Congressional Budget Office

Climate Change: Cost Uncertainties in the Analysis of Climate Change Mitigation Policies

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The Congressional Budget Office

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Economics of Climate Change: The Basics

- **Negative stock externality with very uncertain (and difficult to monetize) effects over long time-span.**
- **Serious free rider problem – effective response likely to require international collective action, but distributional issues make this particularly difficult.**
- **Three potential responses, not mutually exclusive:**
  - Continued research about problem and options;
  - Mitigation: emissions reductions and sequestration;
  - Adaptation: very important, underemphasized.
- **Conclusion from economics: for each response, policy should balance expected marginal costs against expected risk-adjusted discounted marginal damages (just like any investment).**

Policy Responses to Climate Change: Mitigation

- **Classic solution to negative externality problem is to ration use by delineating property rights (Coase).**
  - **Can raise price (i.e. tax) with uncertainty in resulting quantity of emissions; or**
  - **Restrict quantity (i.e. cap-and-trade) with uncertainty in resulting price.**
- **For a stock externality, the potential cost of guessing wrong on price (such as under a tax) is much smaller than the potential cost of guessing wrong on quantity (such as under cap-and-trade).**
- **Nevertheless, domestic and international political debate has focused on gradually declining emission caps.**

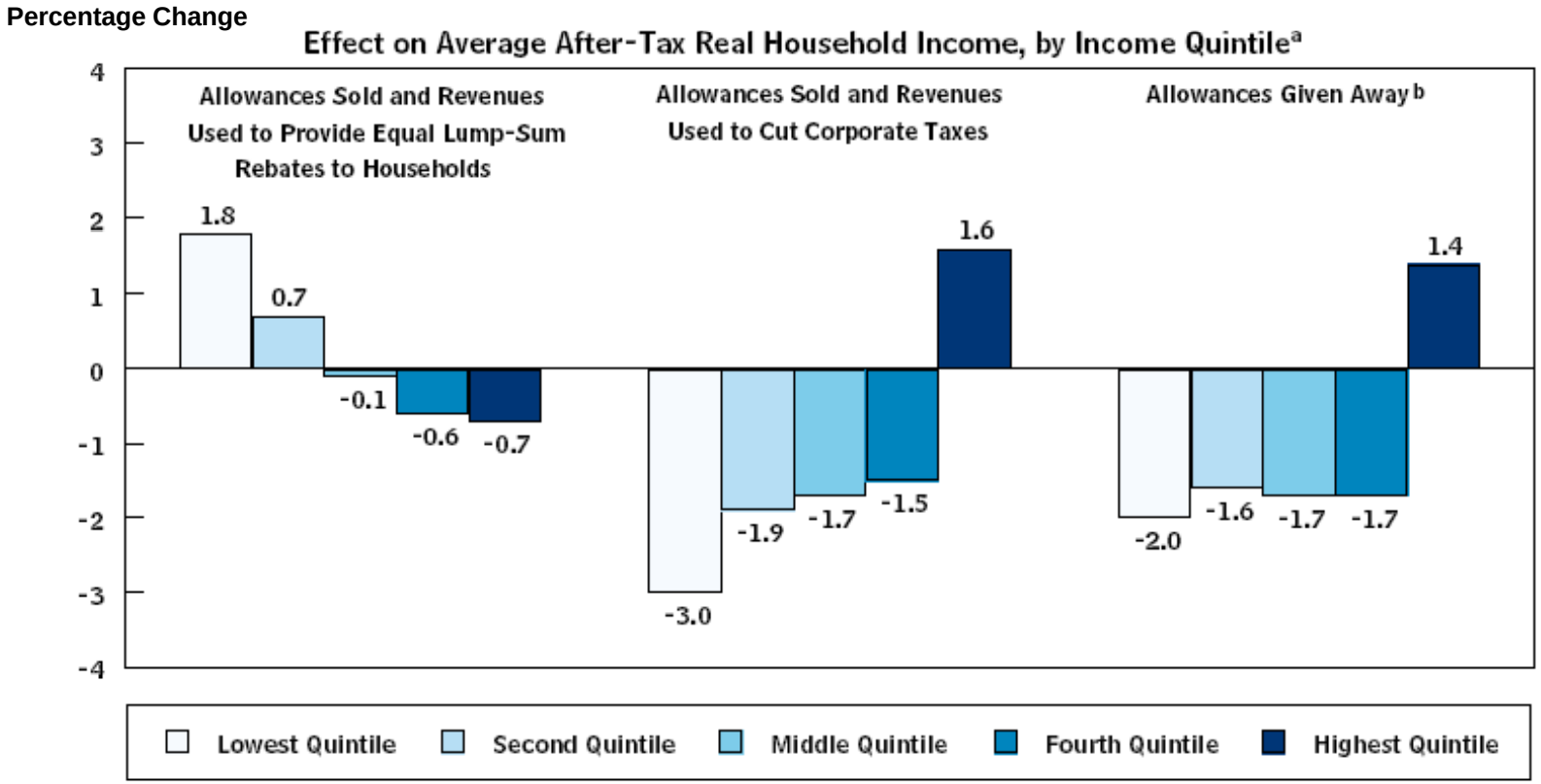
Cap and Trade Policy Design: Flexibility

