

Cost-Benefit Analysis of Climate Policy

EES 3310/5310

Global Climate Change

Jonathan Gilligan

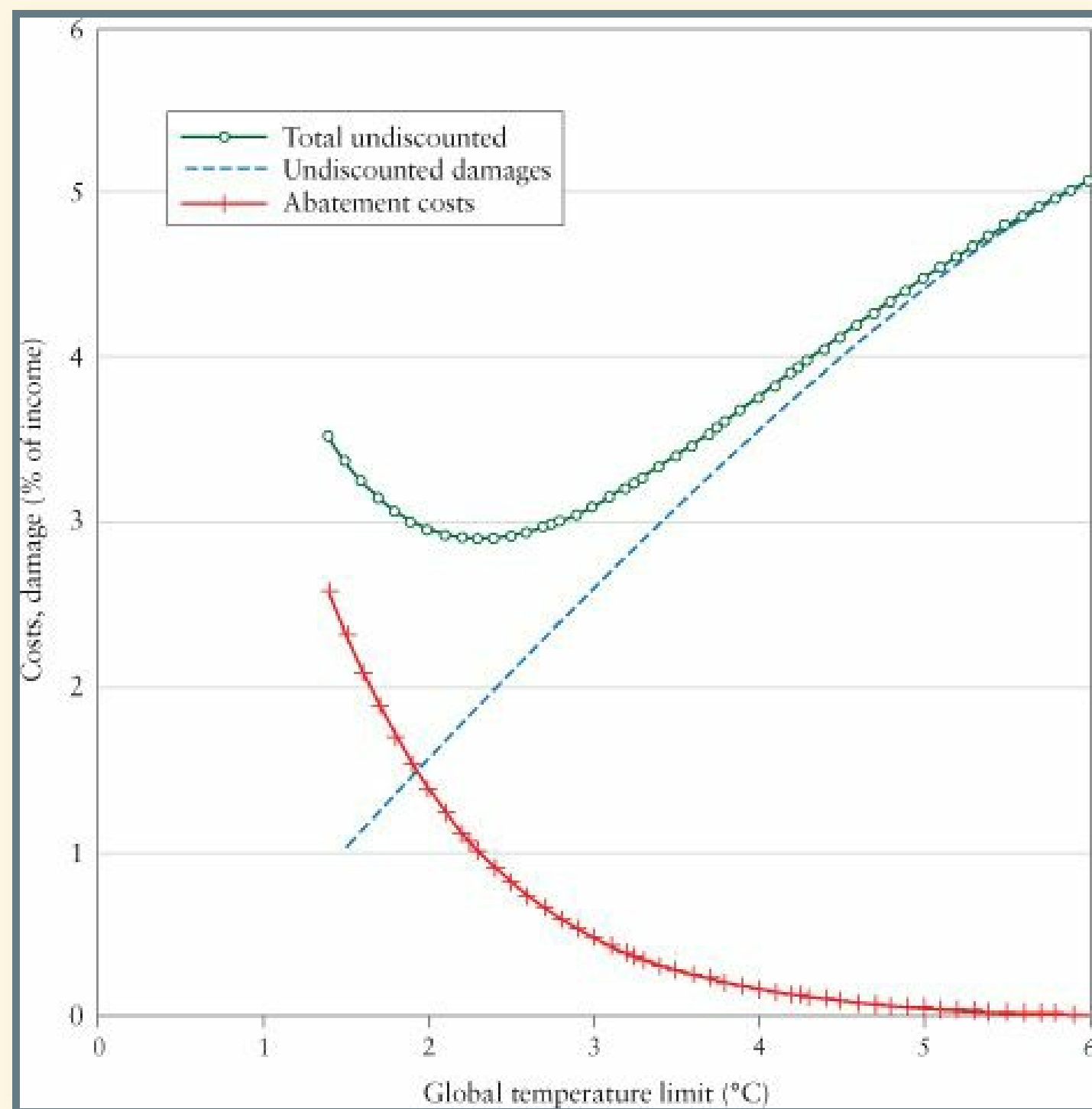
Class #29: Monday, Oct. 30 2018



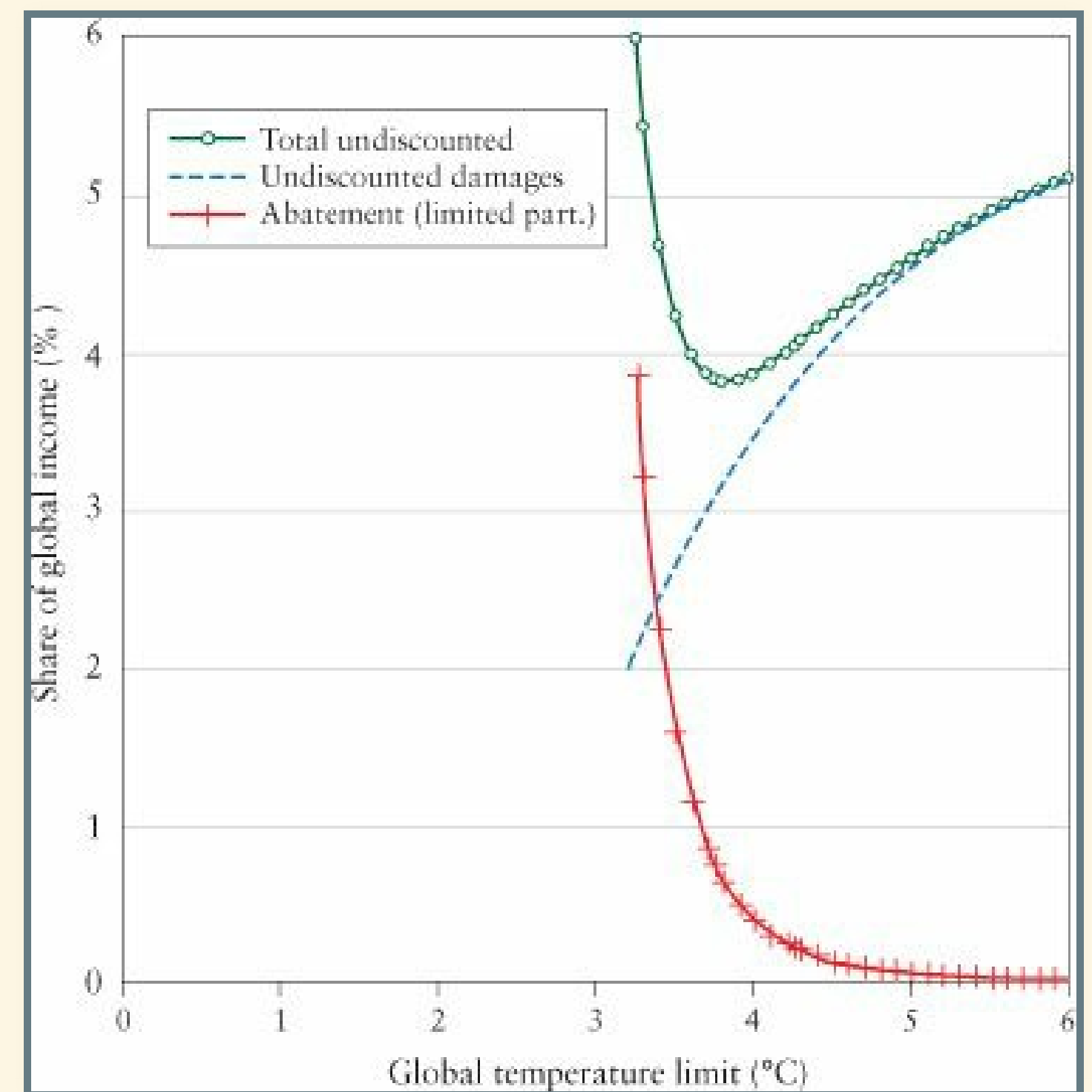
Climate Casino

Climate Casino

Optimal Policy:
