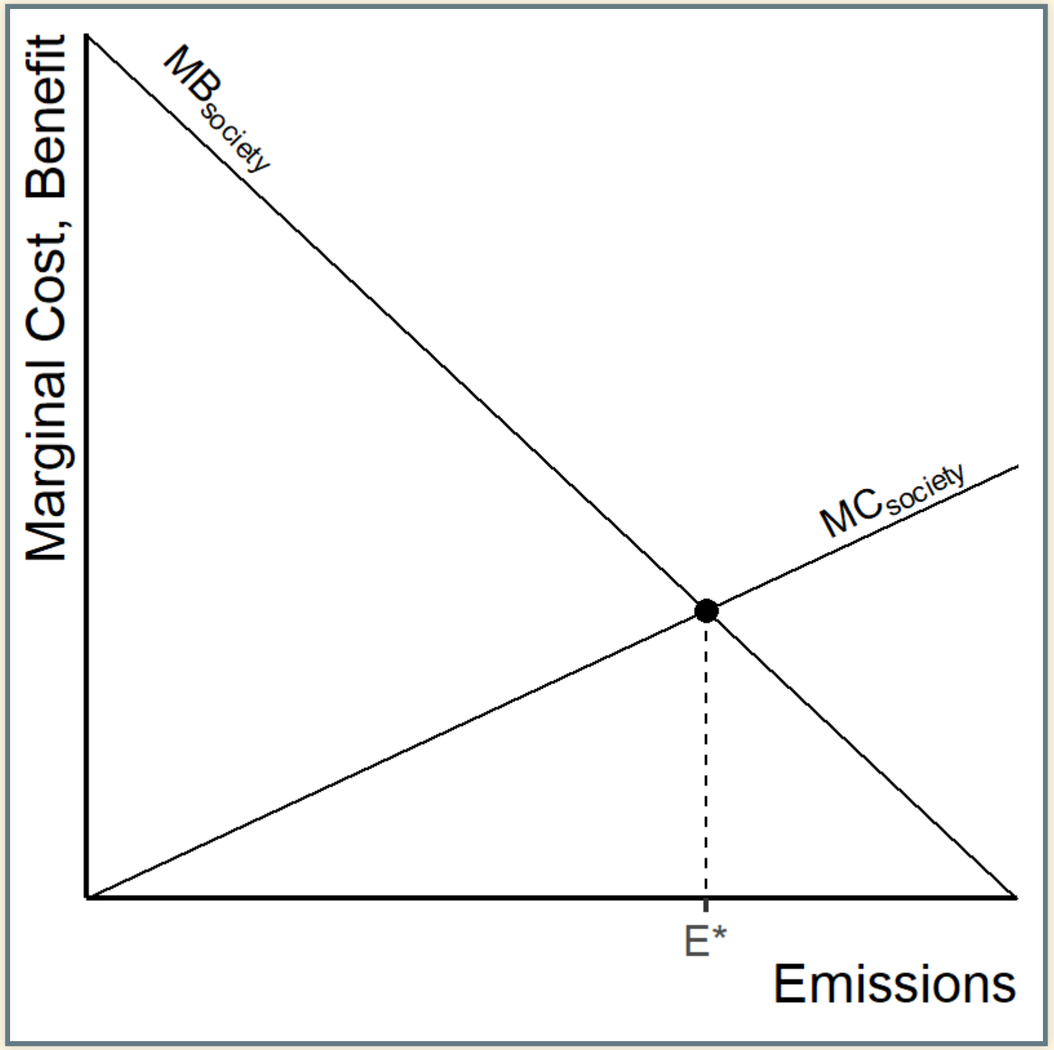
- Why does MB slope down?
  - Optimal emissions:
    - When energy is plentiful, diminishing returns on using more
    - Implications for cutting emissions:
      - Marginal benefit of emissions = marginal cost of cutting emissions.
      - Do cheap things first (small marginal cost to reduce emissions)
      - When you run out of cheap things, turn to expensive ones (higher marginal cost)



