15.023J / 12.848J / ESD.128J Global Climate Change: Economics, Science, and Policy
Spring 2008

Today in Context

Topics to date:

- Climate Science
- Politics and Institutions
- Economics
  - Emissions Projections
  - Mitigation Costs
  - Benefits
  - Policy Analysis (Certainty)

Today ➡ Policy Instrument Choice

Regulatory Instrument Design

- Given a desired reduction in GHG emissions, how do you design the regulation?
- What are the differences between alternative designs?
- On what basis should the approach be chosen?
  - Environmental effectiveness
  - Cost-effectiveness
  - Distributional equity
  - Performance under uncertainty
  - Political feasibility

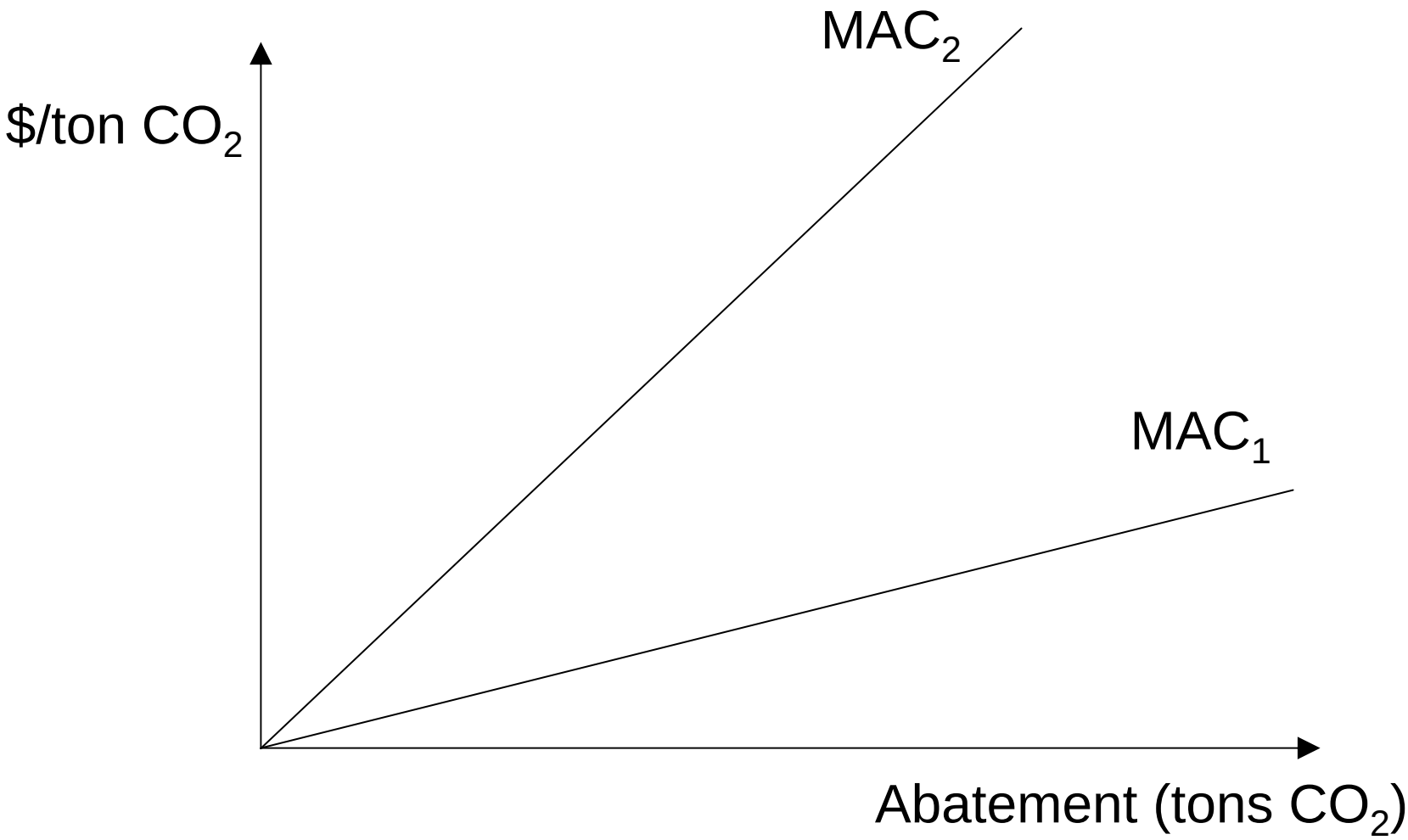
Alternative Instrument Types

- "Command-and-Control"
  - Technology standards
  - Performance
- "Market-Based"
  - Cap-and-trade system
  - Emissions fee (e.g., carbon tax)
- R&D Based
  - Tax credits/subsidies
  - Direct R&D Spending

CAC *vs.* MB

- Command-and-Control
  - Administrative Ease
  - Regulatory “certainty” (?)
- Market-Based
  - Cost-effective -> Why?
    - Equalizes Marginal Costs

Allocation Problem with 2 Sources



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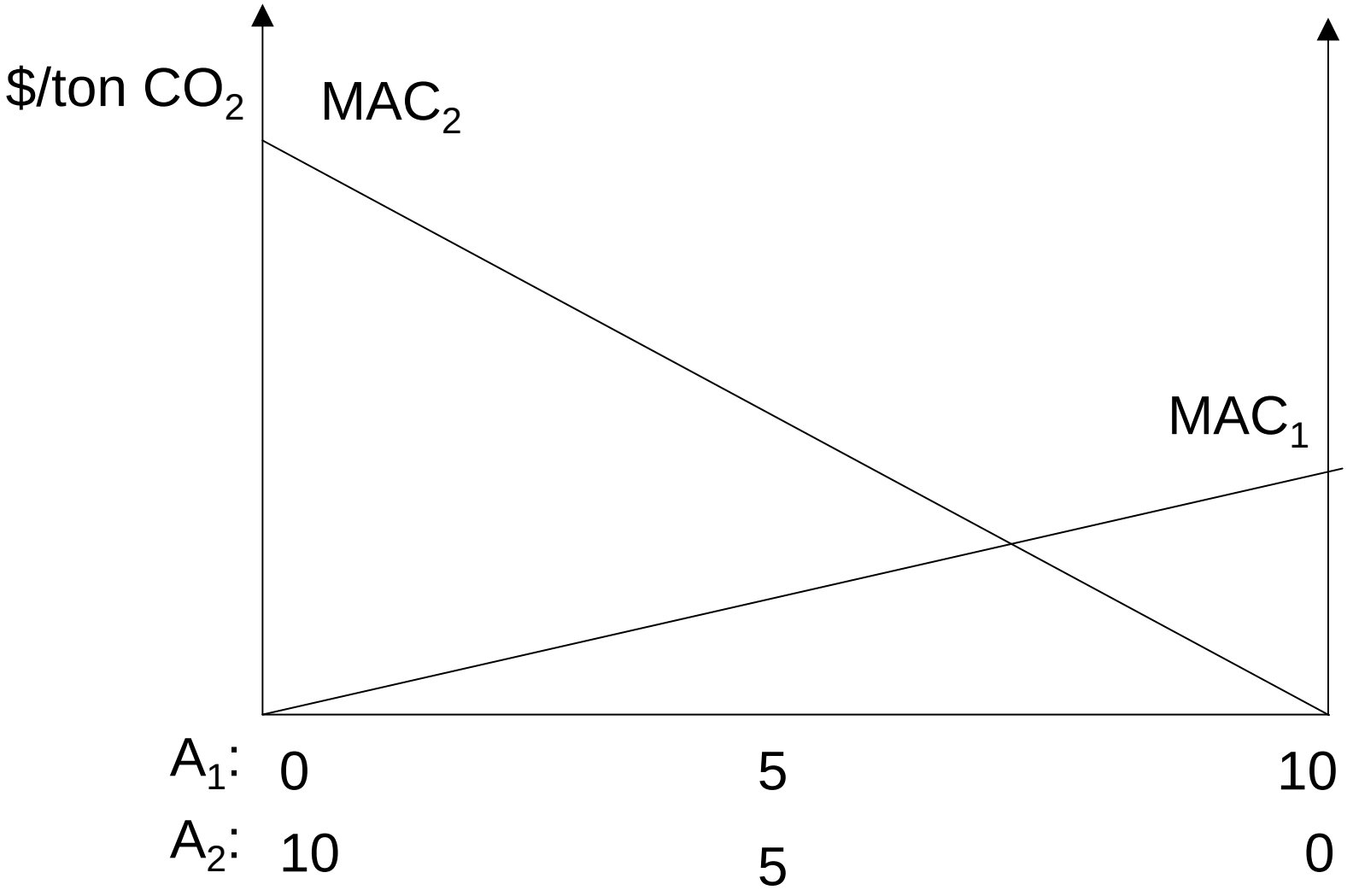