100% efficient

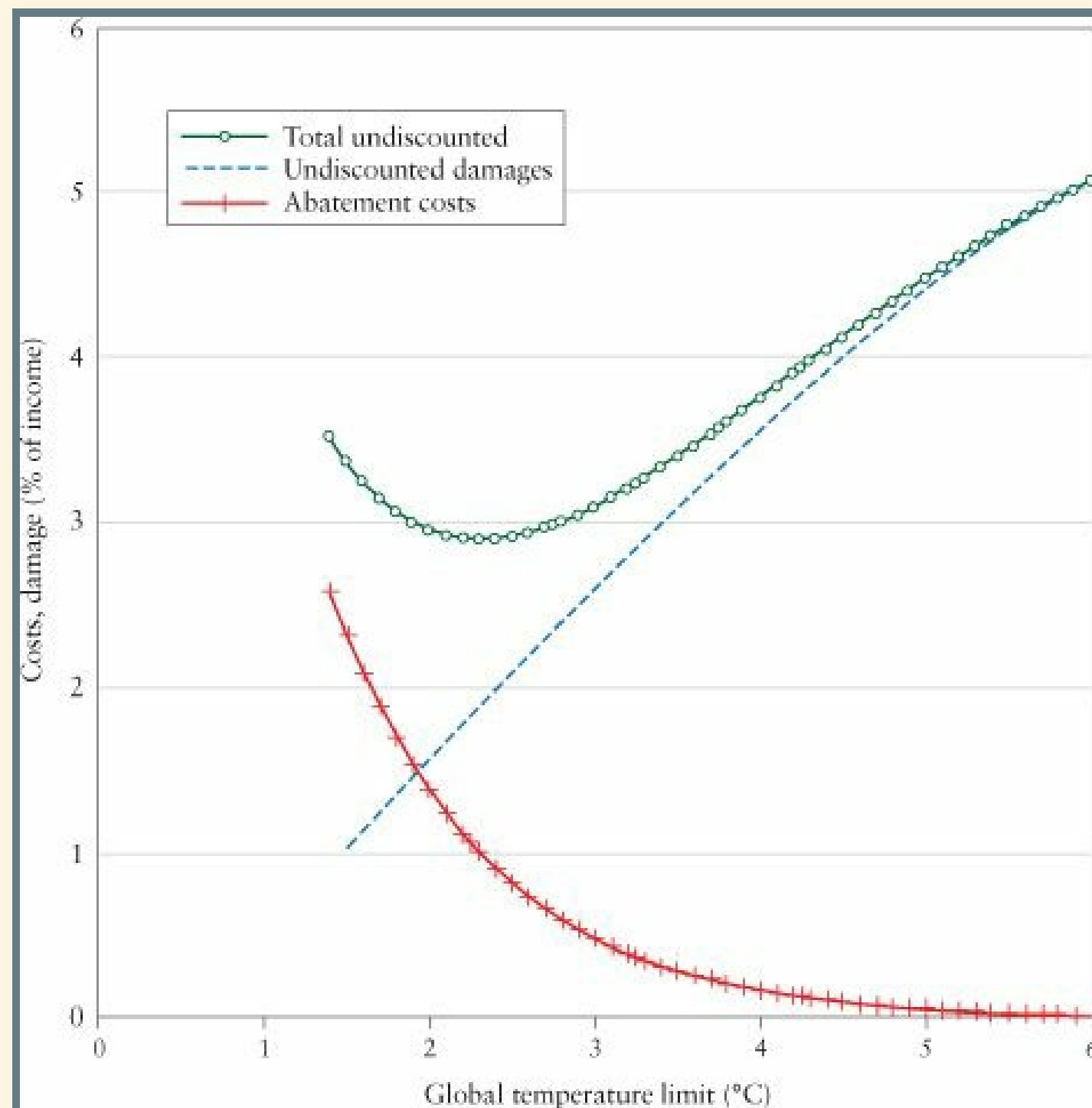


Inefficient:
Limited Participation

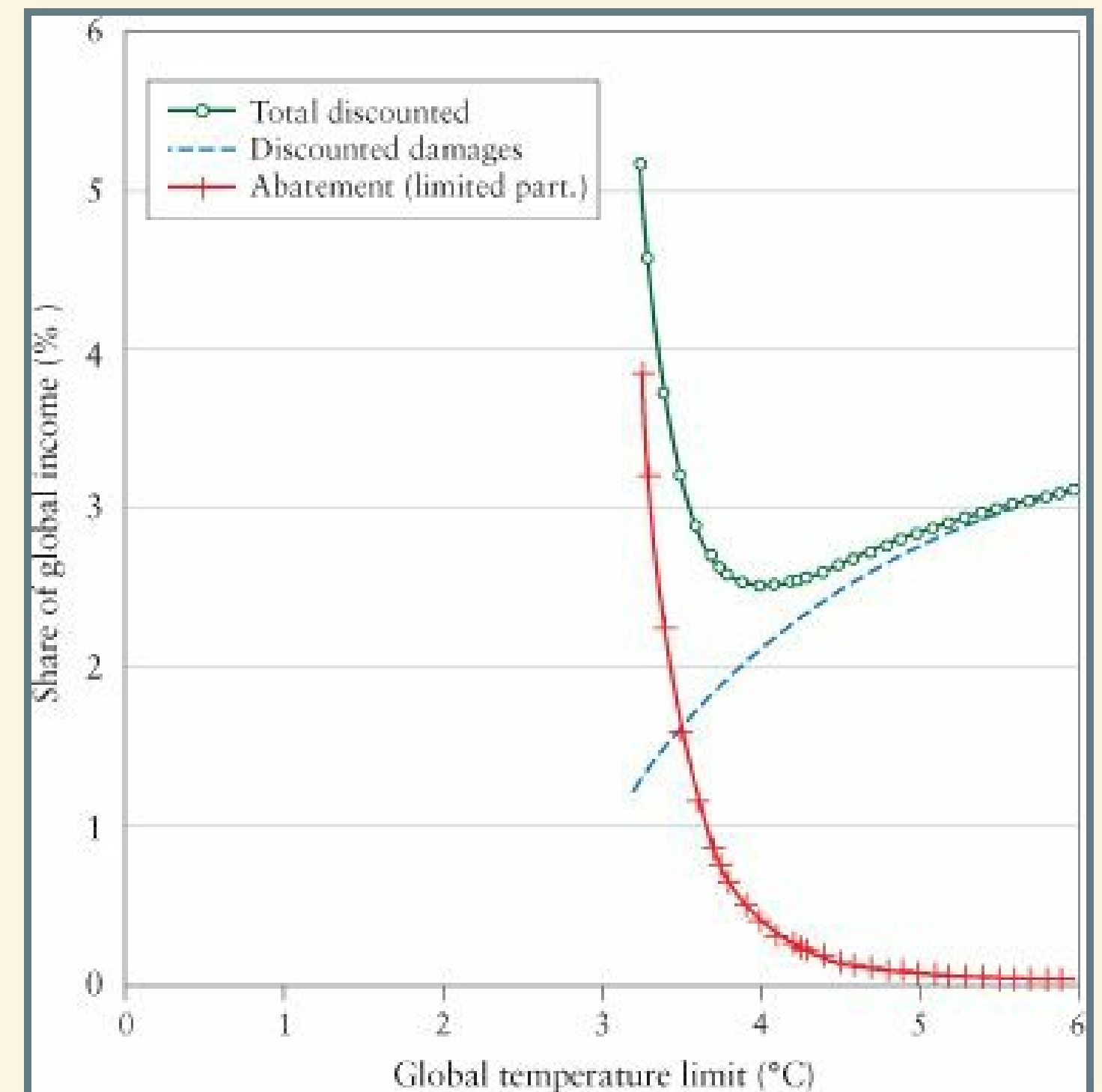


Climate Casino

Optimal Policy:
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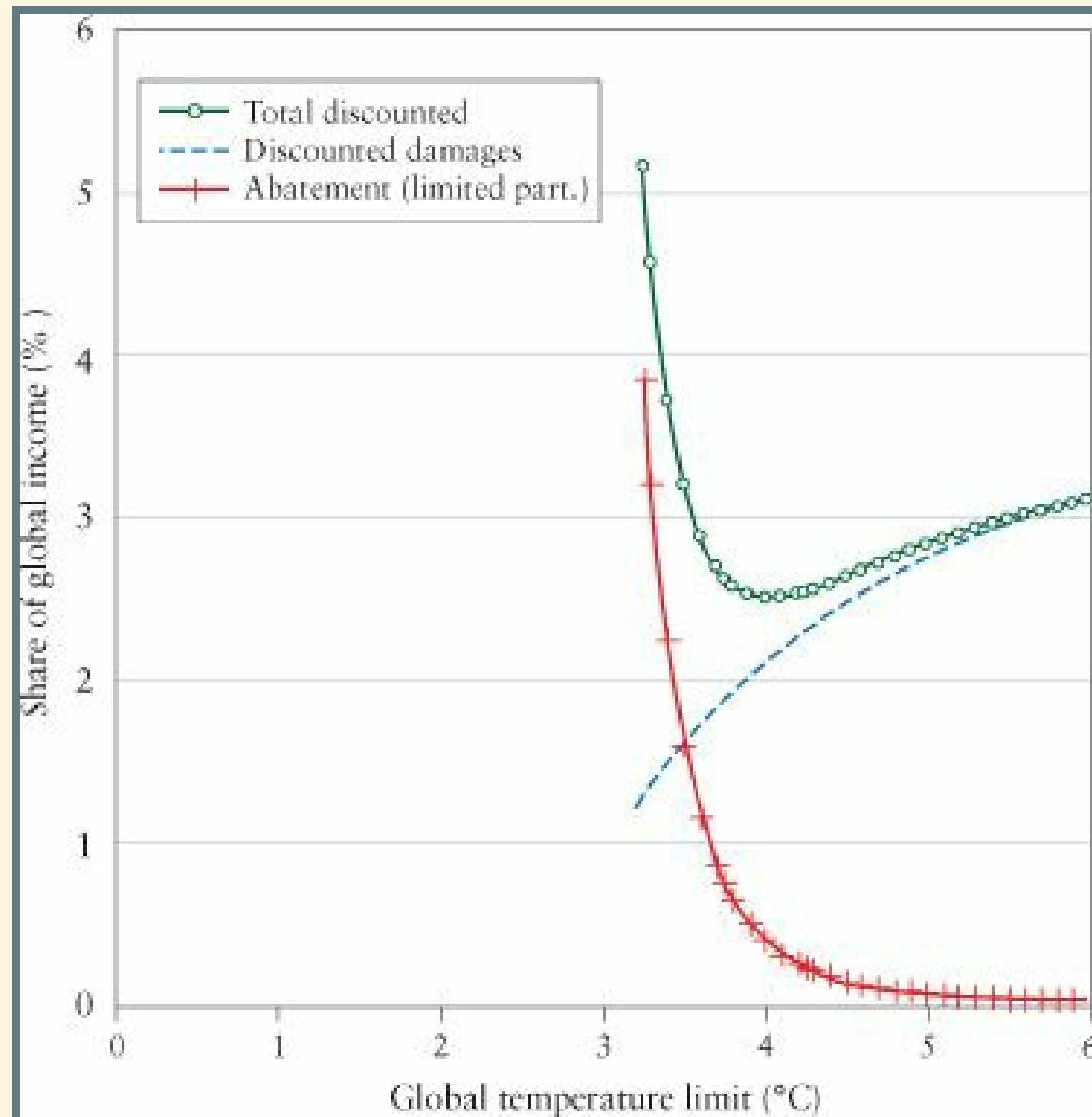