- **Price floors and ceilings could provide timing flexibility and more certainty about allowance prices:**
  - Floor would tighten cap in low-cost years; ceiling would loosen cap in high-cost years.
  - Floor and ceiling could be adjusted periodically to ensure that emissions are on track to achieve long-term targets.
- **Banking and borrowing allow firms to shift emission reductions across years:**
  - Banking would allow firms to exceed required reductions in low cost years and save the allowances for use in future years.
  - Borrowing would allow firms to use future allowances in current year if allowance prices are high.
- **Tension among elements (e.g. price ceiling plus banking).**

Cap and Trade Policy Design: Allocation

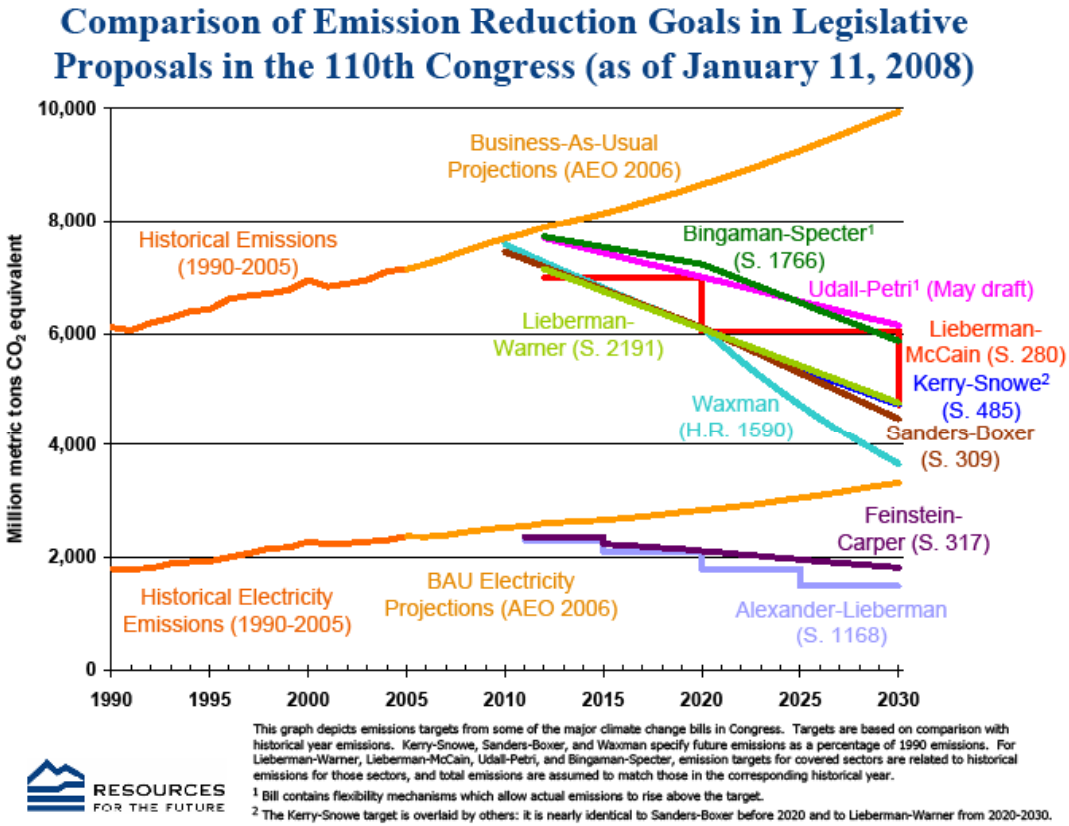
- **Market forces determine who bears the cost of allowances:**
  - **Allowance costs become a part of doing business.**
  - **Primarily borne by consumers in form of price increases (disproportionate burden on low-income households).**
  - **Workers and shareholders could experience transitional costs.**
- **Policymakers determine who receives their value:**
  - **Allowance allocation will transfer value of allowances from those who pay for them to those who get the value.**
  - **Selling allowances: government captures value; ultimate beneficiaries depend on how revenue are recycled.**
  - **Free allocation: receiving entities capture value (equivalent to selling allowances and distributing value).**
  - **Free allocation will not prevent price increases.**