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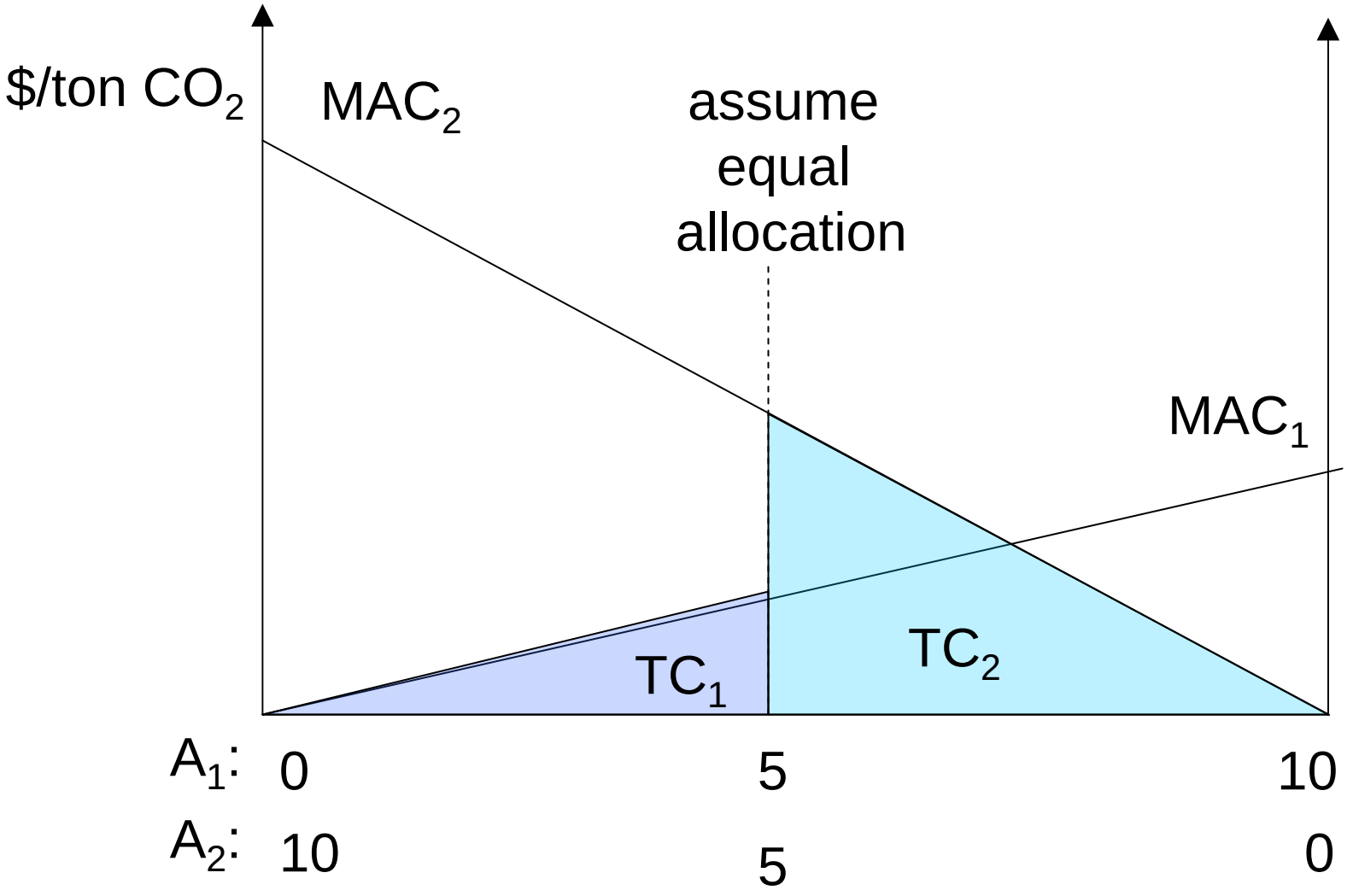

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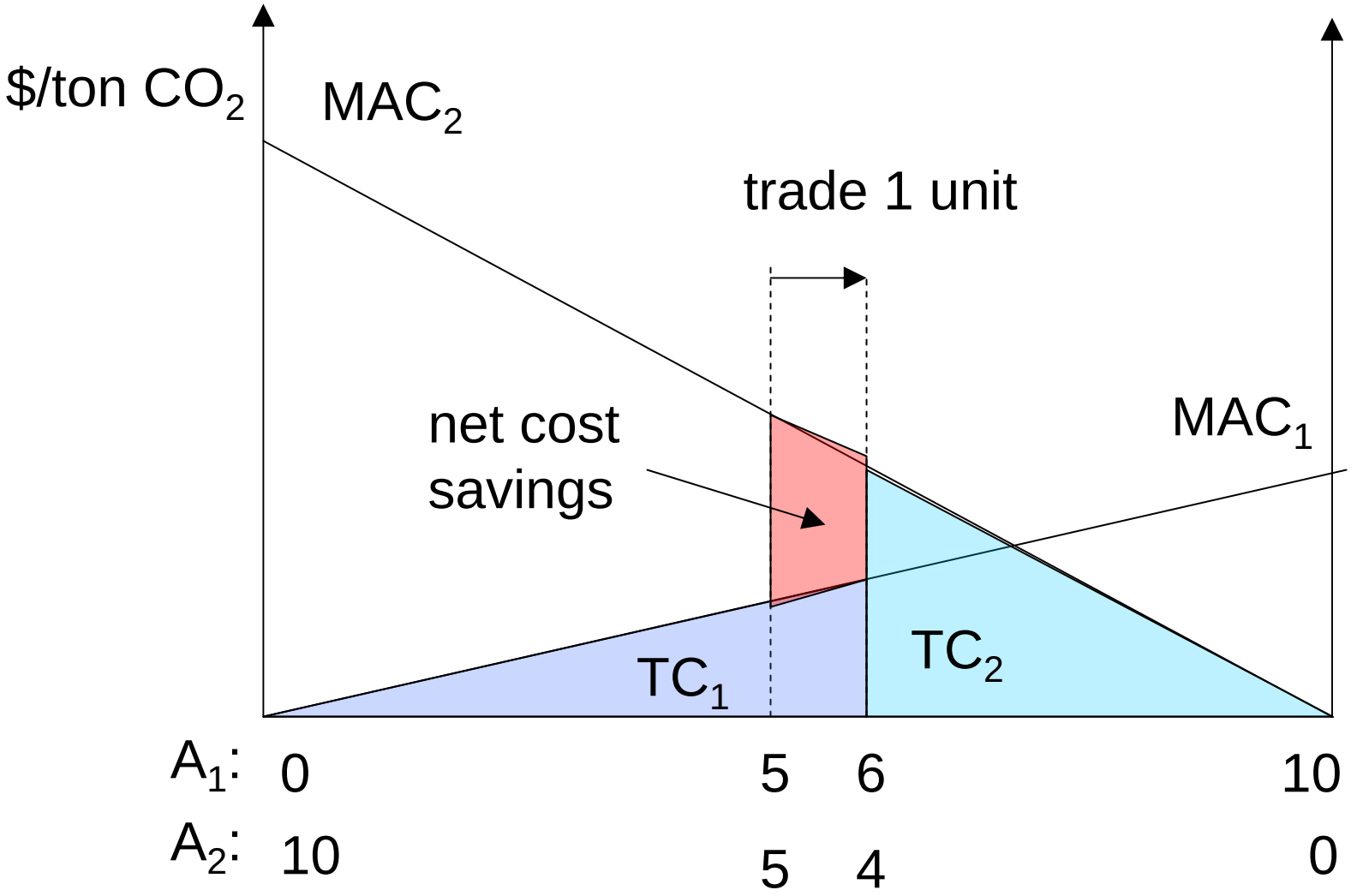

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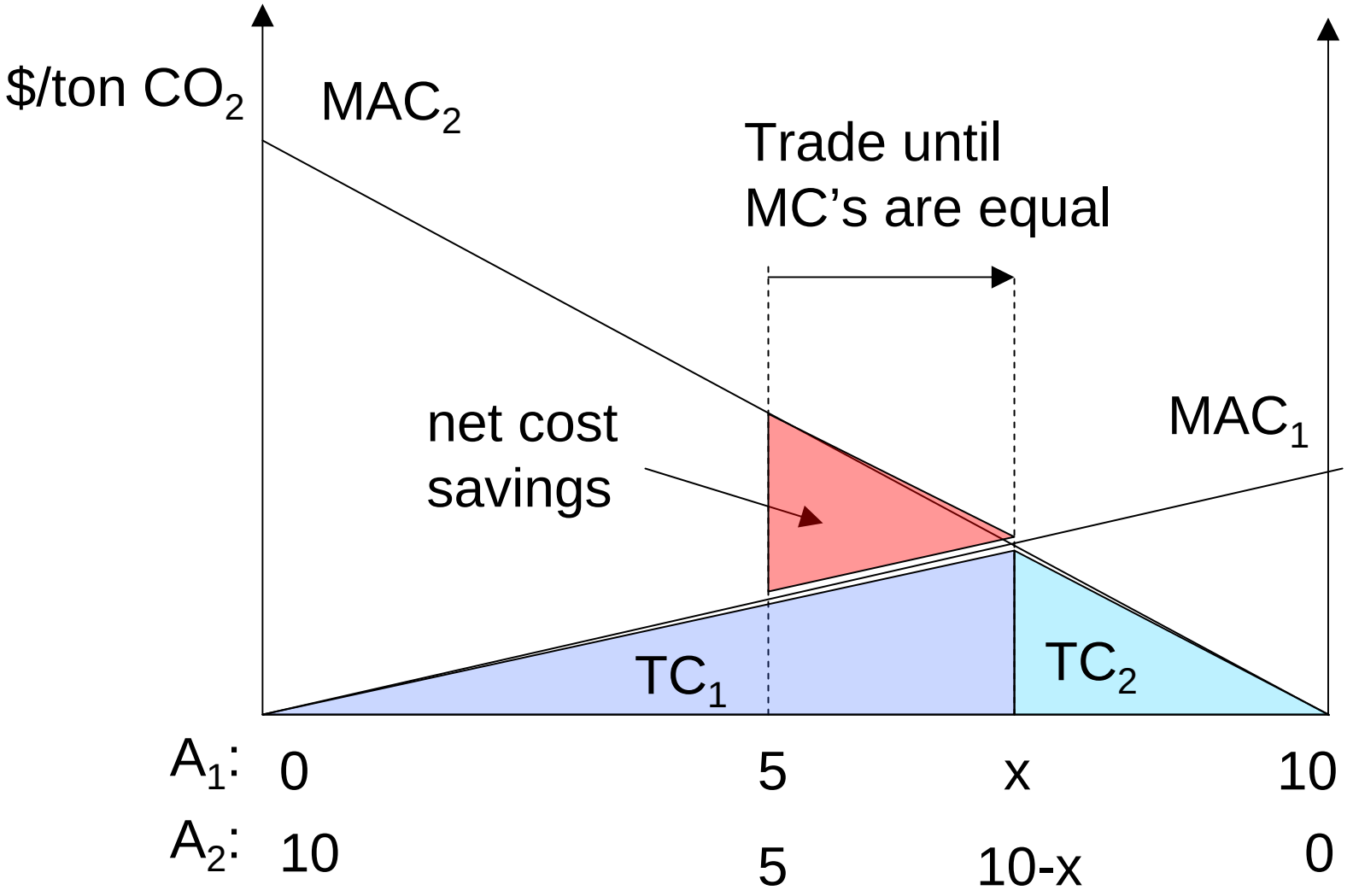