Limited Participation
with Discounting

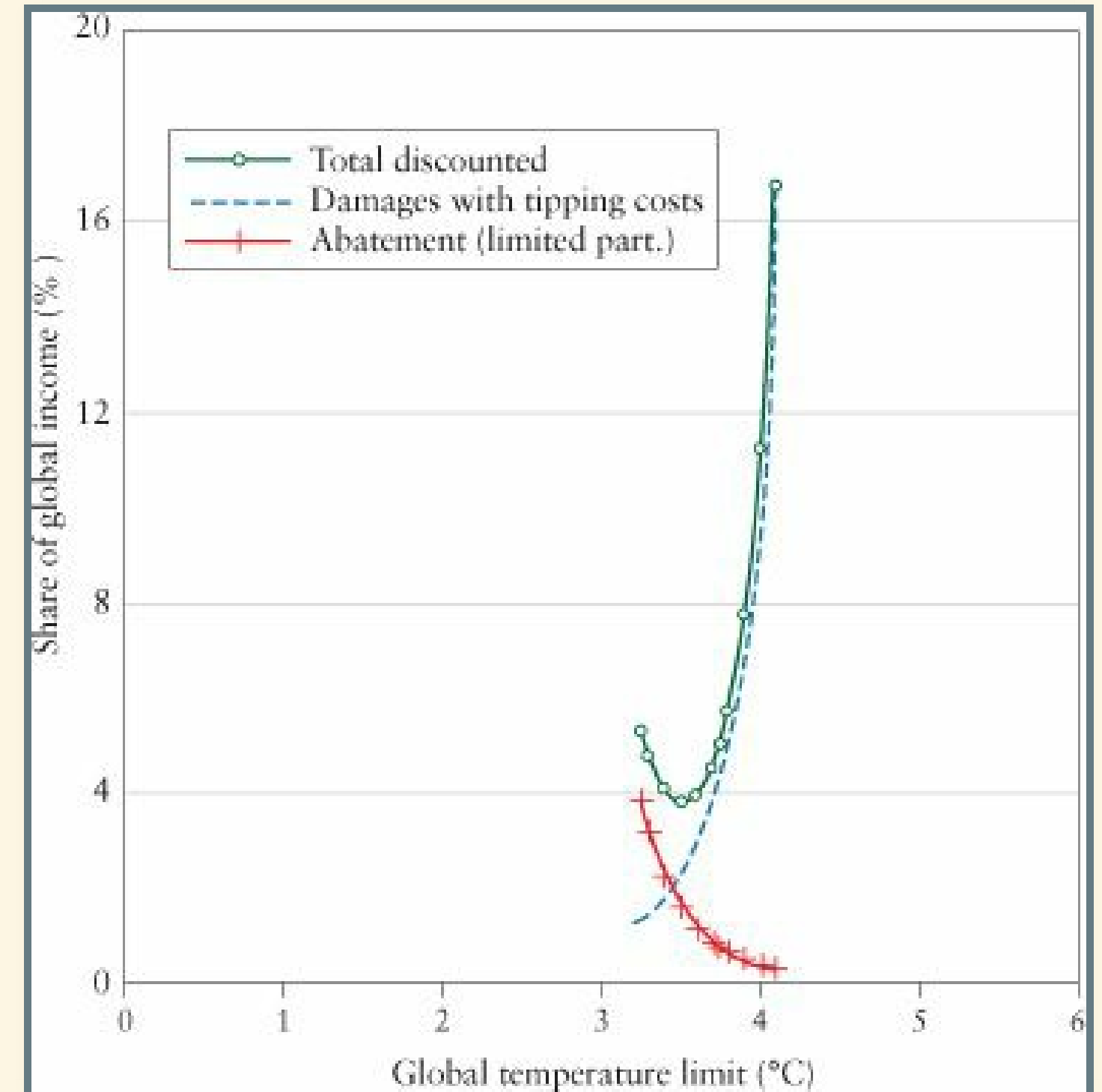


Climate Casino

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

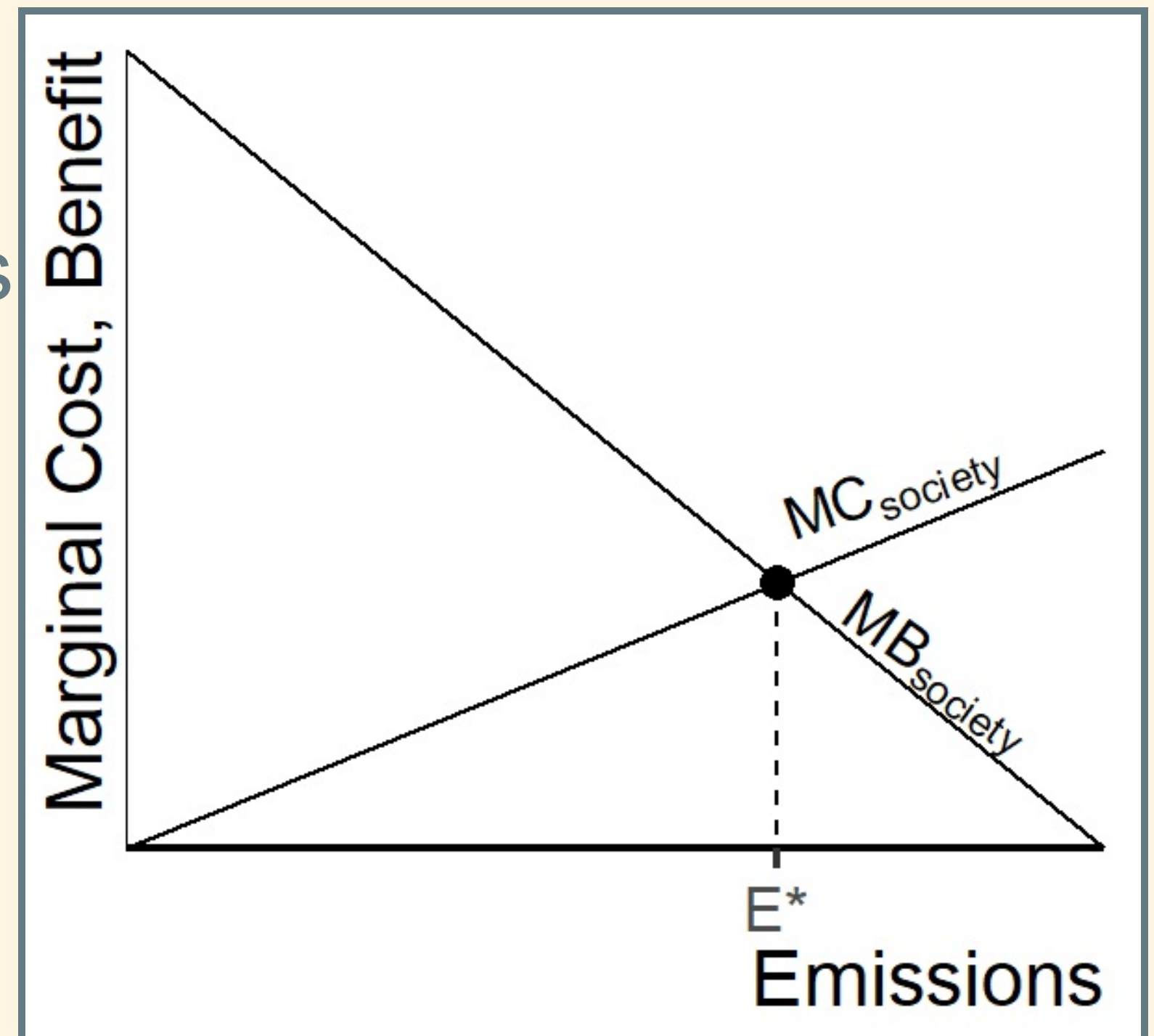
Microeconomics and Emissions Reduction

Technical Microeconomics

- Marginal costs and benefits:
 - iPods:
 - Hundreds of millions to build the first iPod
 - Less than \$100 to build the millionth iPod