Slope of MC

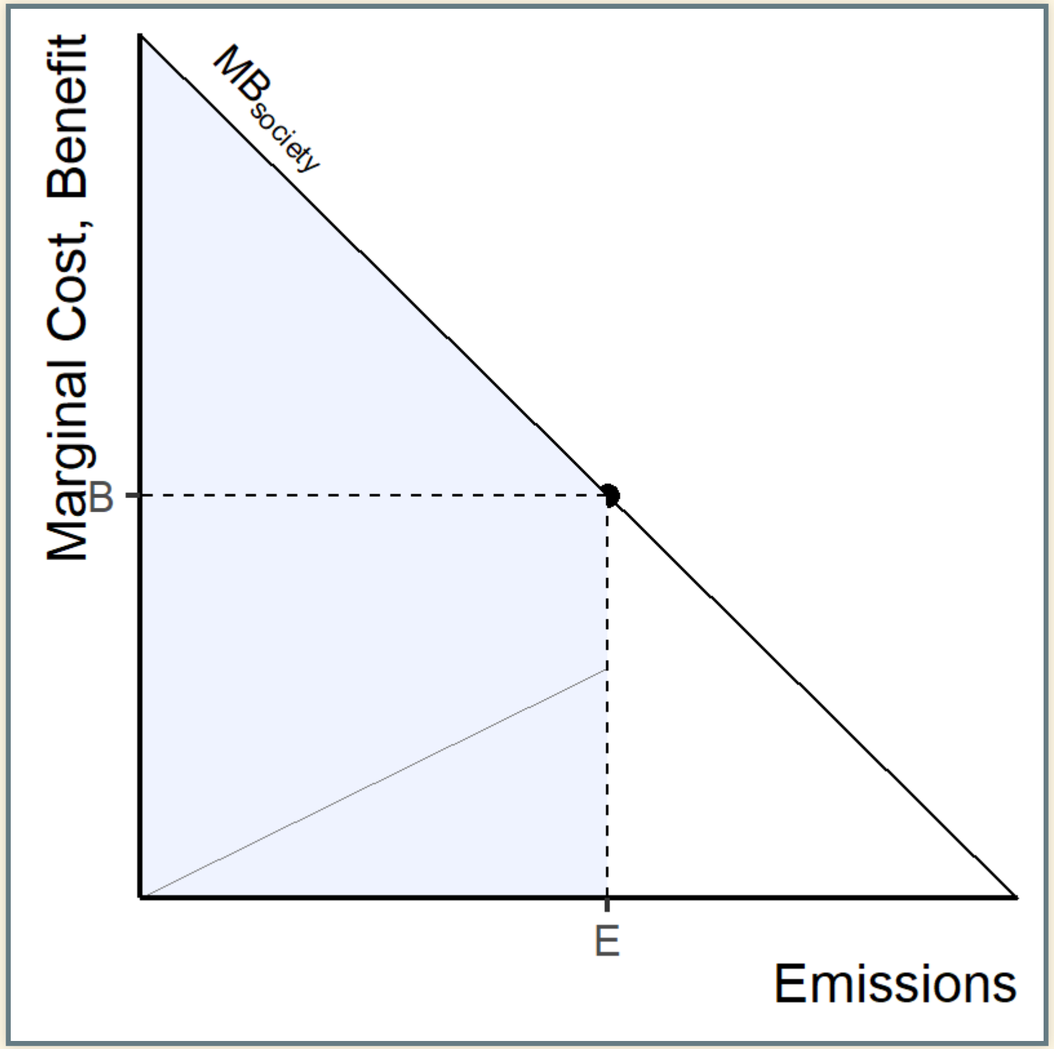
- Costs vs. Benefits of Emissions

- Why does MC slope up?
  - Greater emissions mean more warming
  - Greater warming = greater damage:
    - Going from 3°C to 4°C is much worse than going from 2°C to 3°C
    - Benefit of reducing warming from 4°C to 3°C is worth more than reducing it from 3°C to 2°C