Cost-effectiveness

- Cannot do better than equal marginal costs
- Same analysis holds for
  - Different firms
  - Different industries
  - Different countries

Examples of Emissions Trading

- US experience
  - Phasedown of leaded gasoline in 1980s
  - CFCs/Montreal Protocol
  - CAAA 1990 SO_2 permit trading
  - RECLAIM in S. CA (SO_2 and NO_x)
  - NO_x emissions under Ozone Transport Commission (OTC)
- International experience
  - EU Emissions Trading Scheme
  - Kyoto Protocol

Tax *vs*. Cap-&-Trade

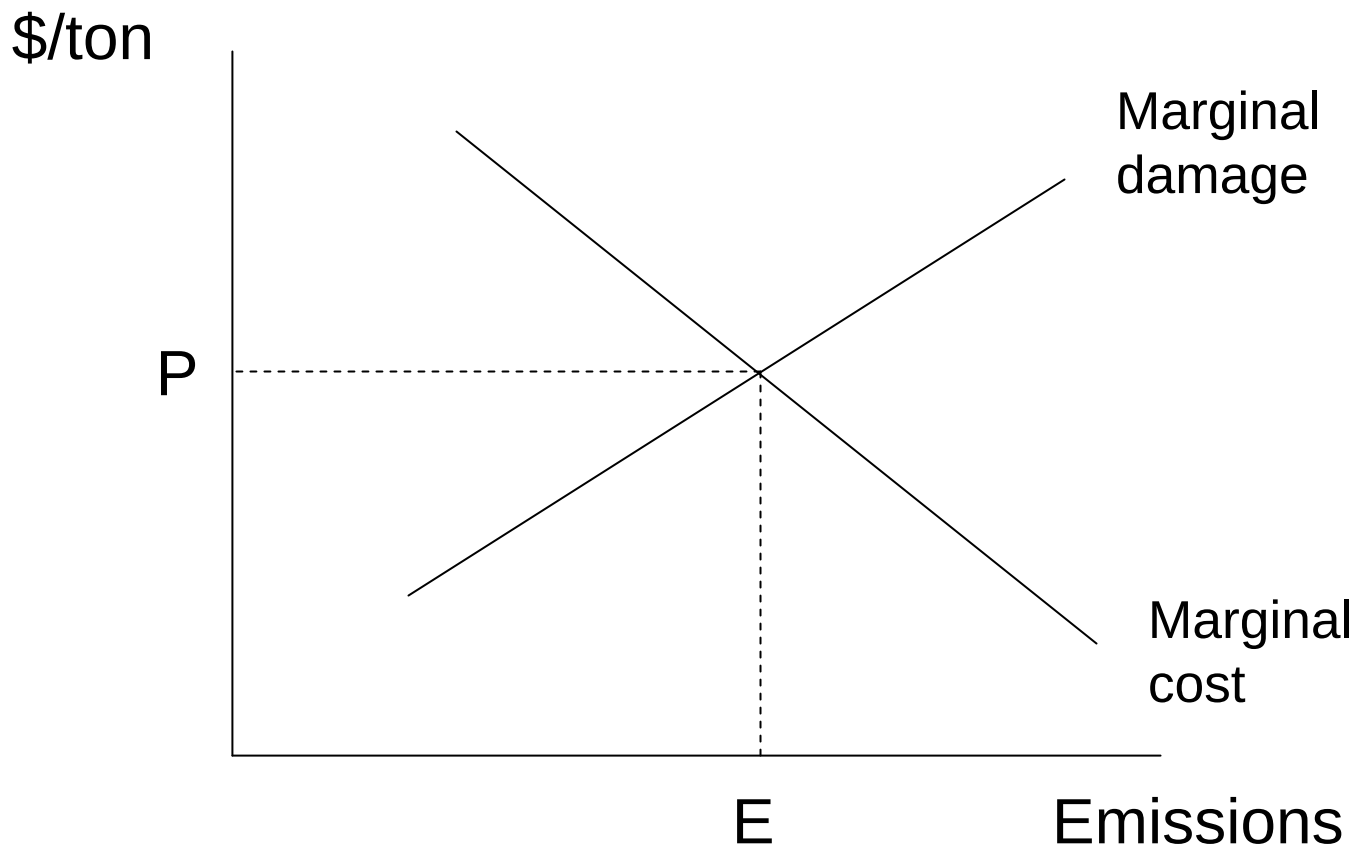
- Pros for tax?
  -
  -
  -
  -
- Pros for cap-and-trade?
  -
  -
  -
  -

Tax *vs*. Cap-&-Trade

- Pros for tax?
  - No price volatility
  - Revenue allows for “double-dividend”
  - Can address distributional effects (consumers)
  - Uncertainty argument (flat marginal benefits)

- Pros for cap-&-trade?
  - Emissions certainty
  - Can raise revenues through auctioning
  - Can address distributional effects (producers)
  - Political feasibility in U.S.