 - Production possibilities:
 - Economies of scale
 - Marginal costs fall as volume increases
 - Diminishing returns:
 - Marginal costs rise as volume increases
- Gross costs:
 - Sum of marginal costs for all units produced

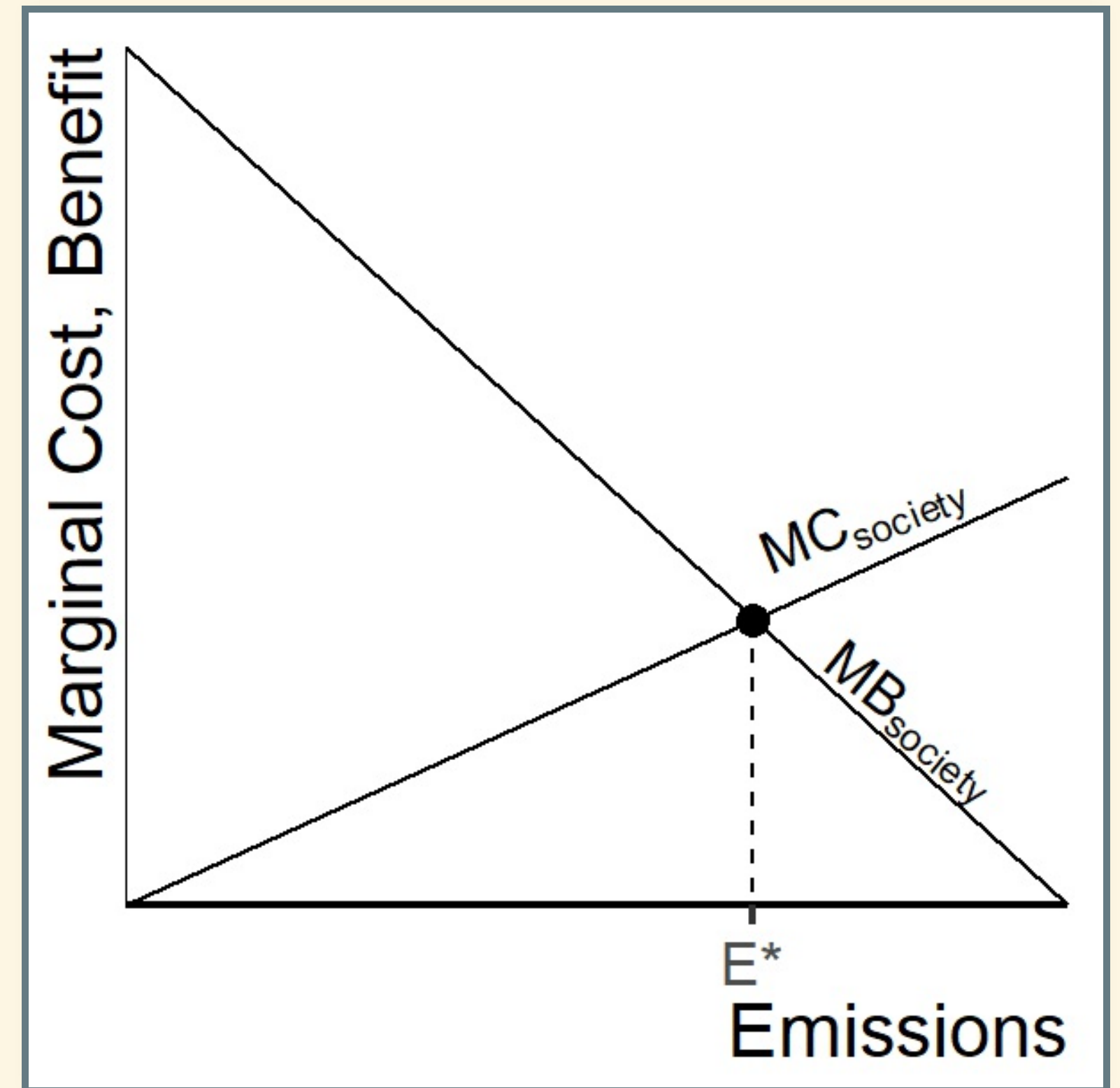
Using Graphs to Avoid Math

- Costs vs. benefits for increasing CO₂ 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.