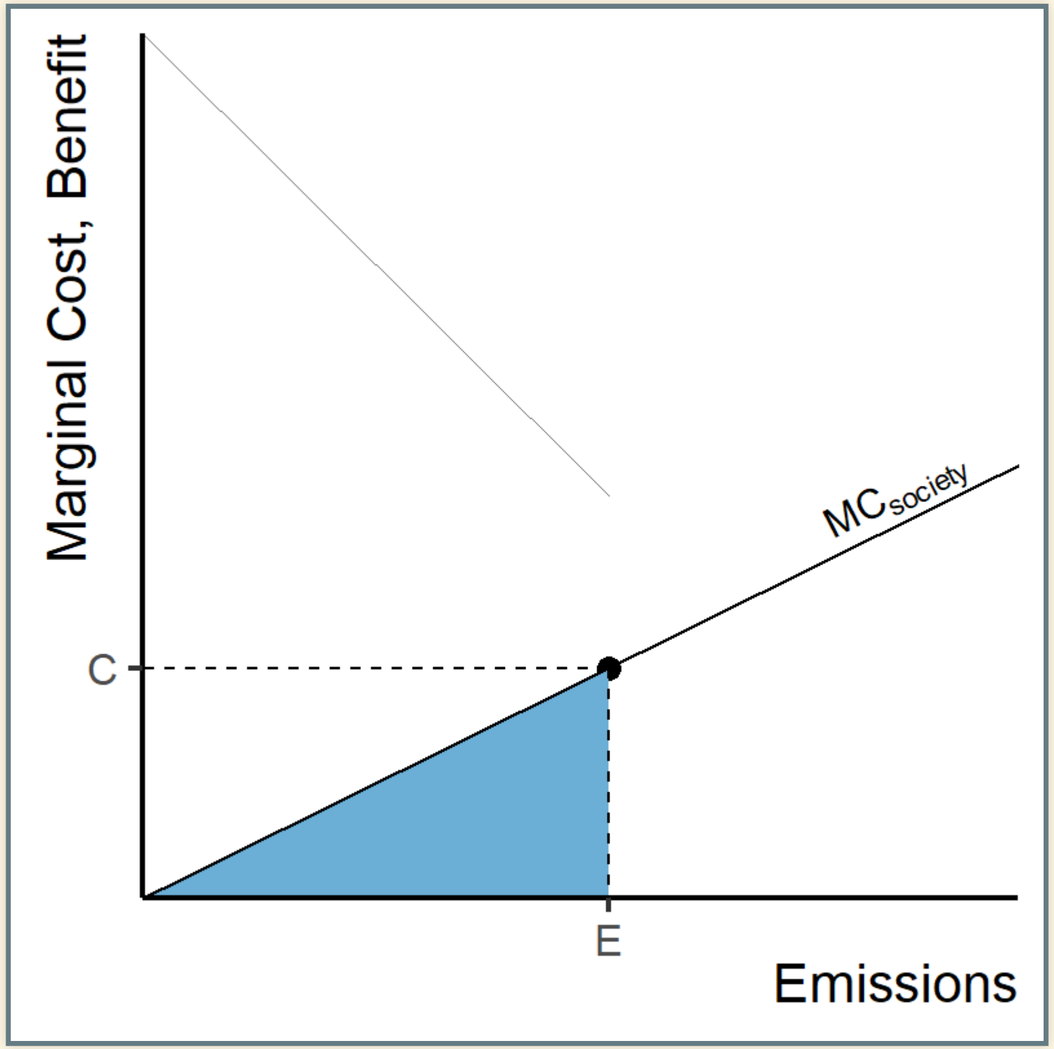
Marginal vs. Gross Benefit

- E = emissions (abatement)
- B = marginal benefit
- Blue area = total gross benefit to society from emissions