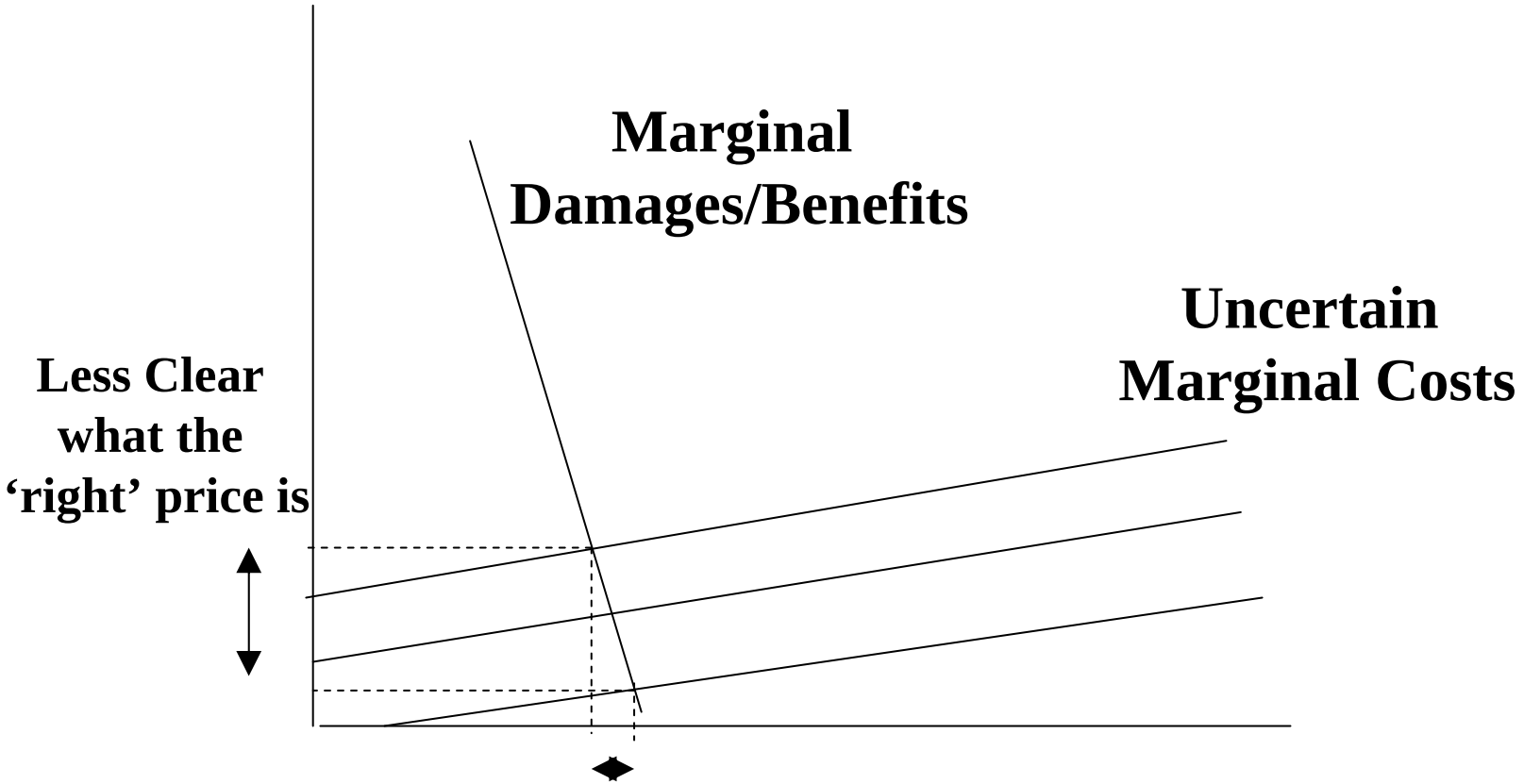
Efficient Abatement Under Certainty



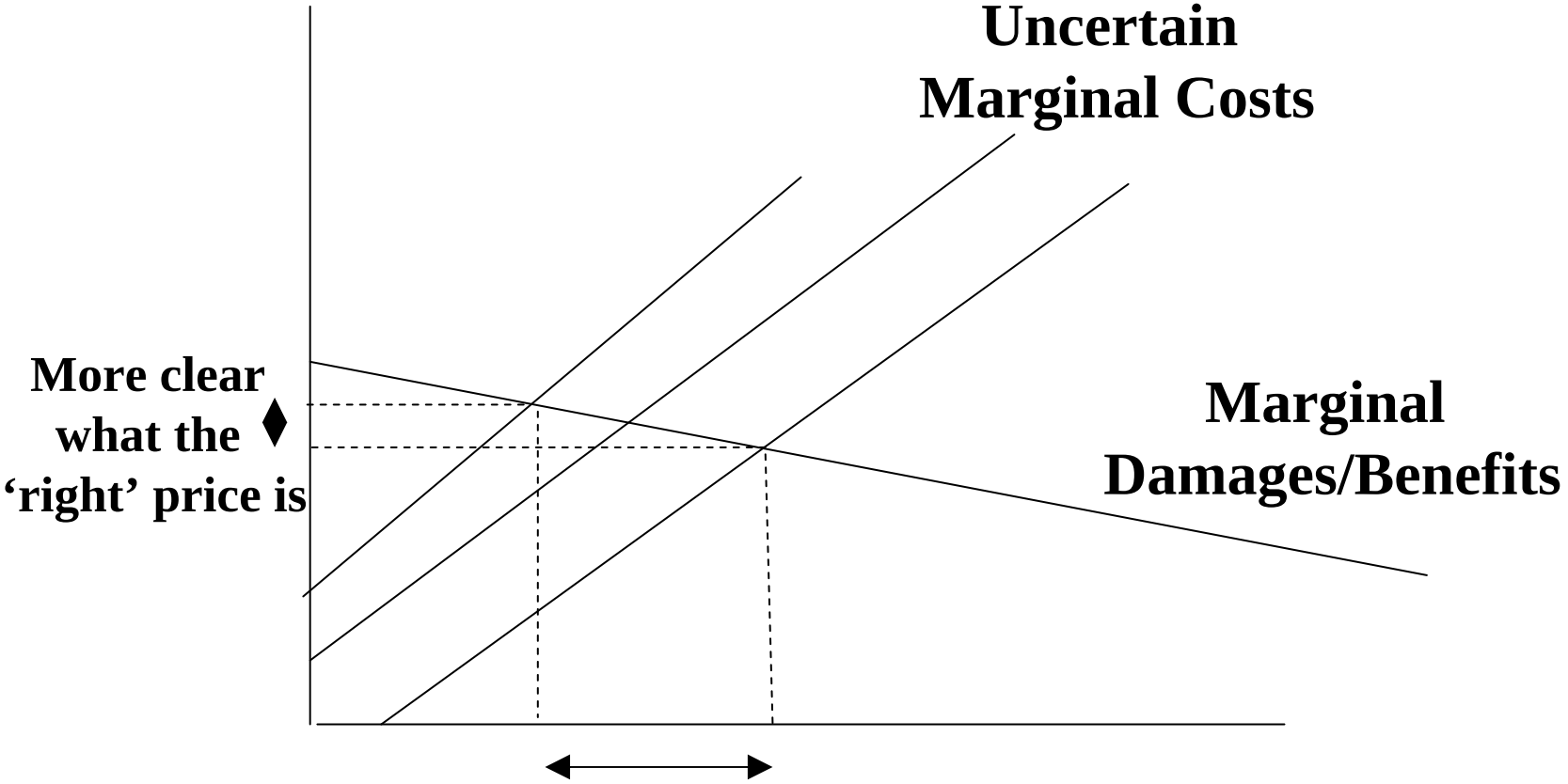
Weitzman (1974)

- When uncertain, which should we use?
- Answer: Look at the *relative slopes* of marginal costs and marginal damages
- If Marginal damages relatively STEEP, use QUANTITY instrument
- If marginal damages are relatively FLAT, use PRICE instrument

Steep MD: Price Uncertainty Bigger



Flat MD: Quant. Uncertainty Bigger



Dilemma for the U.S.

- Marginal Climate Change Damages are FLAT

  (in emissions, the relevant var. for policy)
- Given uncertainty, should use CARBON TAX
- BUT…
- U.S. is “allergic” to taxes
- We like tradable permits (worked for SO_2)

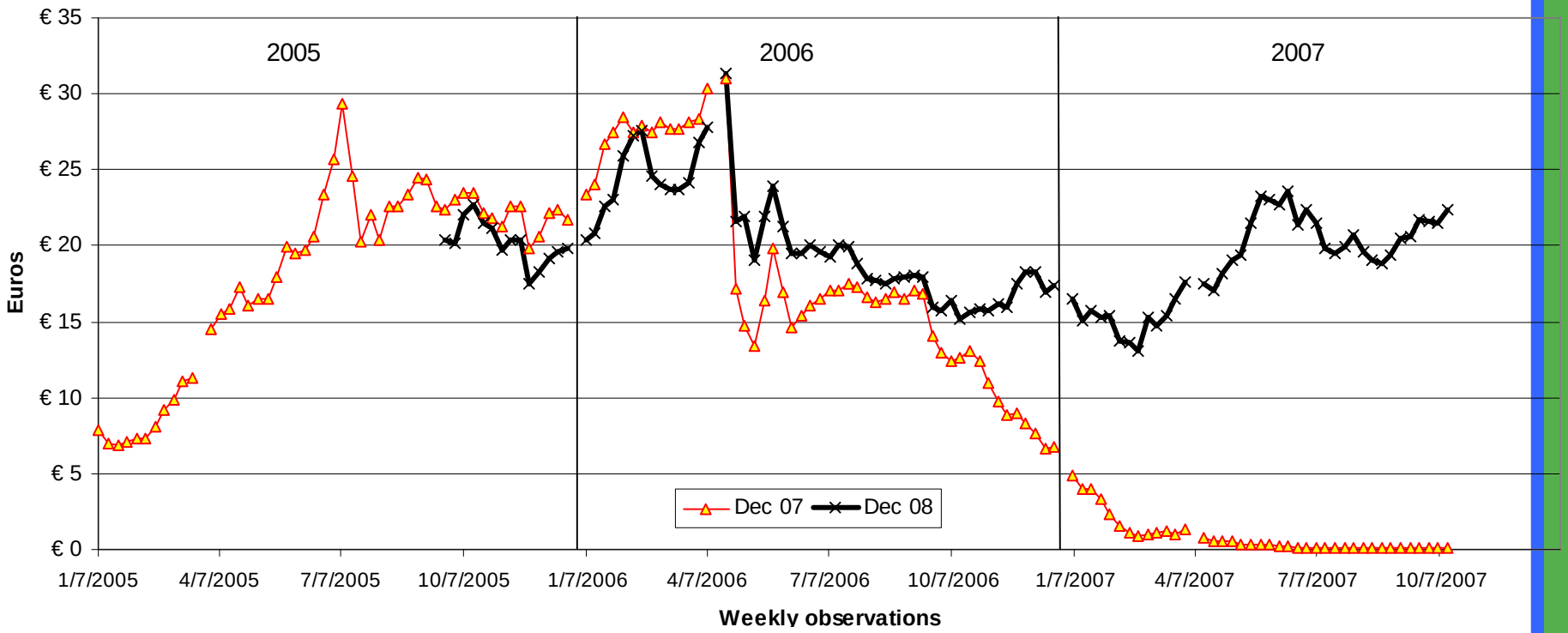
Modifications to Cap & Trade

- Safety Valve
- Emissions Intensity Target
- Banking and Borrowing

Issues in Cap-&-Trade Design

- Coverage
  - Sectors
  - Gases
- Stringency of the target, and path
- Method of allowance allocation
- Banking and borrowing
- Point of regulation
- Safety valve
- Revenue use
- International linkage
  - Trade in goods
  - Trade in allowances

ETS Price History



Issues in Allowance Allocation

- Why does it matter?
- Auction *vs*. distribute for free
- Who should get permits if given away?
  - Economics
  - Politics
- Revenue recycling and “double dividend”
- Special issues of regulated utilities