Effects of a 15 Percent Cut in CO_2 Emissions



110th Congress: Legislative Bills for Regulating Greenhouse Gas Emissions

- S. 280 (Lieberman/McCain)
- S. 309 (Sanders/Boxer)
- S. 317 (Feinstein/Carper)
- S. 485 (Kerry/Snowe)
- S. 1766 (Bingaman/Specter)
- S. 2191 (Lieberman/Warner)
- S. 3036 (Managers' Amendment)
- H.R. 620 (Olver/Gilchrest)
- H.R. 1590 (Waxman)
- H.R. 2069 (Stark) – tax bill
- H.R. 3416 (Larson) – tax bill
- Dingell-Boucher Discussion Draft



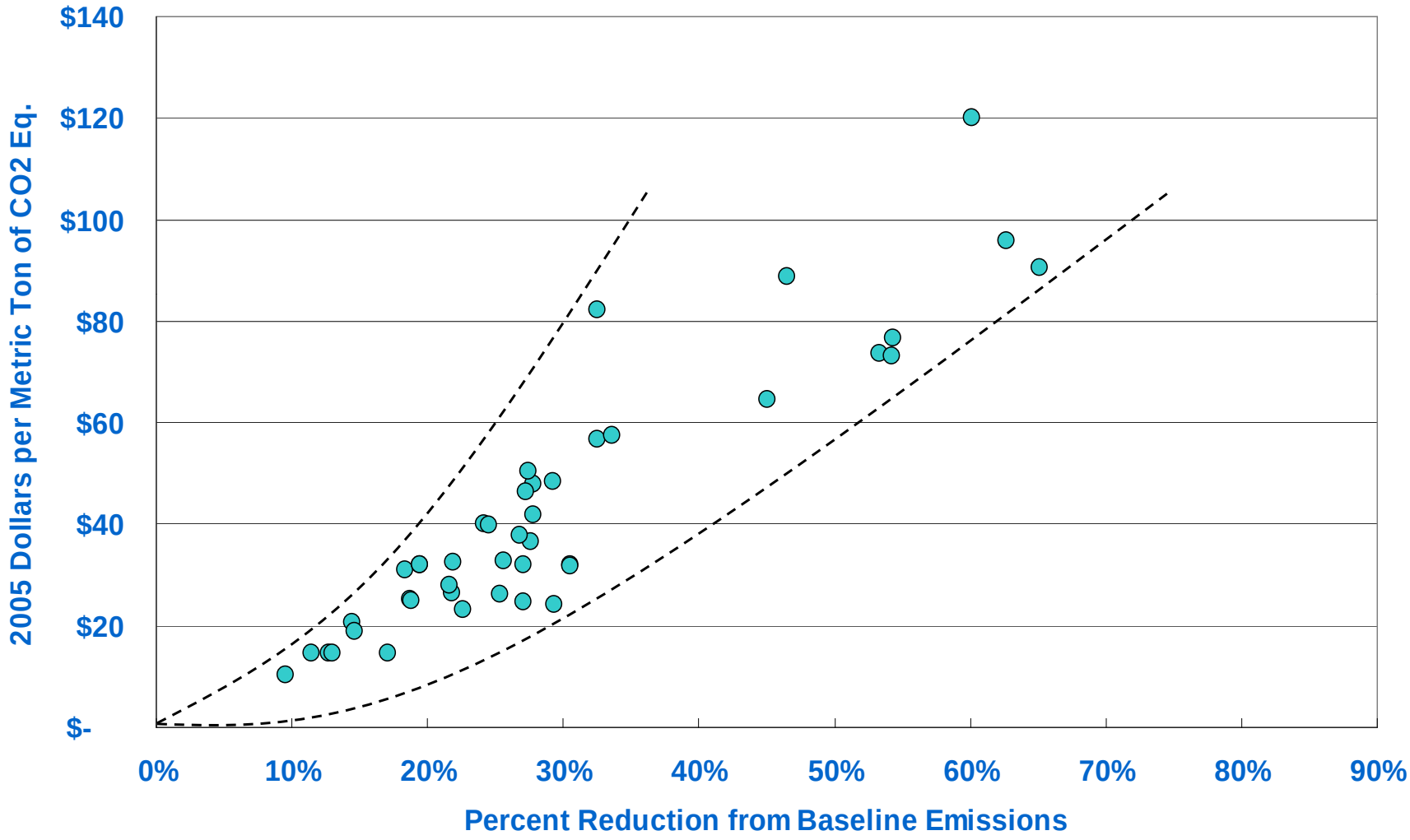
Features of S.2191 / S.3036

- S.2191 would cover about 88% of projected emissions in two caps (one for hydrofluorocarbons)
- Caps tighten over time, and would cut covered emissions by about 51% (projected baseline U.S. GHG emissions from 2010 to 2050: about 376 billion MT CO2 equivalent)
- No explicit provision to limit allowance prices
- Carbon Market Efficiency Board can implement cost-relief measures
- Limited borrowing and unlimited banking of allowances
- Domestic offsets (from uncovered sectors and forestry) and international offsets each limited to 15 percent of total allowance submission in any given year
- Large, gradually declining share of allowances distributed to regulated or non-regulated entities
- Some allowances allocated as subsidies for promoting activities such as carbon capture and sequestration
- Gradually rising shares of allowances auctioned, with revenues to be allocated to various funds for technology development and deployment as well as various types of adaptation and consumer assistance

Issues for S.2191 Cost Estimate

- **Determine how freely allocated allowances should be included in budget.**
  - Primary consideration is how “cash like” they are expected to be.
  - Group I gases counted as both a revenue and an outlay: giving away allowances equivalent to selling allowances and directing revenues to firms.
  - Group II gases are not: market is less liquid.
- **Estimate allowance price to determine potential value of allowances.**
- **Determine revenue offsets.**
  - Some of the revenue collected by a new tax is “offset” by a decrease in the collection of other taxes.
  - Provides a more accurate accounting of budget effects.
- **Determine outlays.**

Mitigation Costs for Reducting U.S. Greenhouse Gas Emissions in 2030 (Not Including Offsets)



Determinants of Allowance Prices

Unit of measurement

- $/Metric Ton of Carbon Equivalent or $/Metric Ton of Carbon Dioxide Equivalent
- Adjustment for inflation!