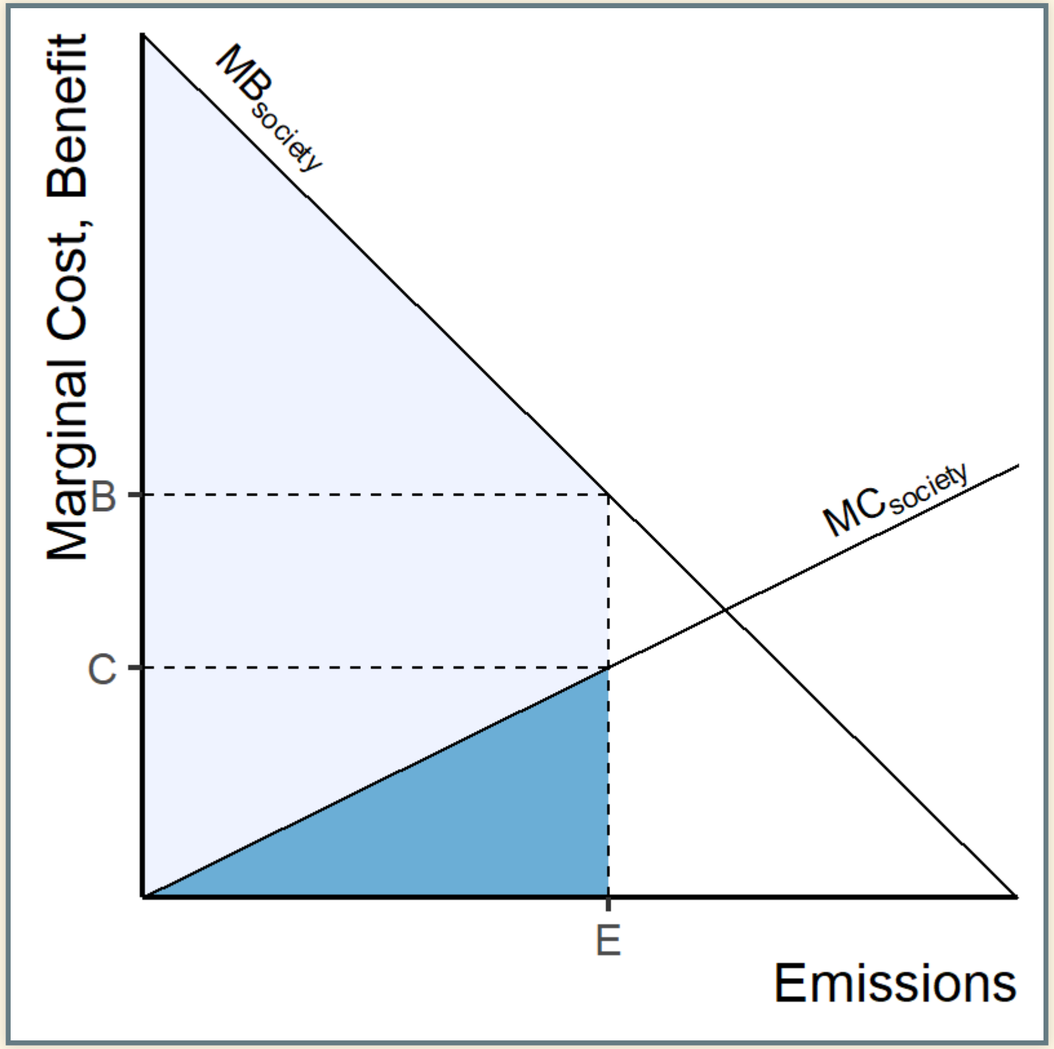
Marginal vs. Gross Cost

- E = emissions (abatement)
- C = marginal cost
- Blue area = total gross cost to society from emissions