Analysis of Current US Bills

- Simplified versions to span the range
  - Emissions 2012-2050 for “core” examples
  - Safety valve version (not handed out)
- Handling of actions abroad
  - Europe, Japan, Canada, Aus & NZ decline gradually from Kyoto period to 50% below 1990 by 2050
  - All others begin in 2025, to 2015 level by 2030, hold 2000 level 2035-2050
- Ignore command-&-control features

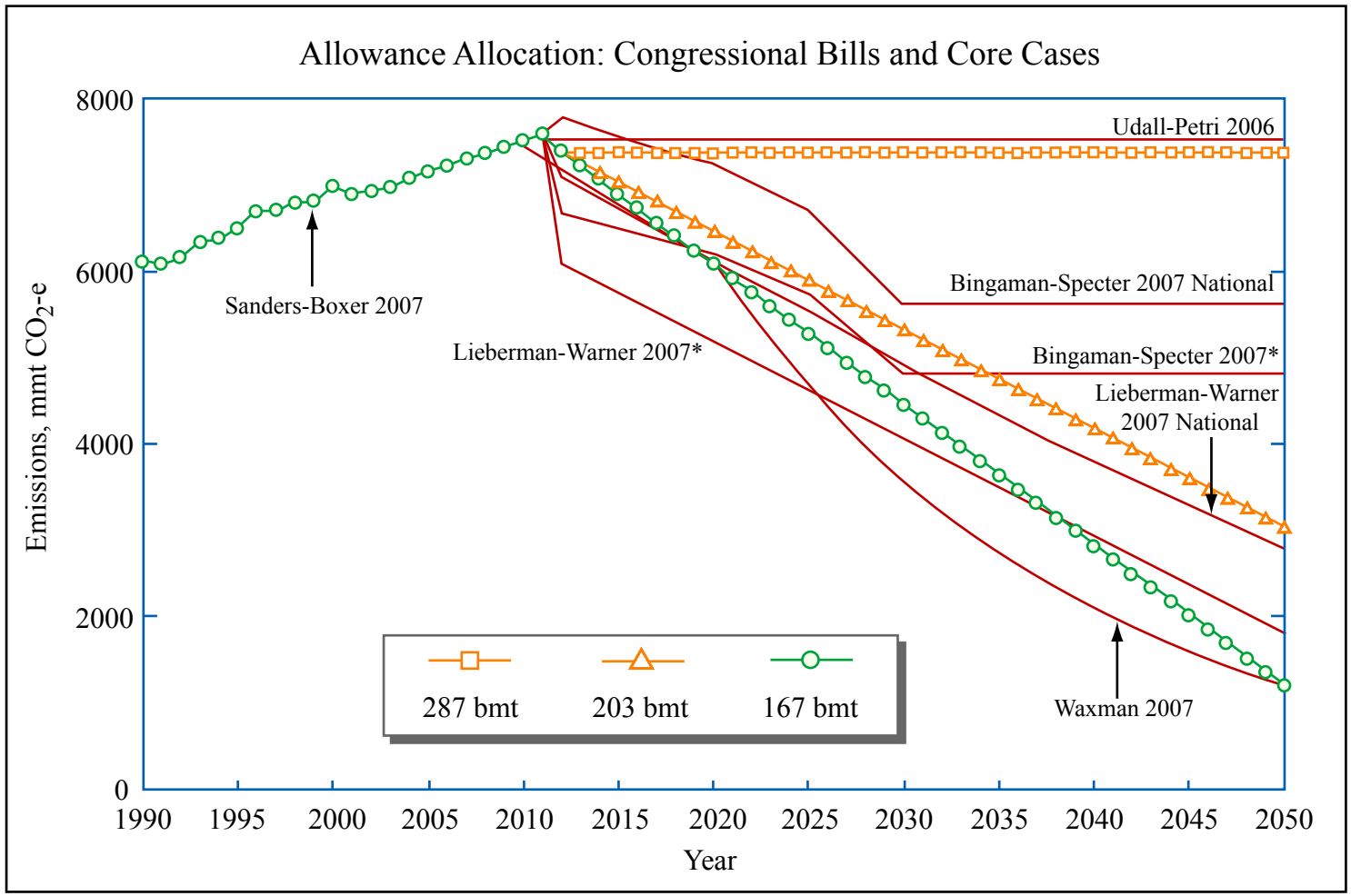
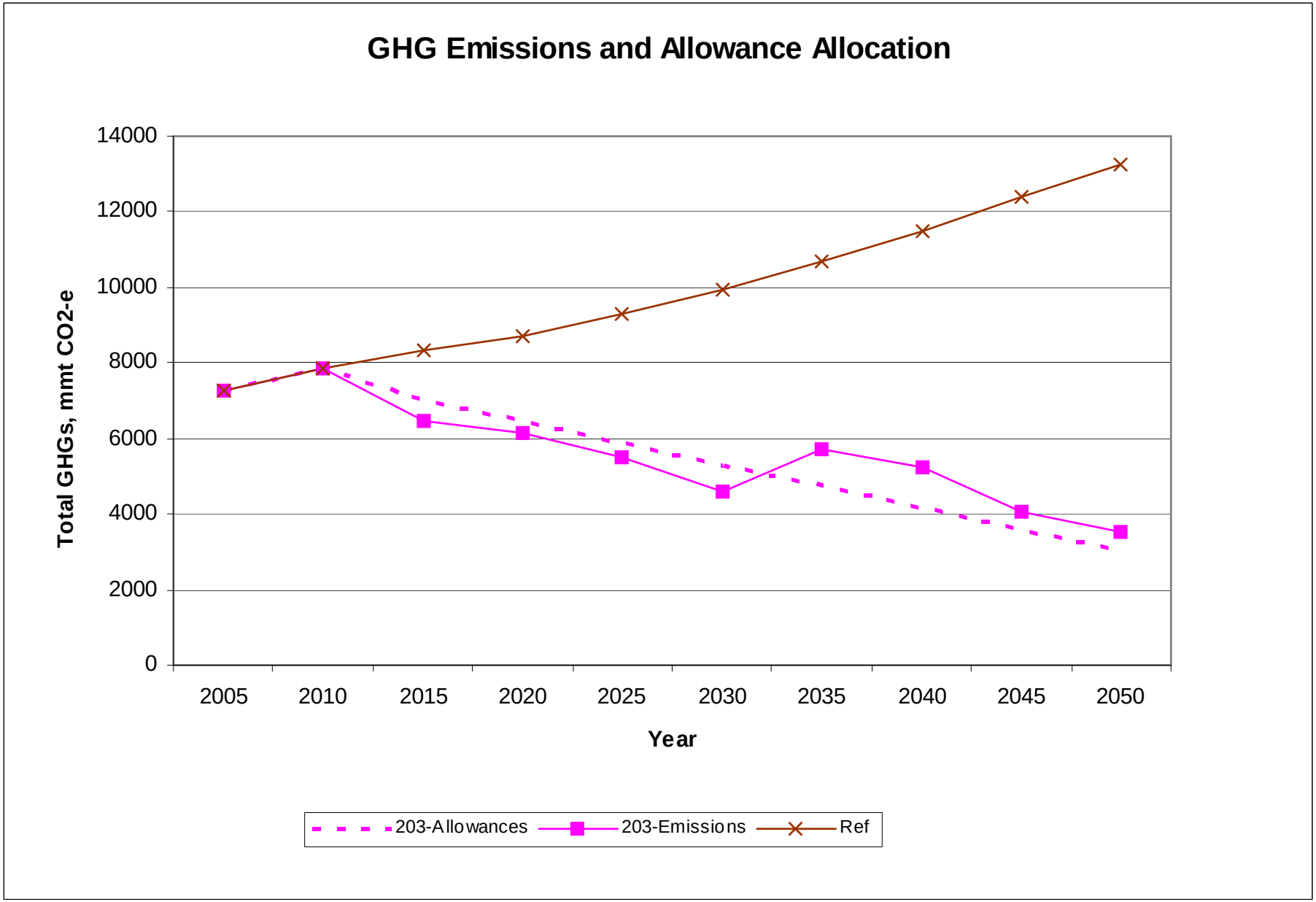
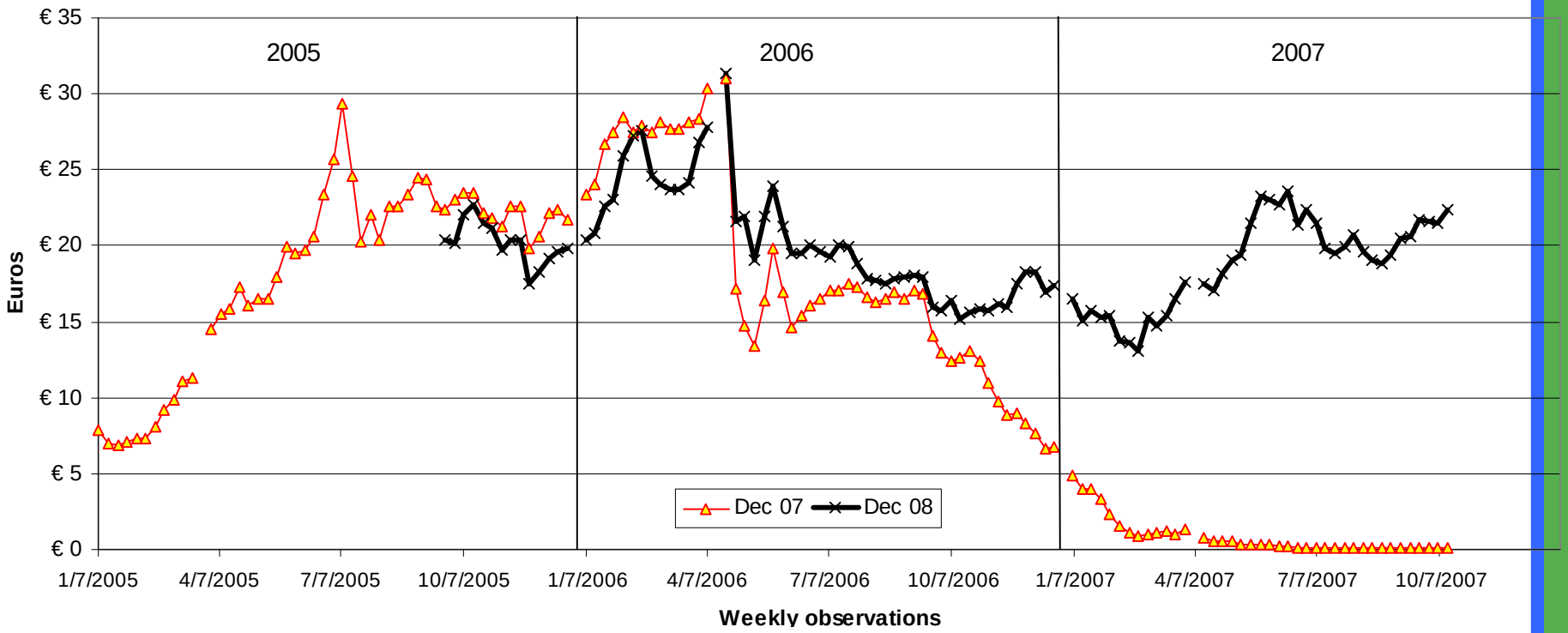
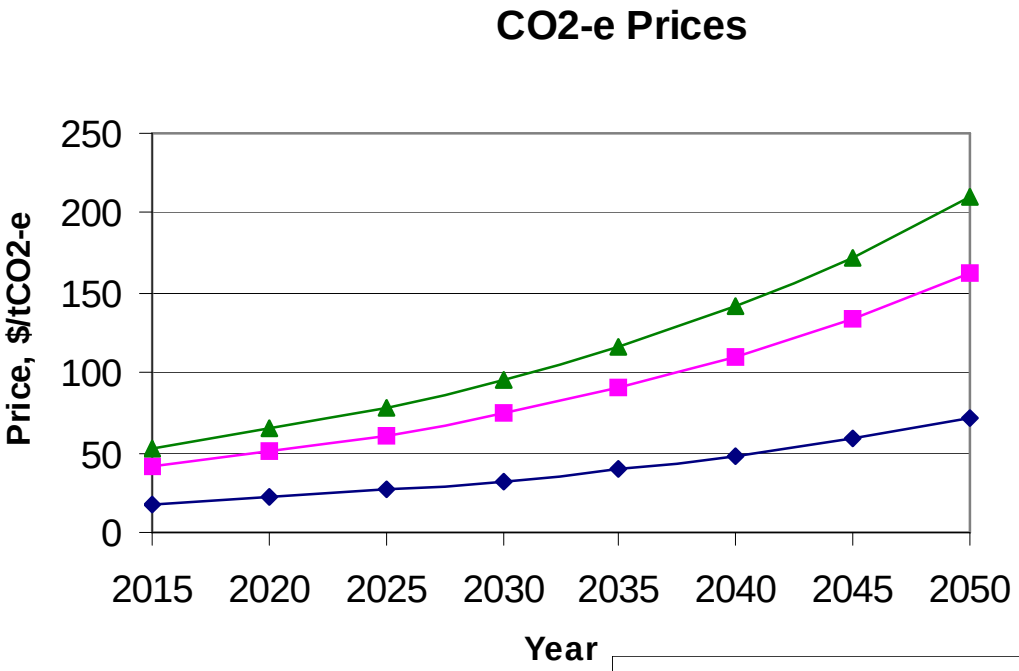