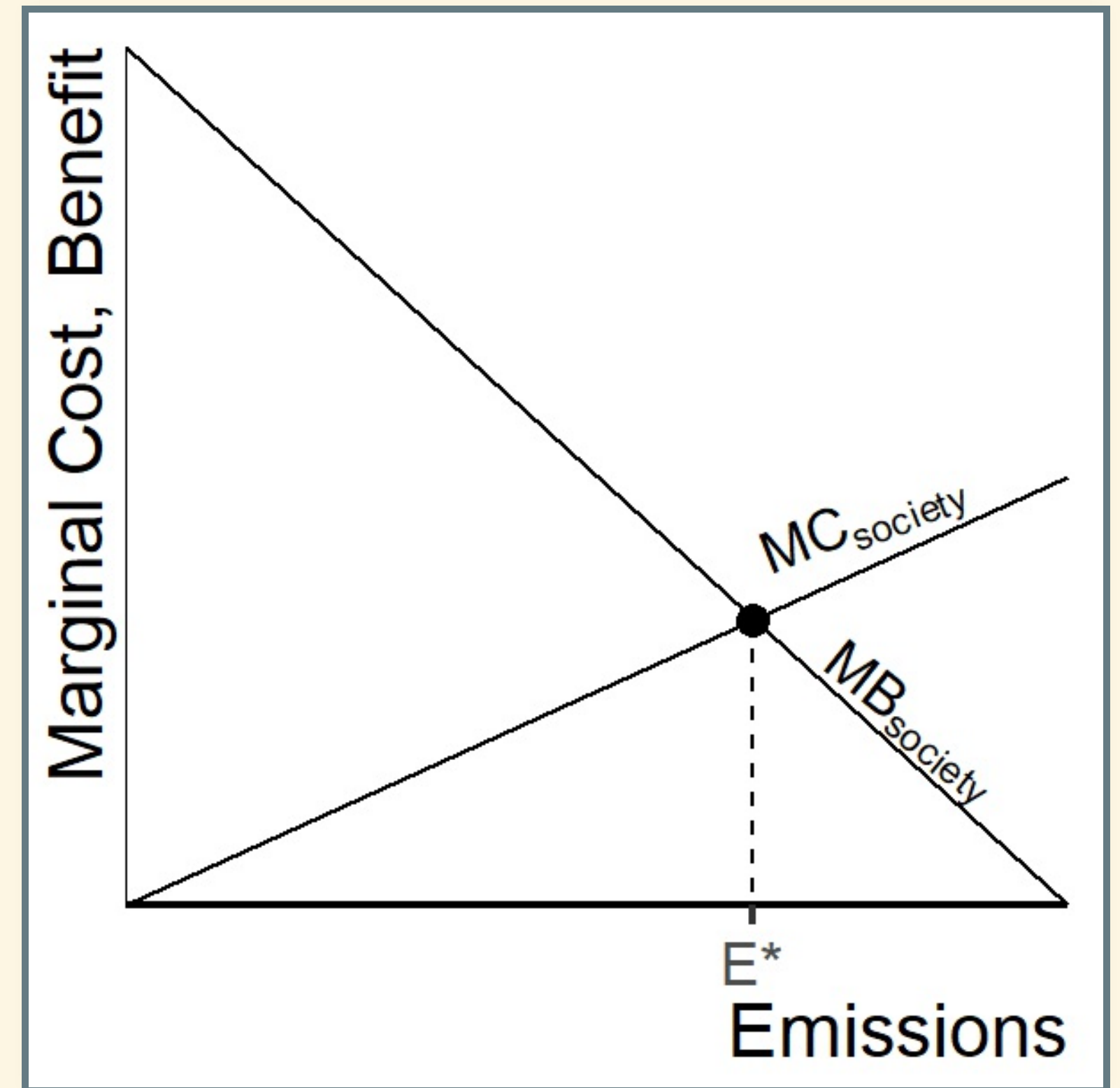
Slope of MB

- 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



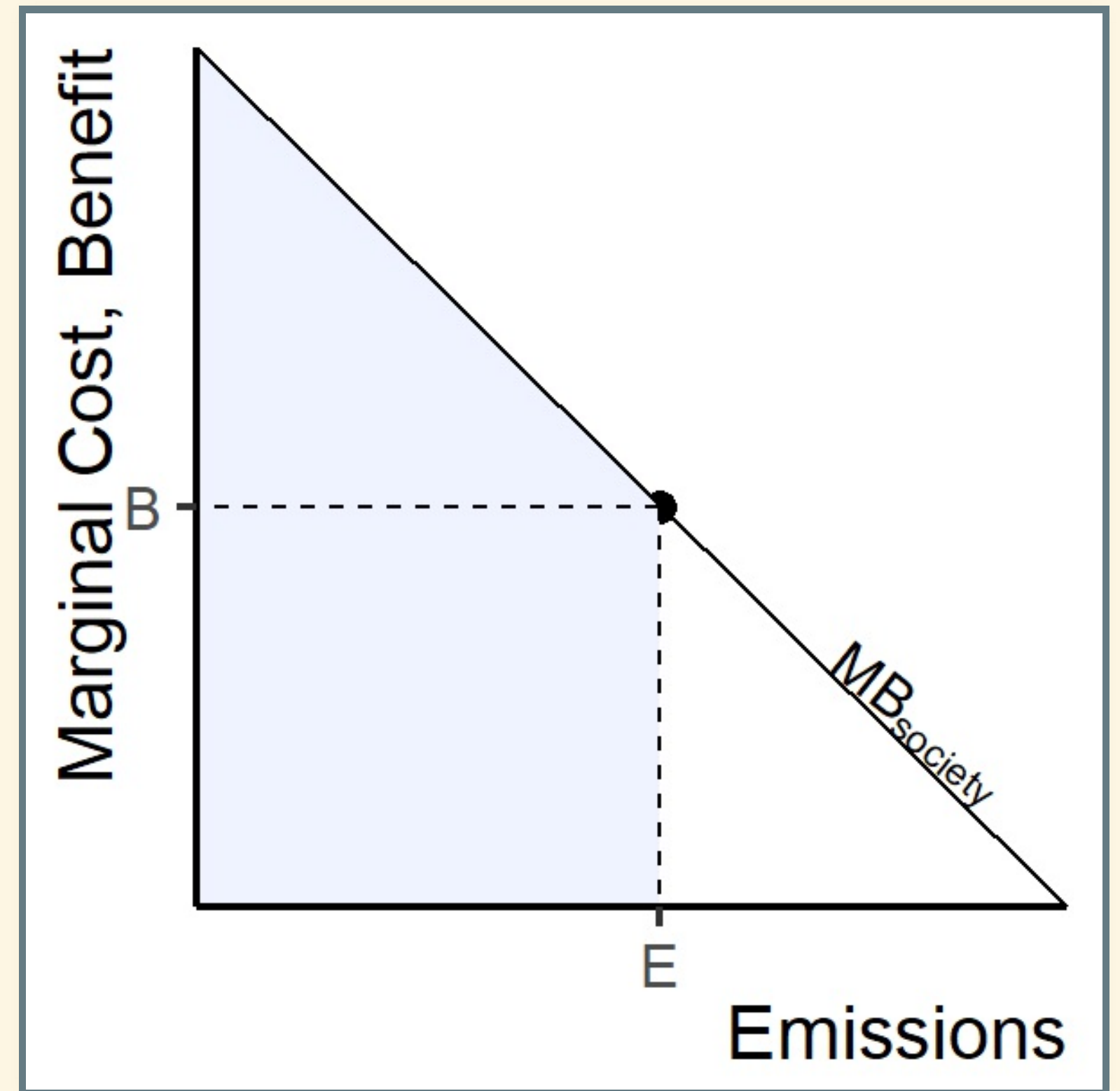
Slope of MC

- 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



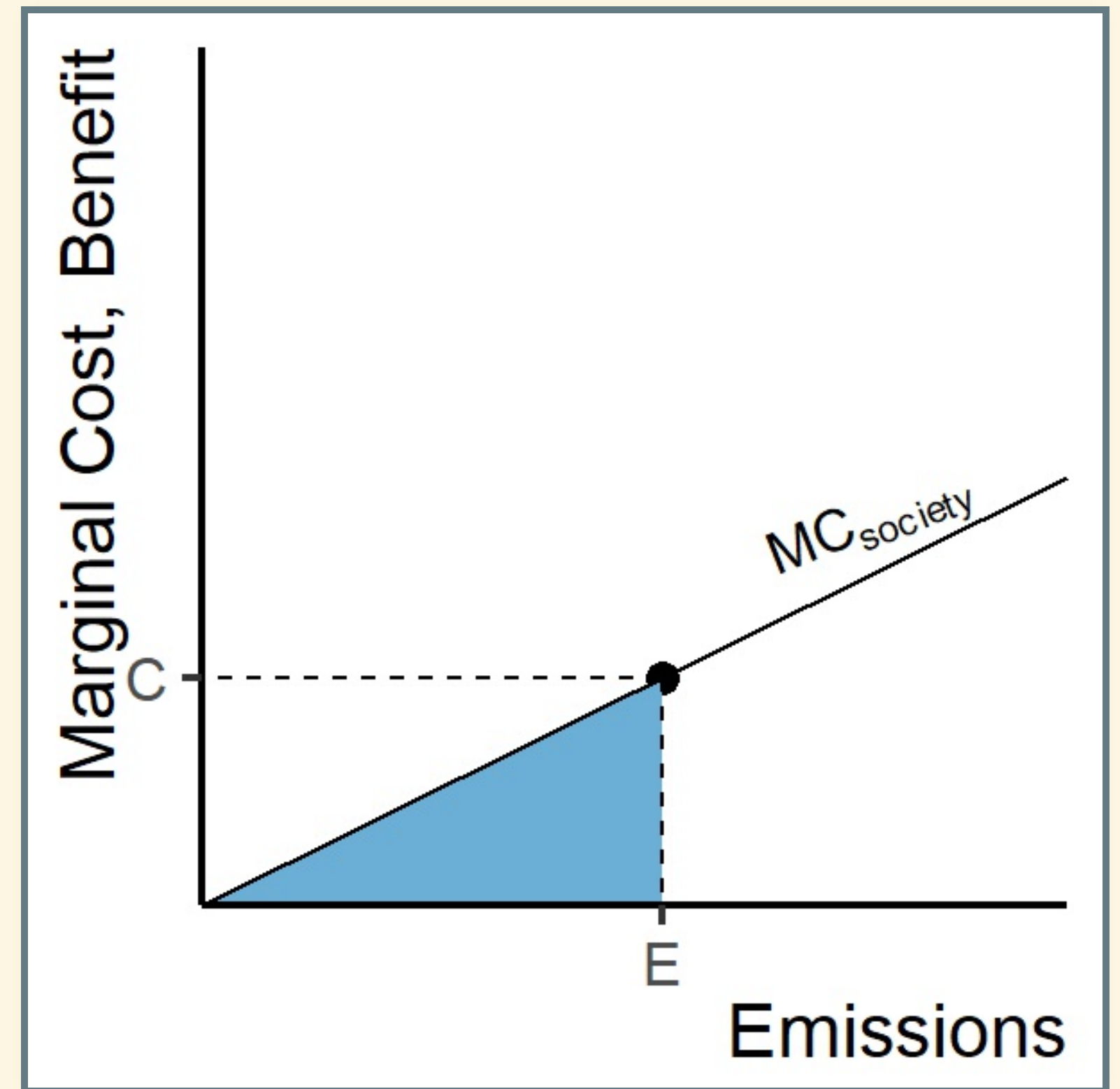
Marginal vs. Gross Benefit