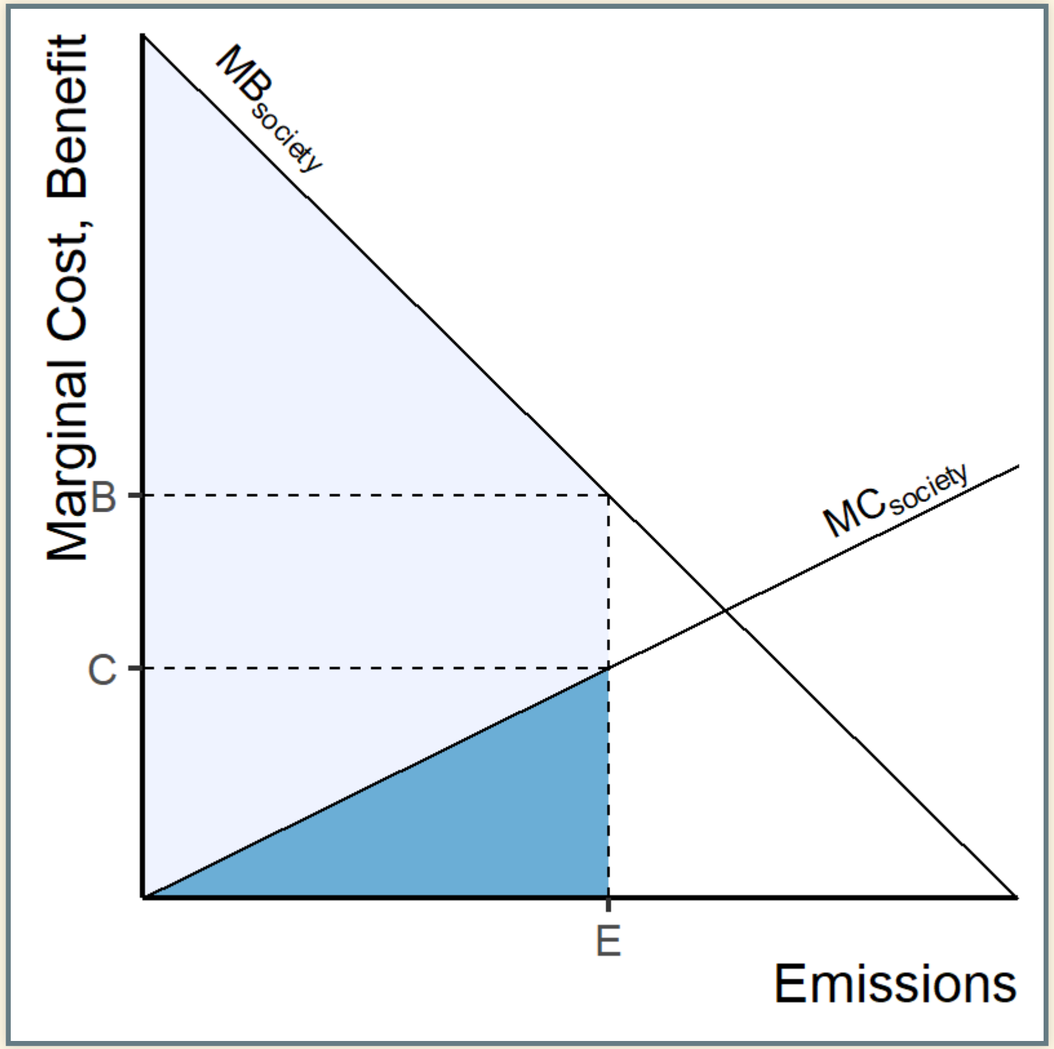
Putting it Together

- Marginal benefit at E = B
- Marginal cost at E = C
- Marginal net benefit at E = (B - C)