Figure by MIT OpenCourseWare.

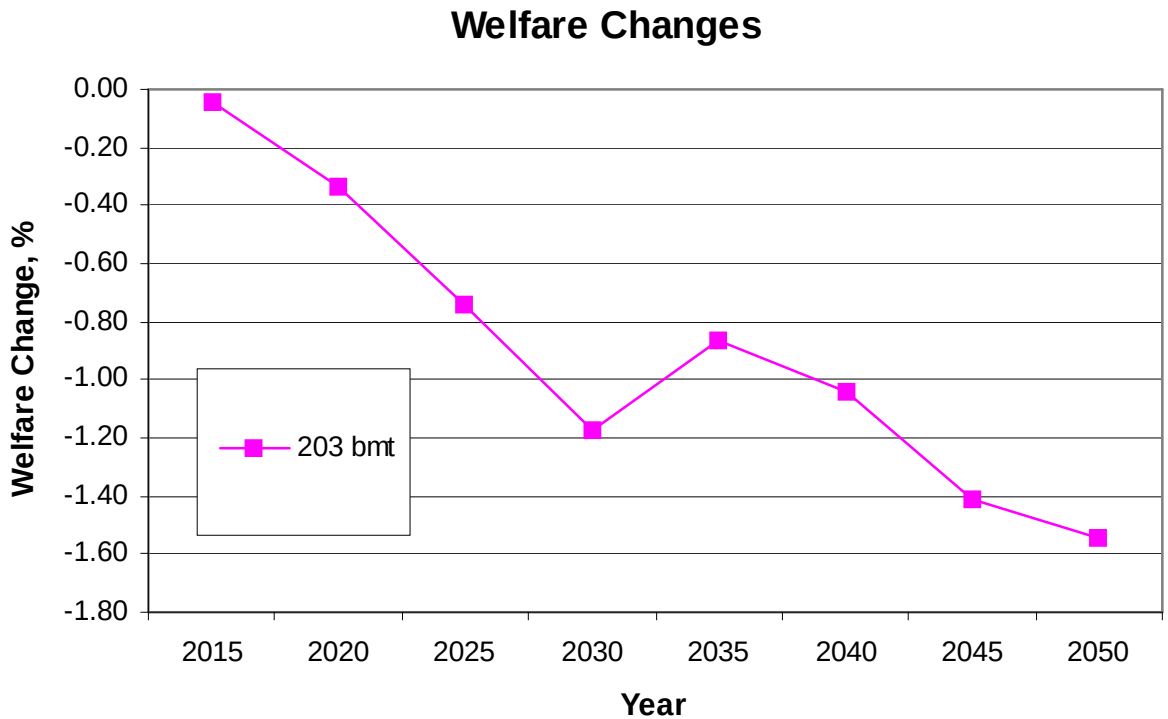

GHG Emissions and Allowance Allocation
Total GHGs, mmt CO2-e
14000
12000
10000
8000
6000
4000
2000
0
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
203-Allowances
203-Emissions
Ref