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



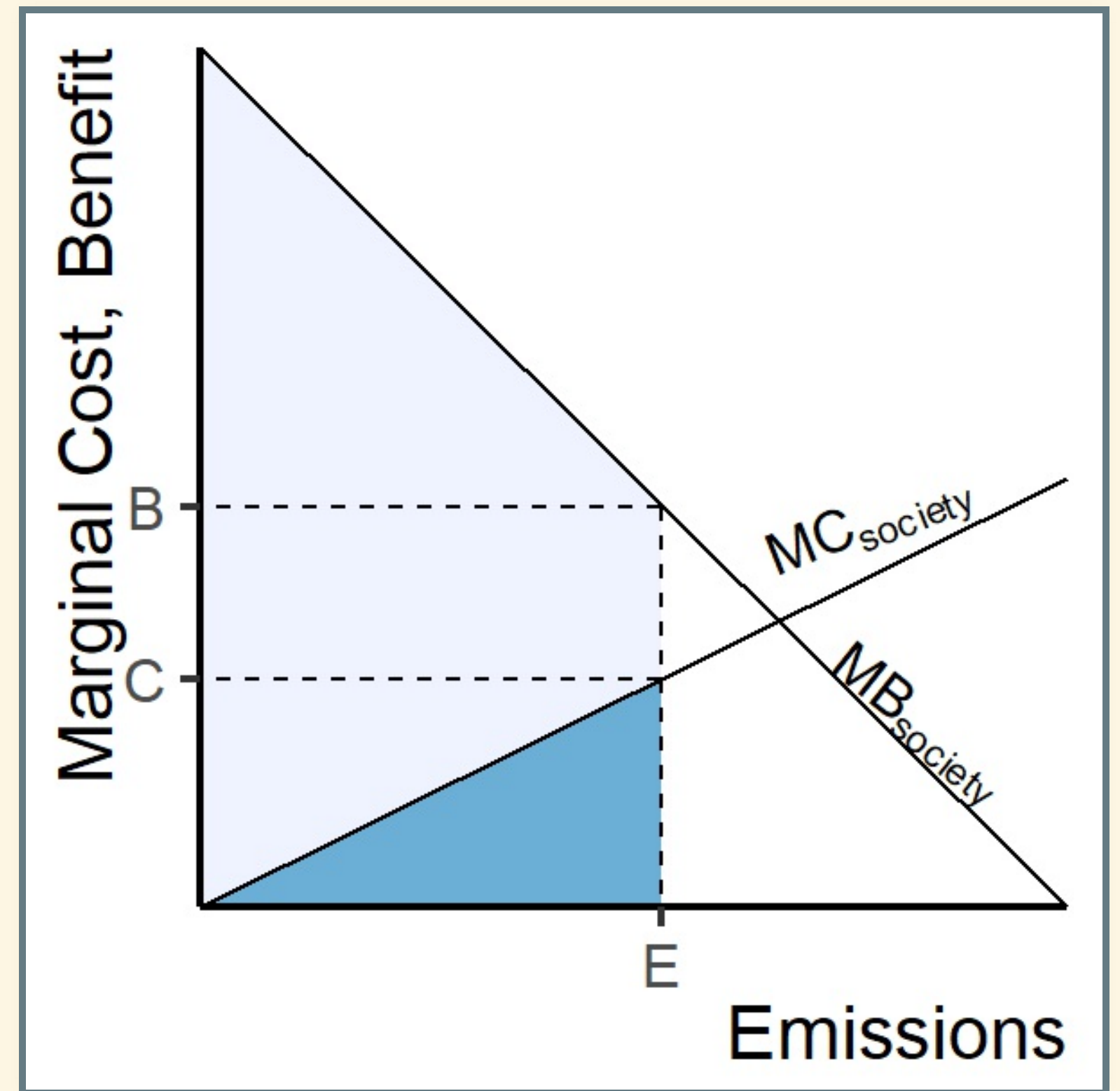
Marginal vs. Gross Cost

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



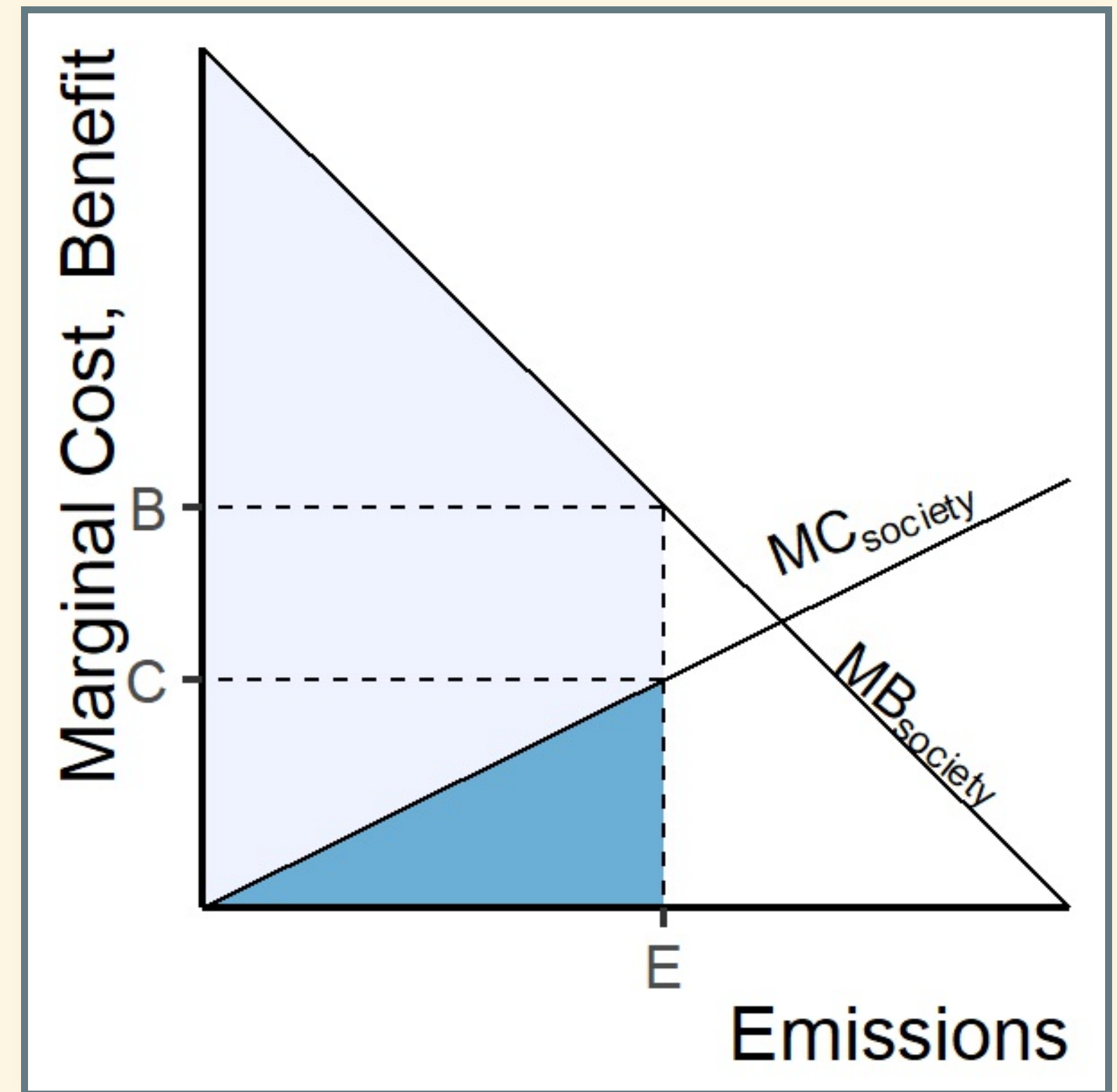
Putting it Together

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