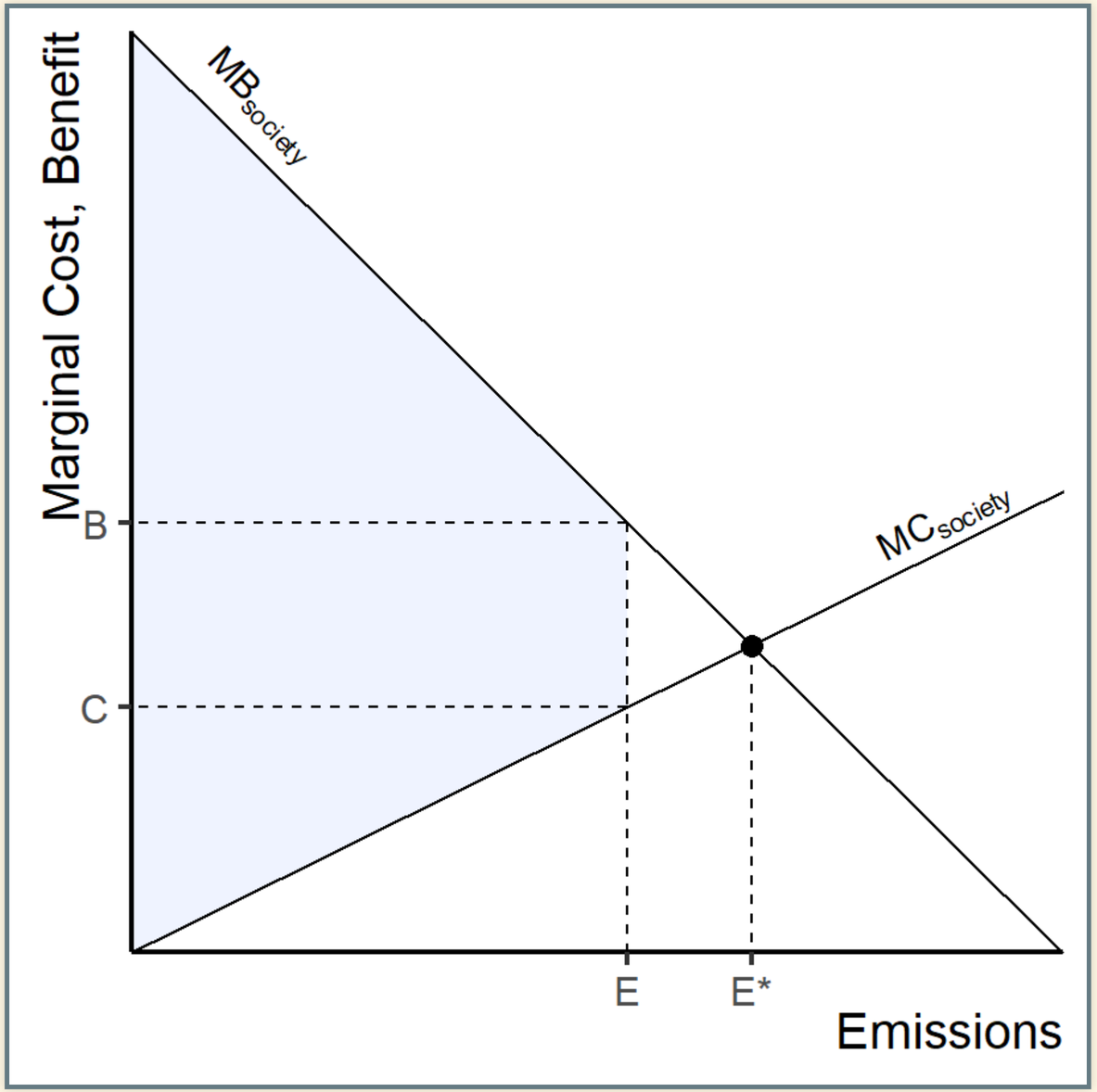


Putting it Together

- Gross benefit at E = area under MB (light + dark blue)
- Gross cost at E = area under MC (dark blue)
- Gross net benefit at E = gross benefit - gross cost
  - Light-blue trapezoid