ETS Price History

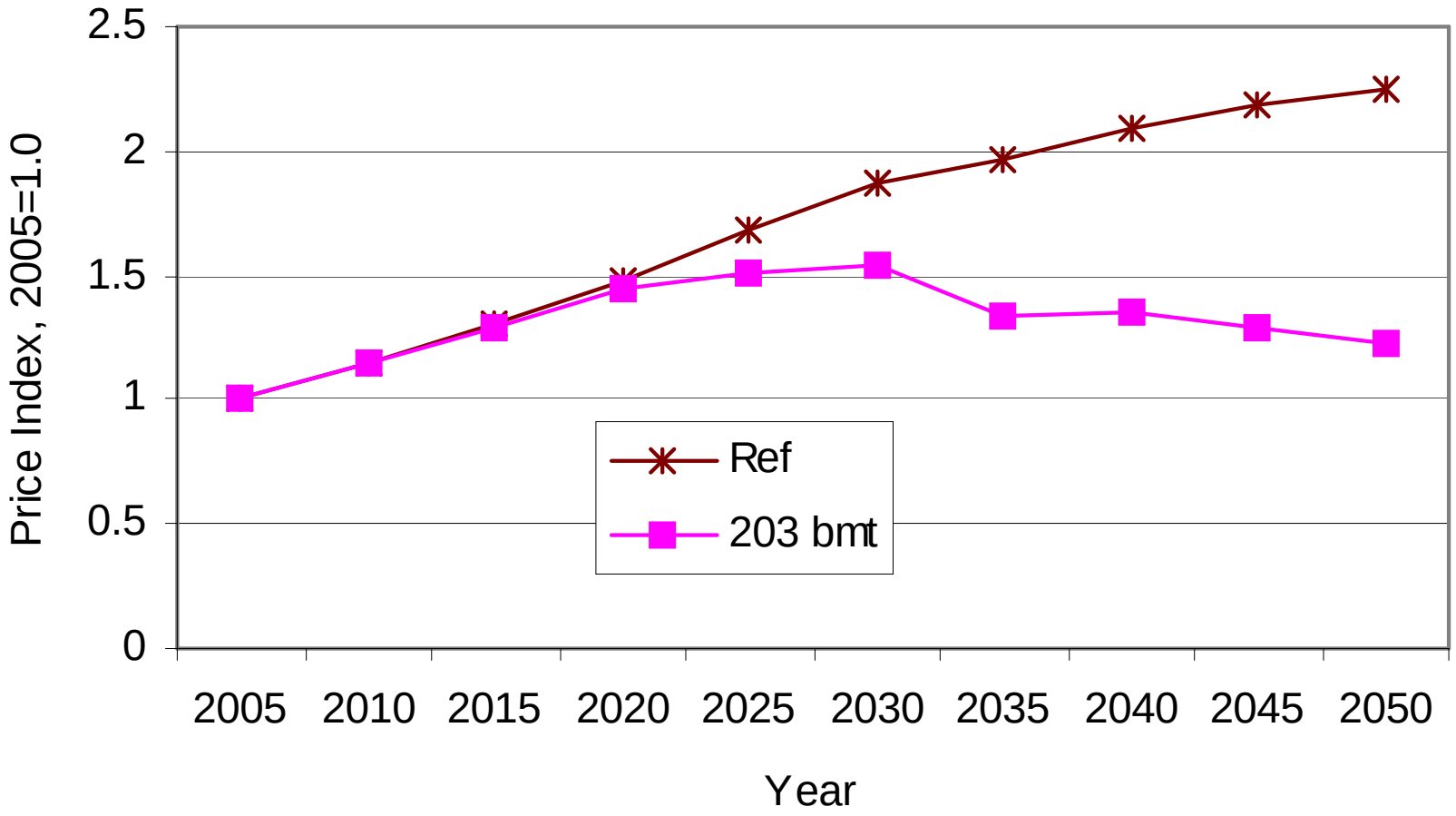


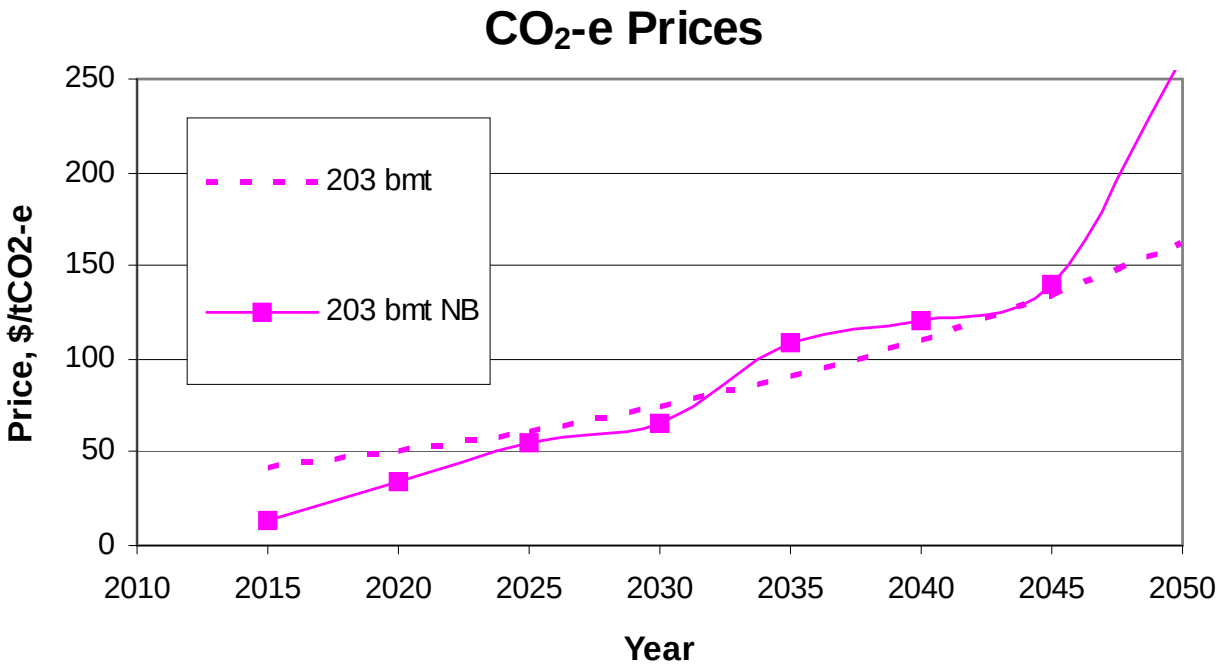


Case with banking

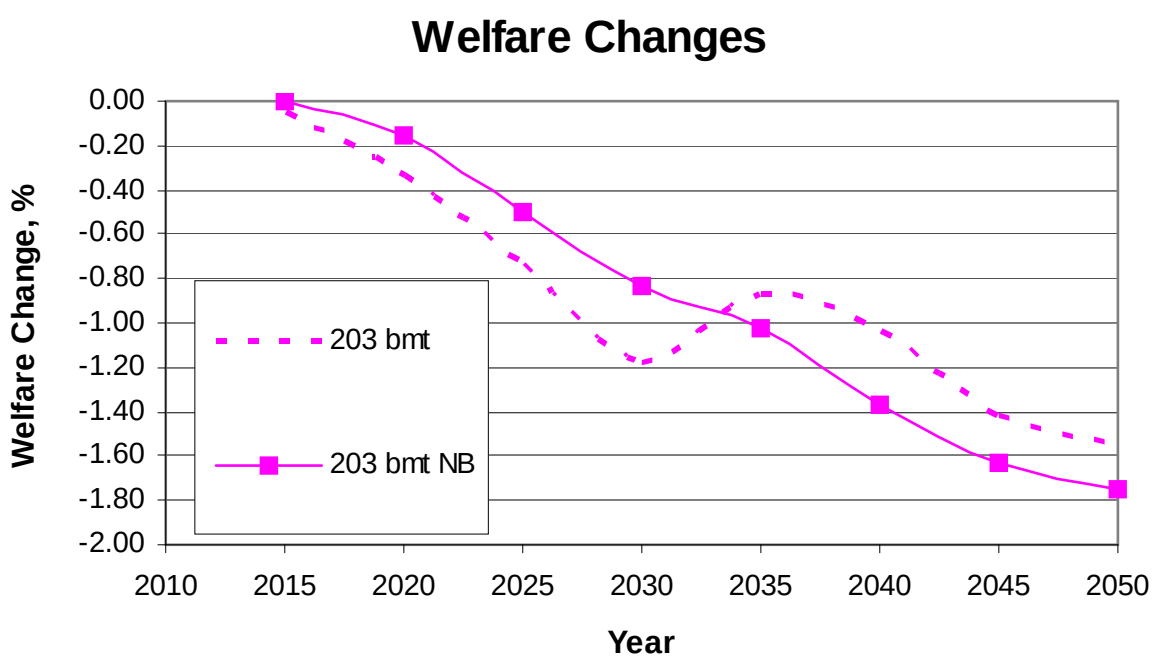


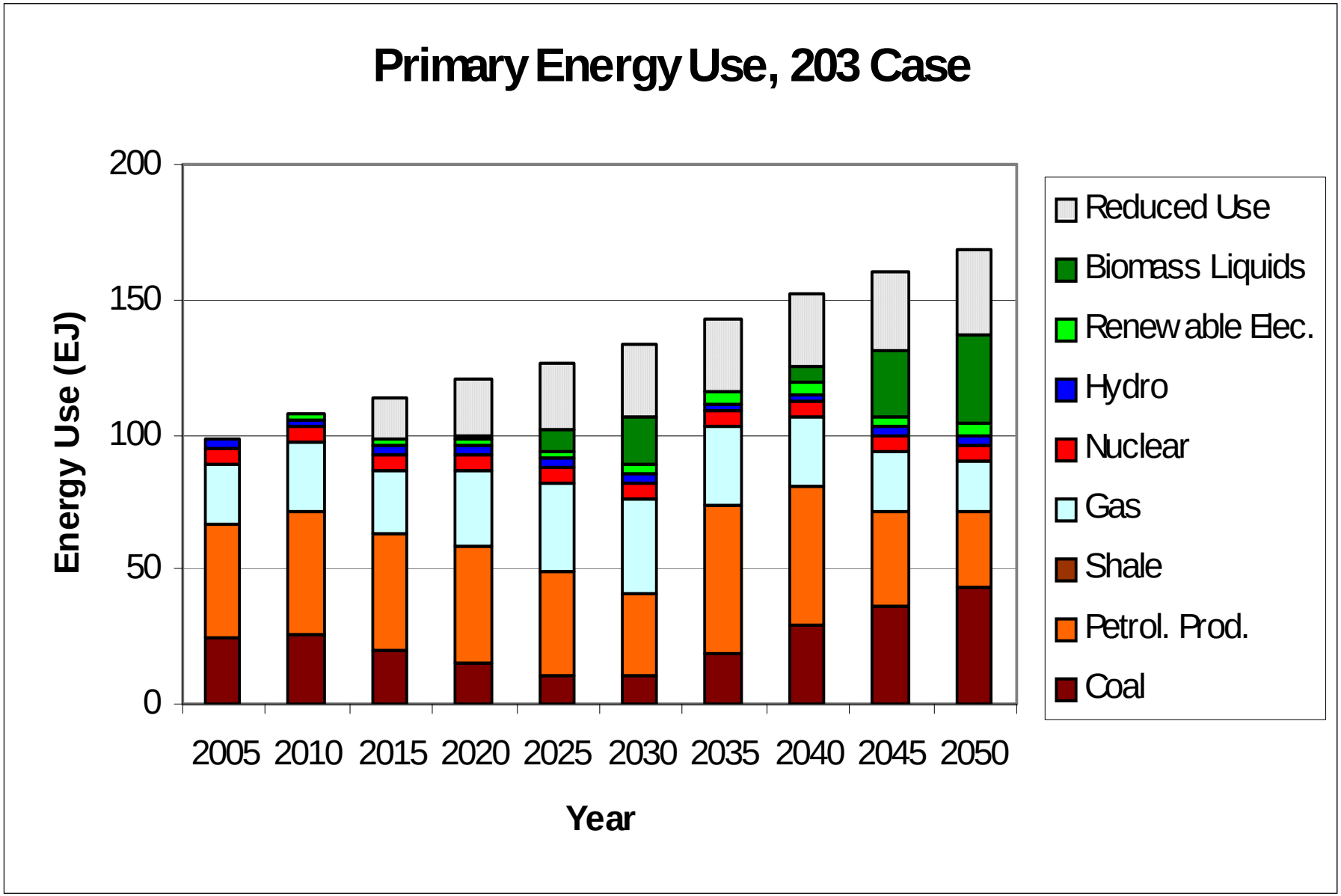
Effects on Petroleum Prices

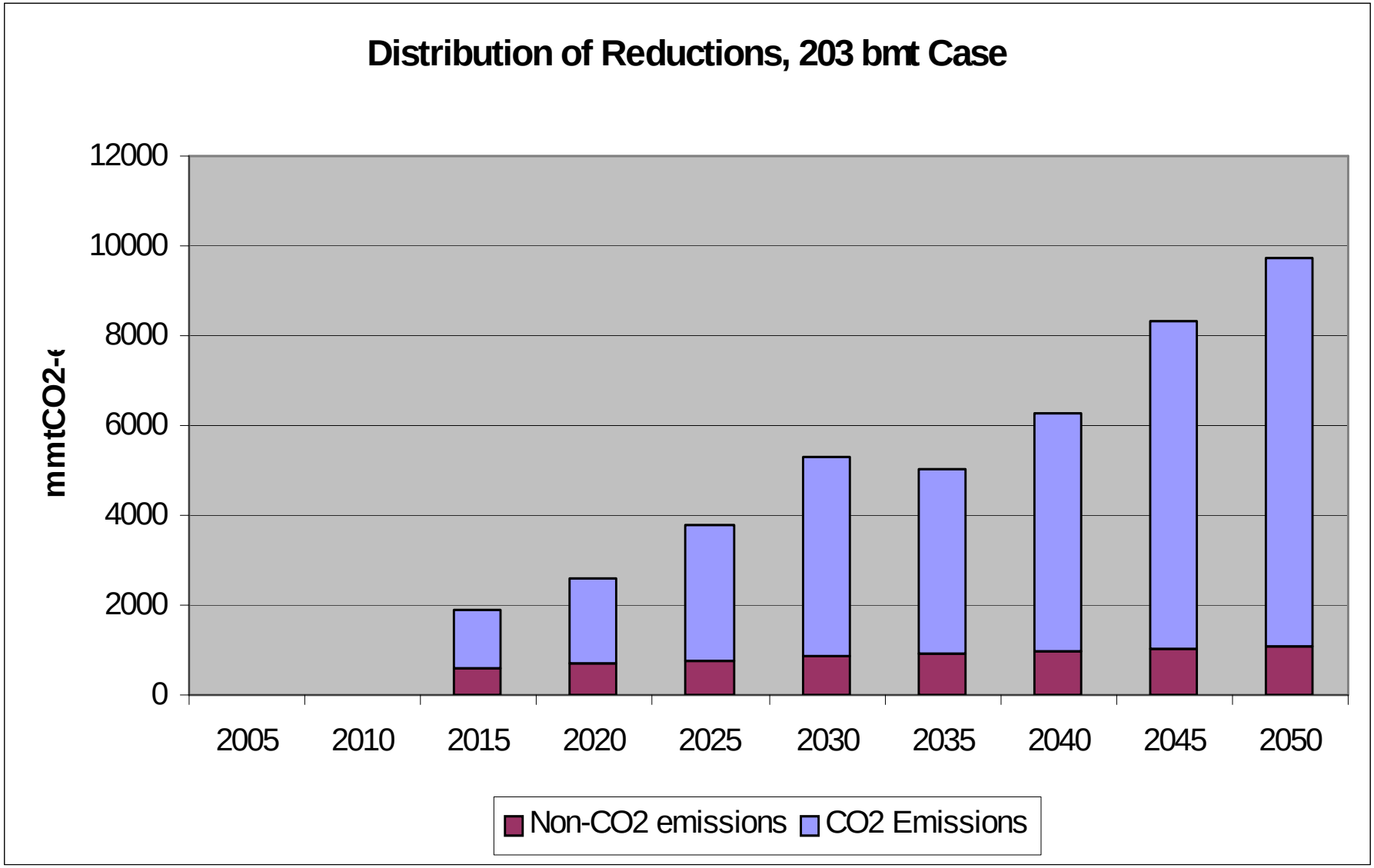




Effect of banking on price & cost




Primary Energy Use, 203 Case
Energy Use (EJ)
200
150
100
50
0