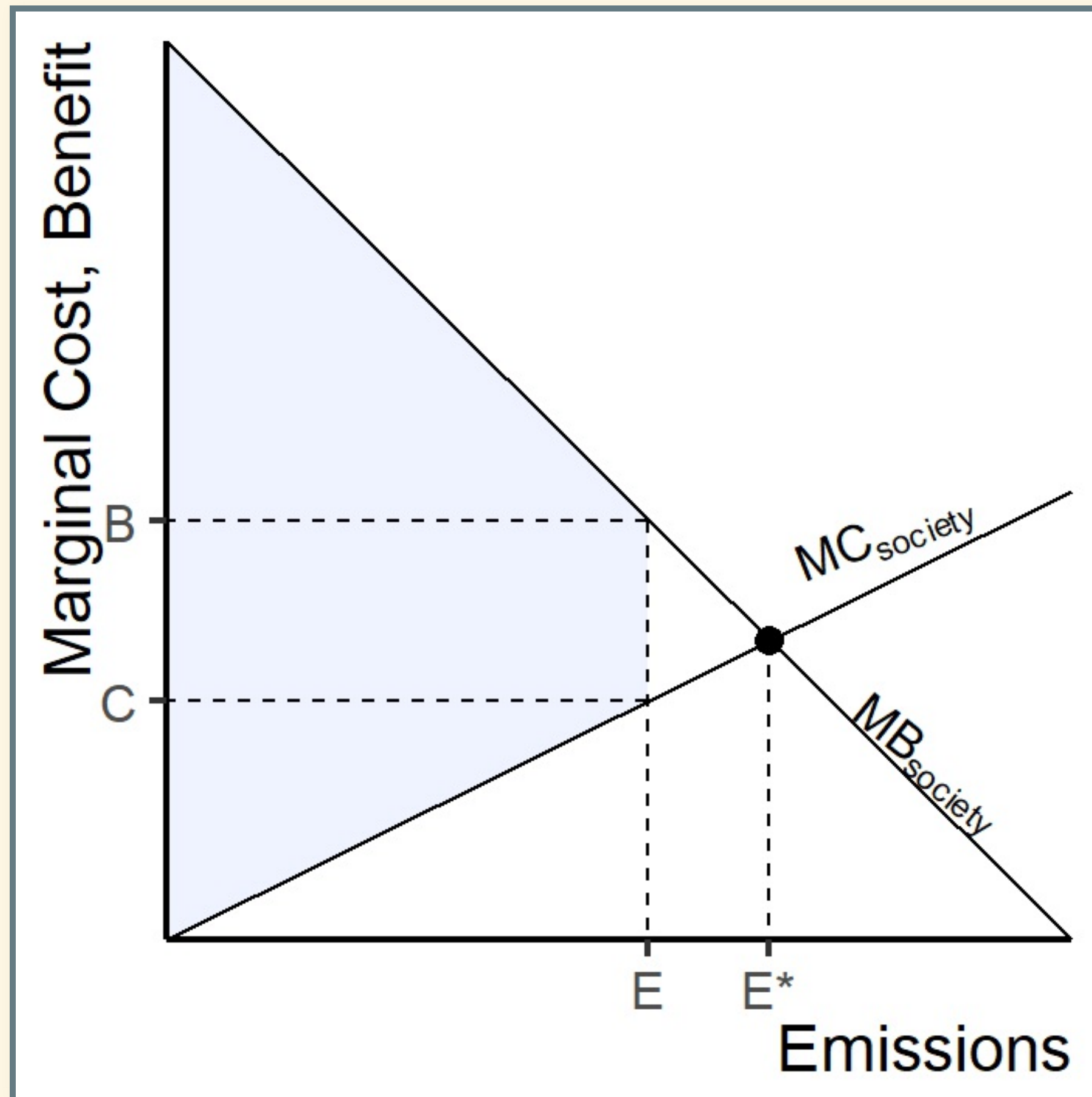


Putting it Together

- 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



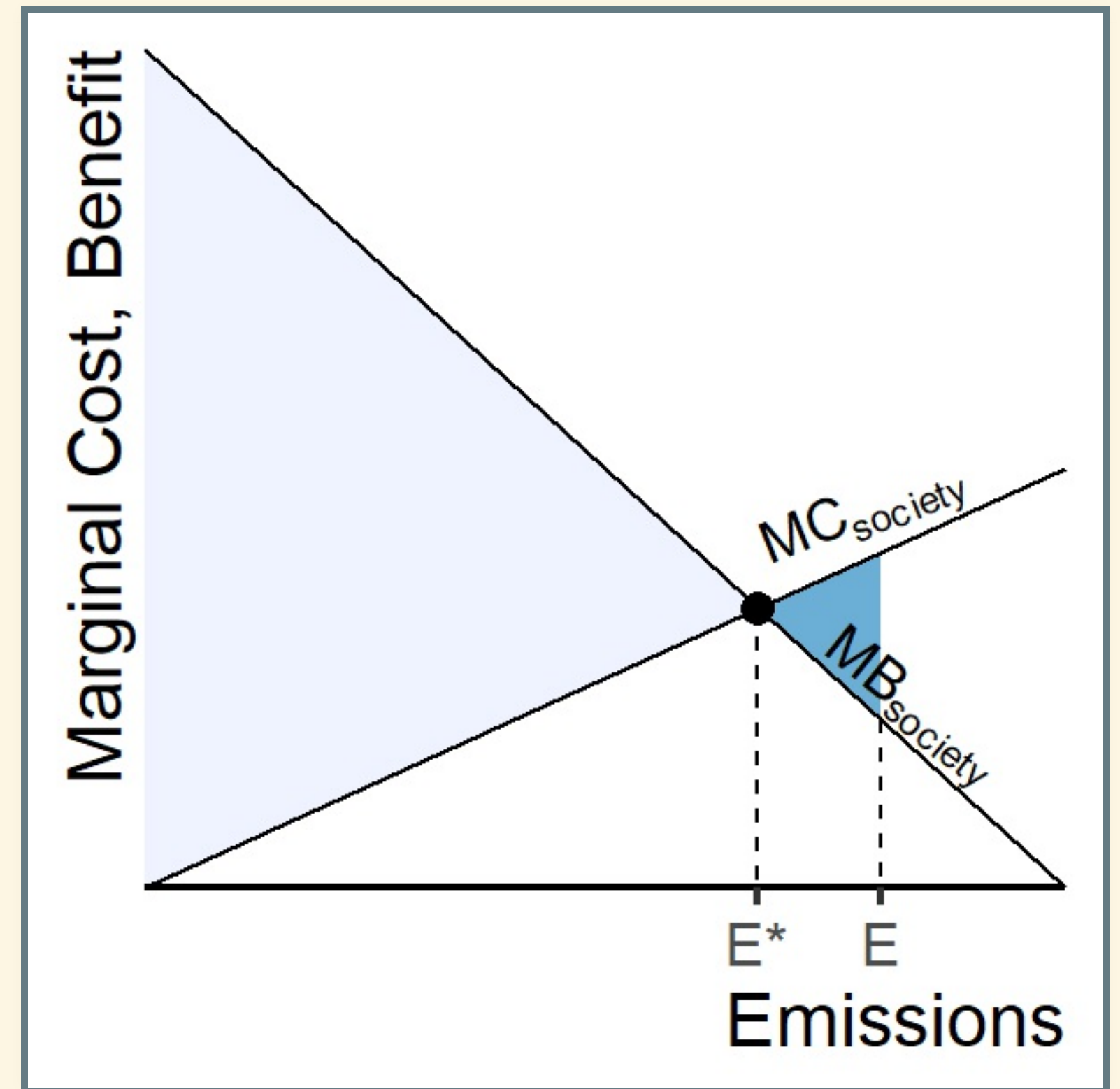
Total Net Benefit



Optimizing Emissions

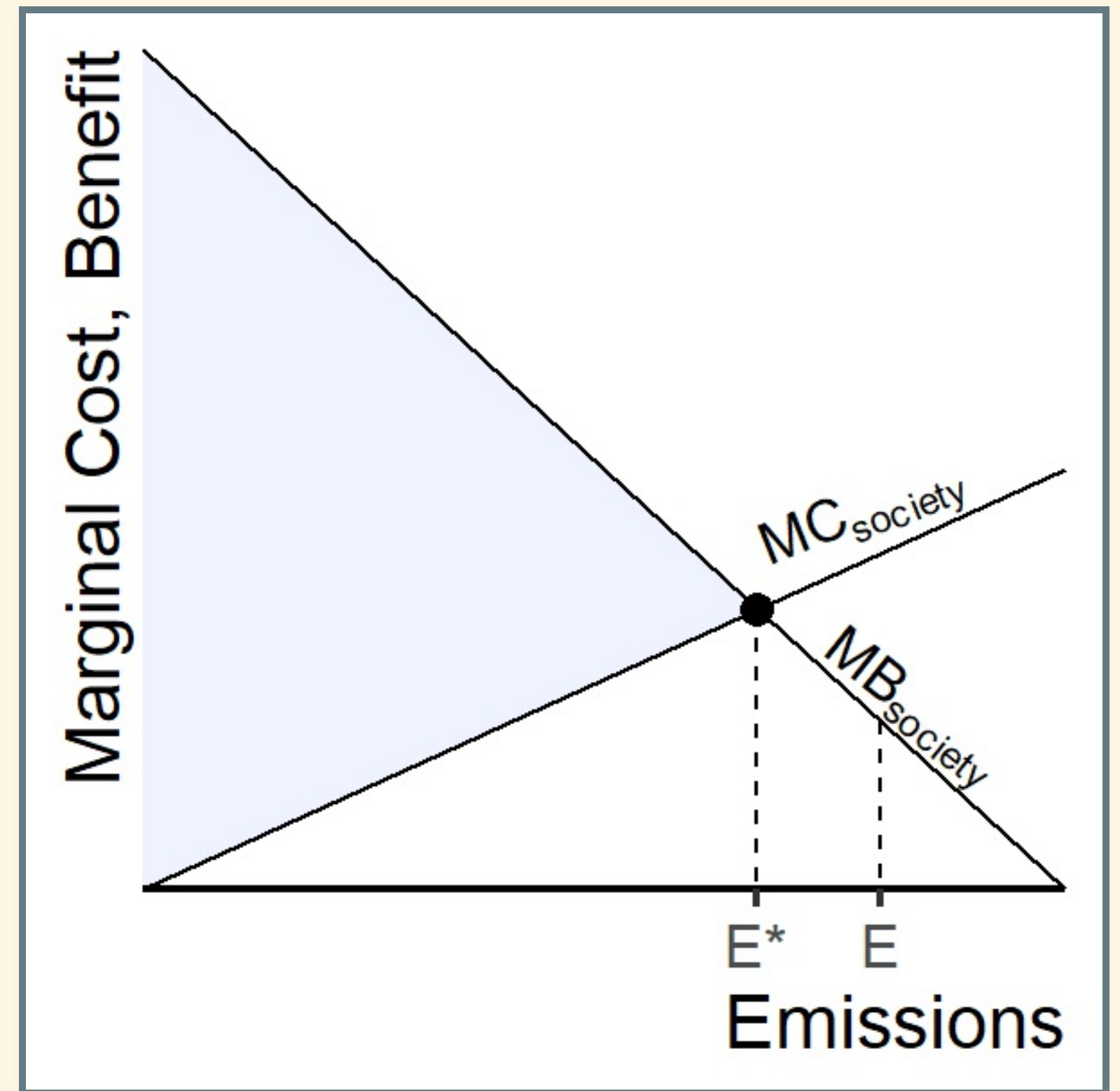
Optimum Emissions