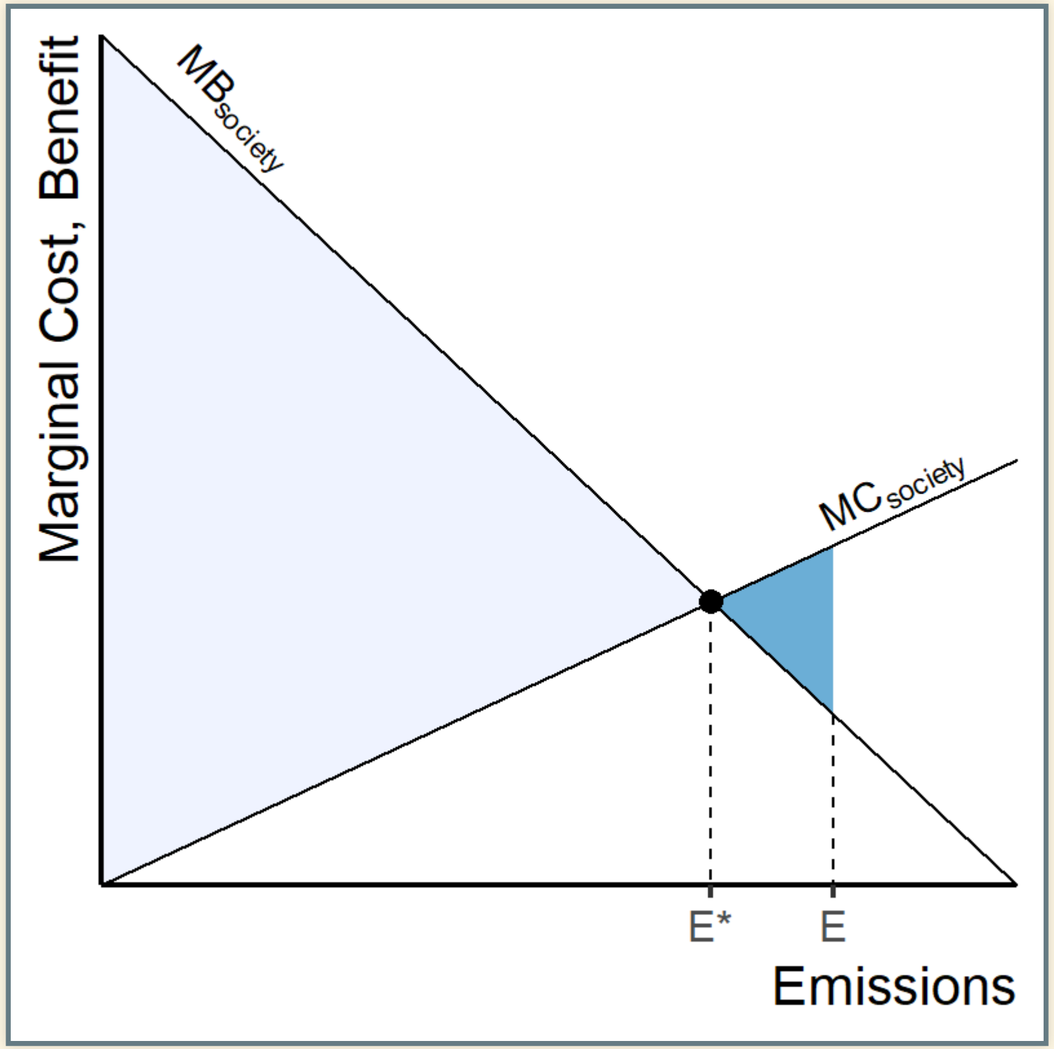
Total Net Benefit



Optimizing Emissions

Optimum Emissions

- Optimum emissions = E*
- Actual emissions = E
- Little triangle on right:
  Costs > Benefits (net loss)
- EPA issues only enough permits to allow emissions of E*
- Free trading in permits cuts emissions to E* at lowest possible cost
- Total net benefits to society are maximized.