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
Reduced Use
Biomass Liquids
Renewable Elec.
Hydro
Nuclear
Gas
Shale
Petrol. Prod.
Coal


Distribution of Reductions, 203 bmt Case
mmtCO2-e
12000
10000
8000
6000
4000
2000
0
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Non-CO2 emissions
CO2 Emissions

Impacts on Temperature Change

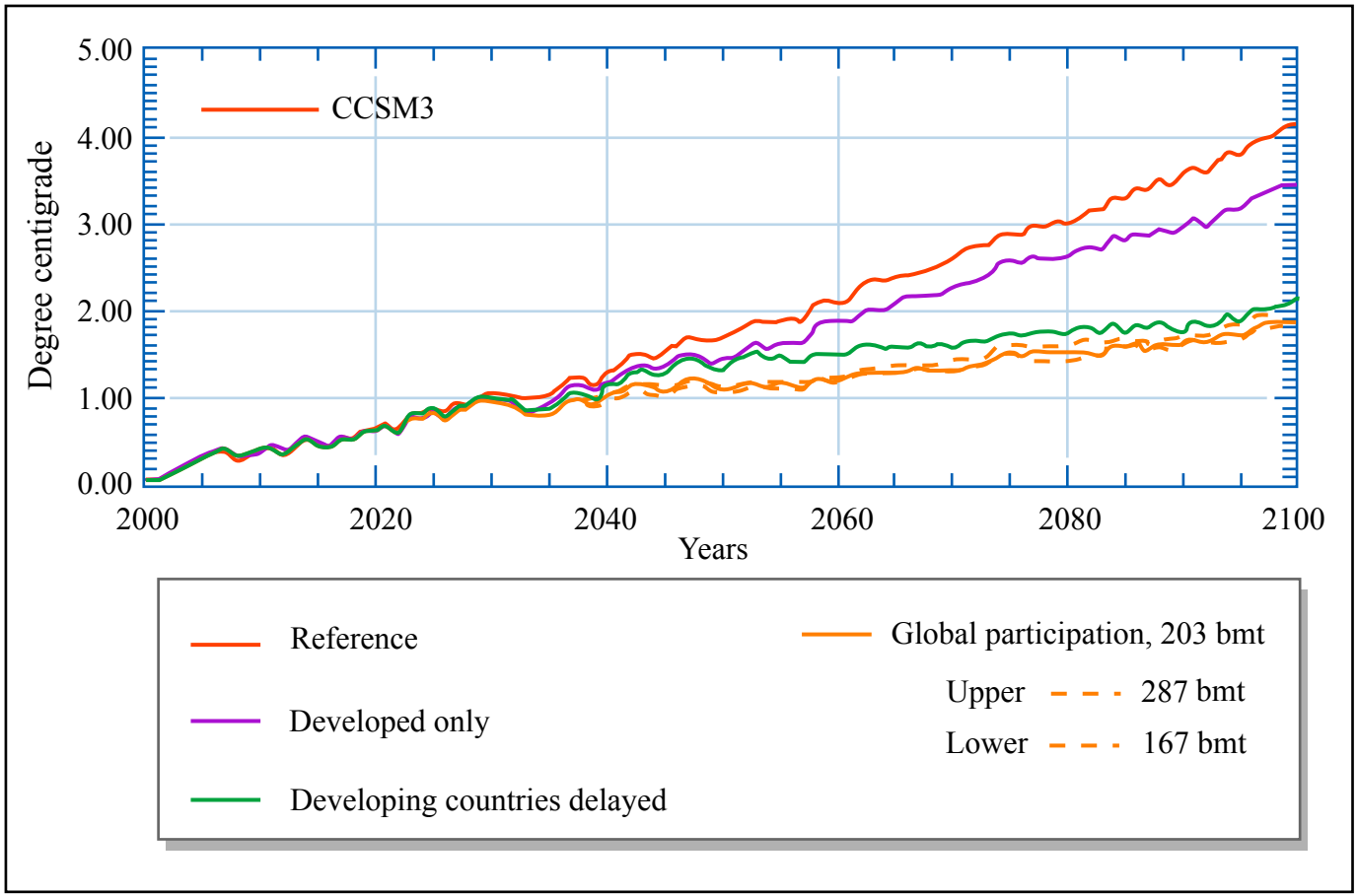


Figure by MIT OpenCourseWare.