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



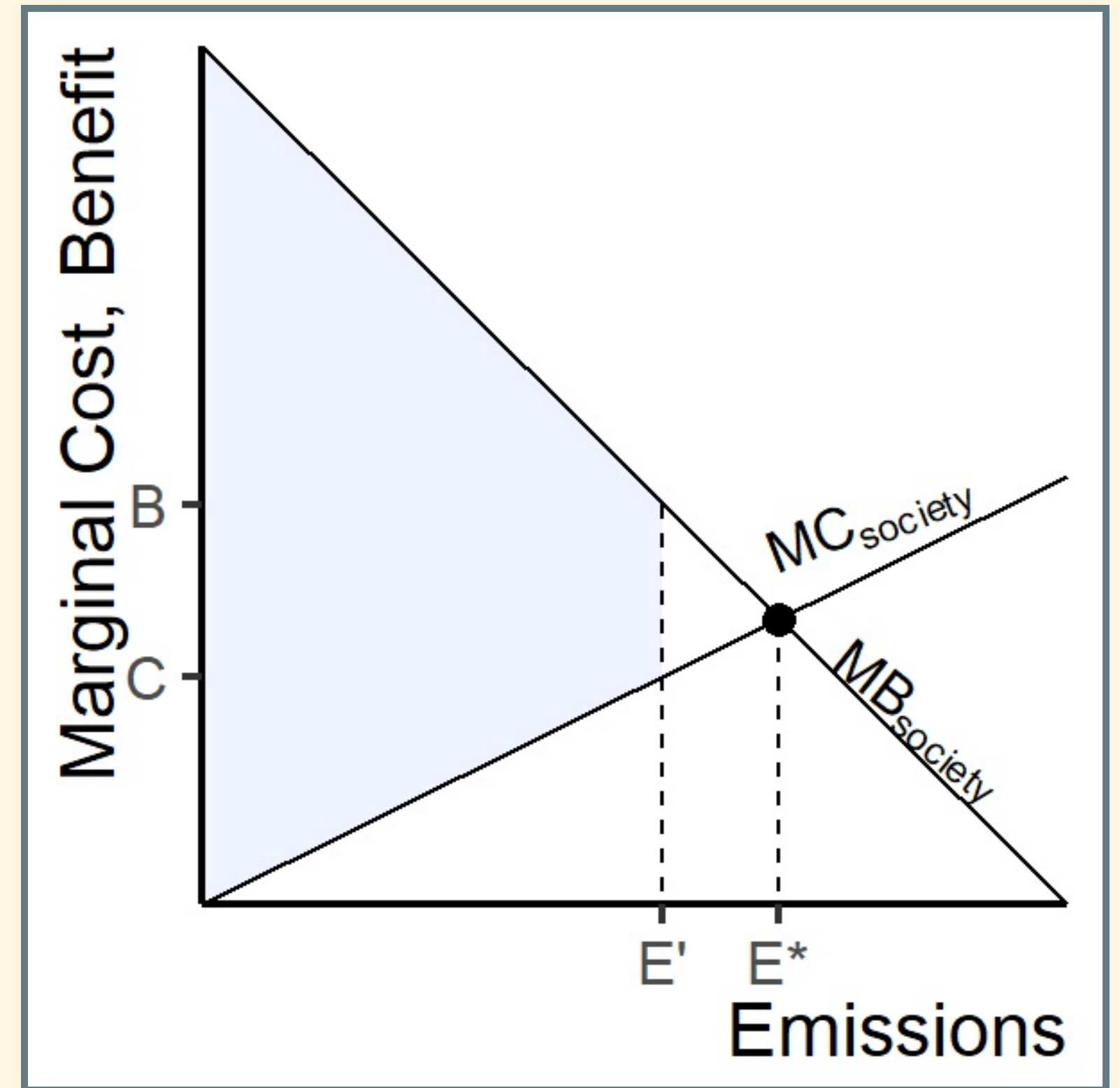
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Deadweight Losses

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



Deadweight Losses

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