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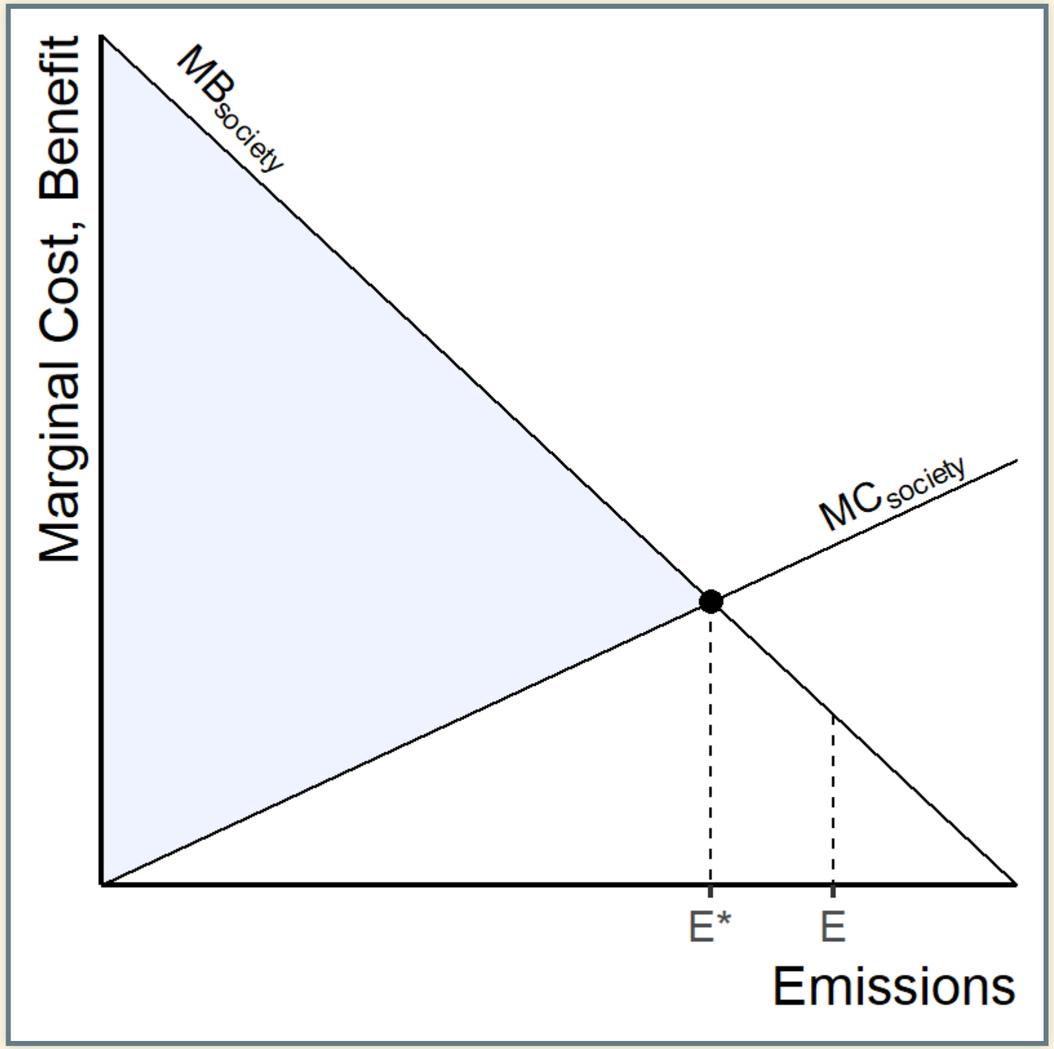
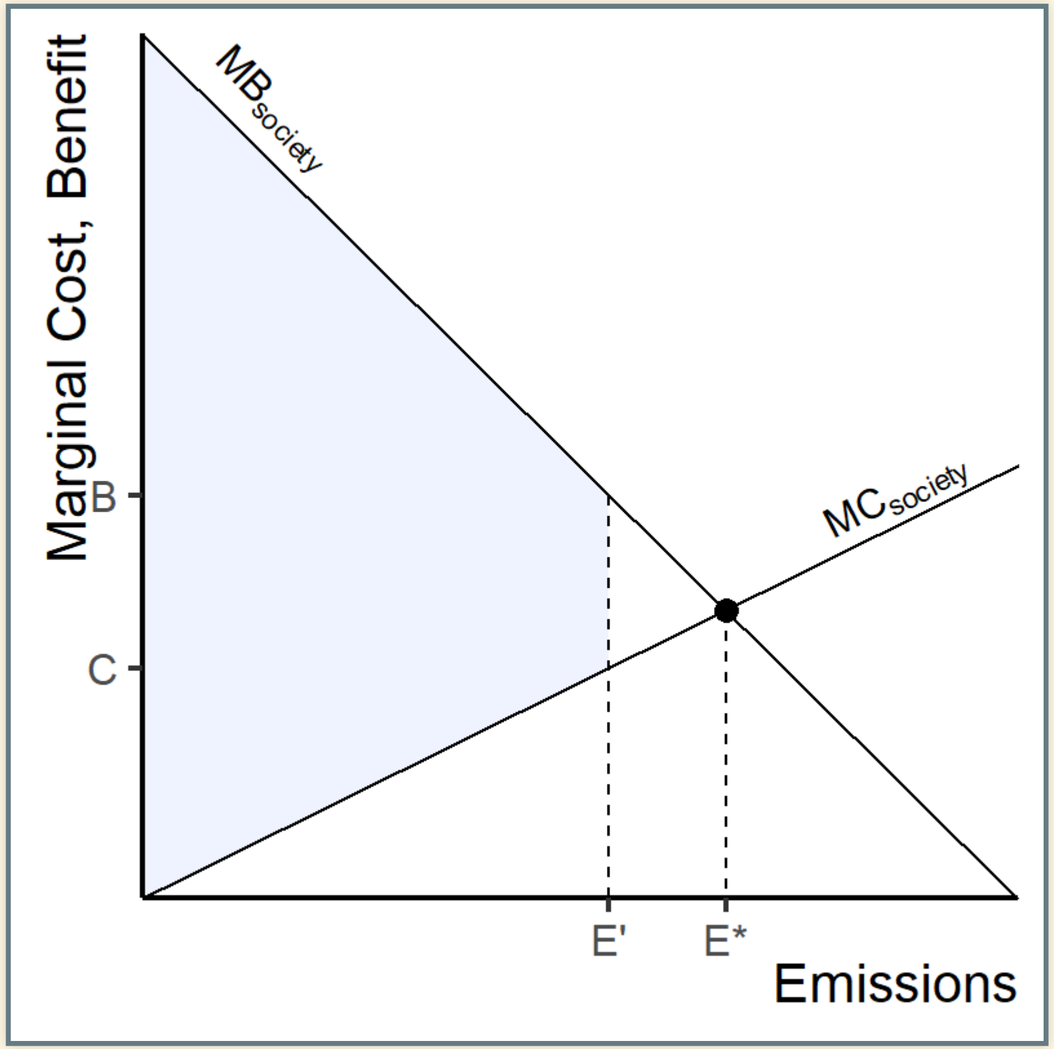


Deadweight Losses

- Optimum: E*
- EPA cuts emissions too far, to E’
- Deadweight loss = empty triangle (difference between actual net benefit and optimum net benefit).



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