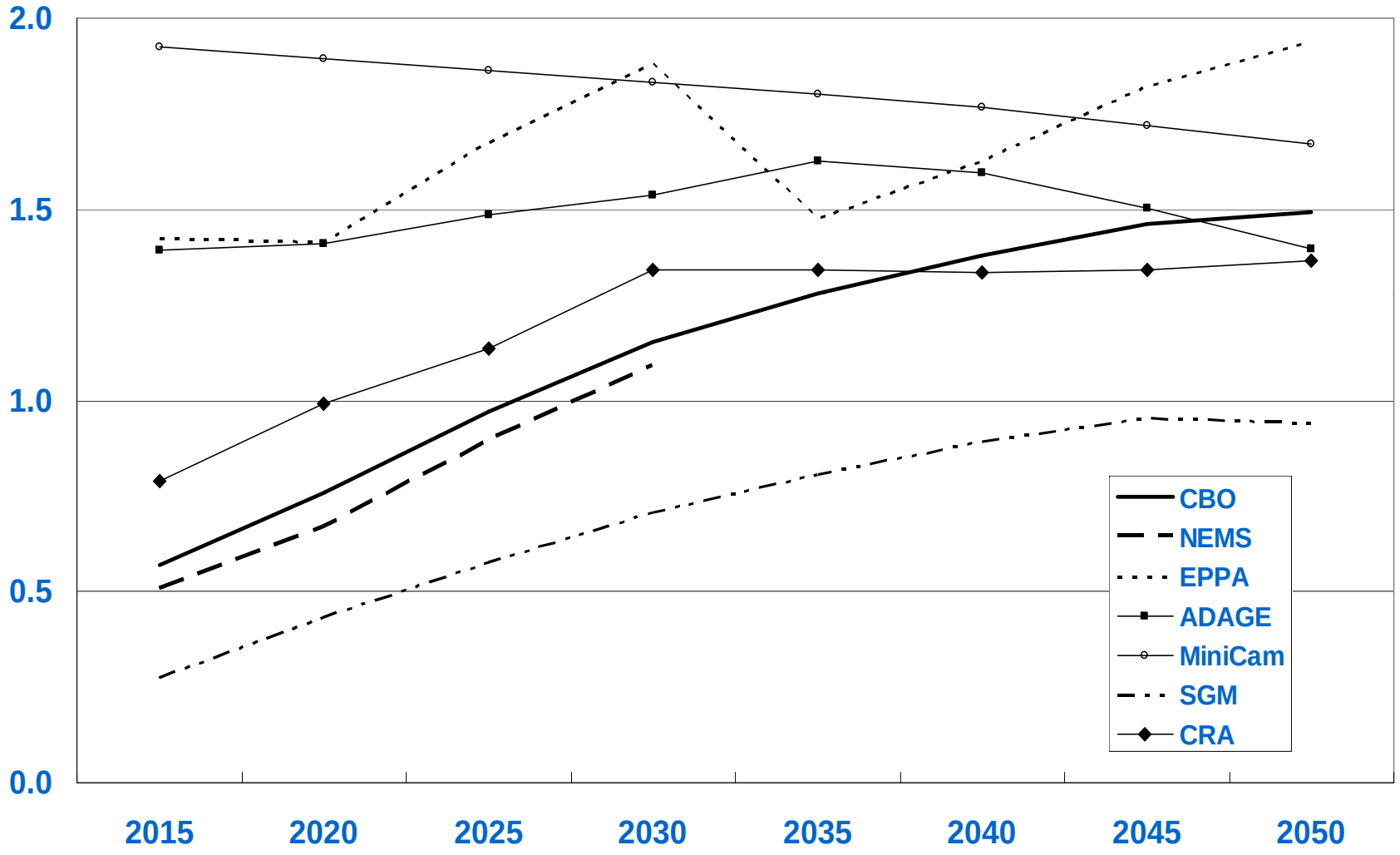
Reference projections for emissions and prices

- Nearly everyone relies on reference (and sometimes high-technology) baselines from EIA (reference energy-related CO2 emissions in 2030 have fallen ~13% in one year and ~21% in three years)

Assumed responsiveness of households and firms to changes in prices of goods and services associated with emissions

- Can vary considerably by scenario for any given model
- Tends to be dominated by fuel switching and technology shifts in electricity generation
- For non- CO2 emissions and for biological sequestration, essentially all analyses draw on two EPA studies that mainly quantify engineering costs

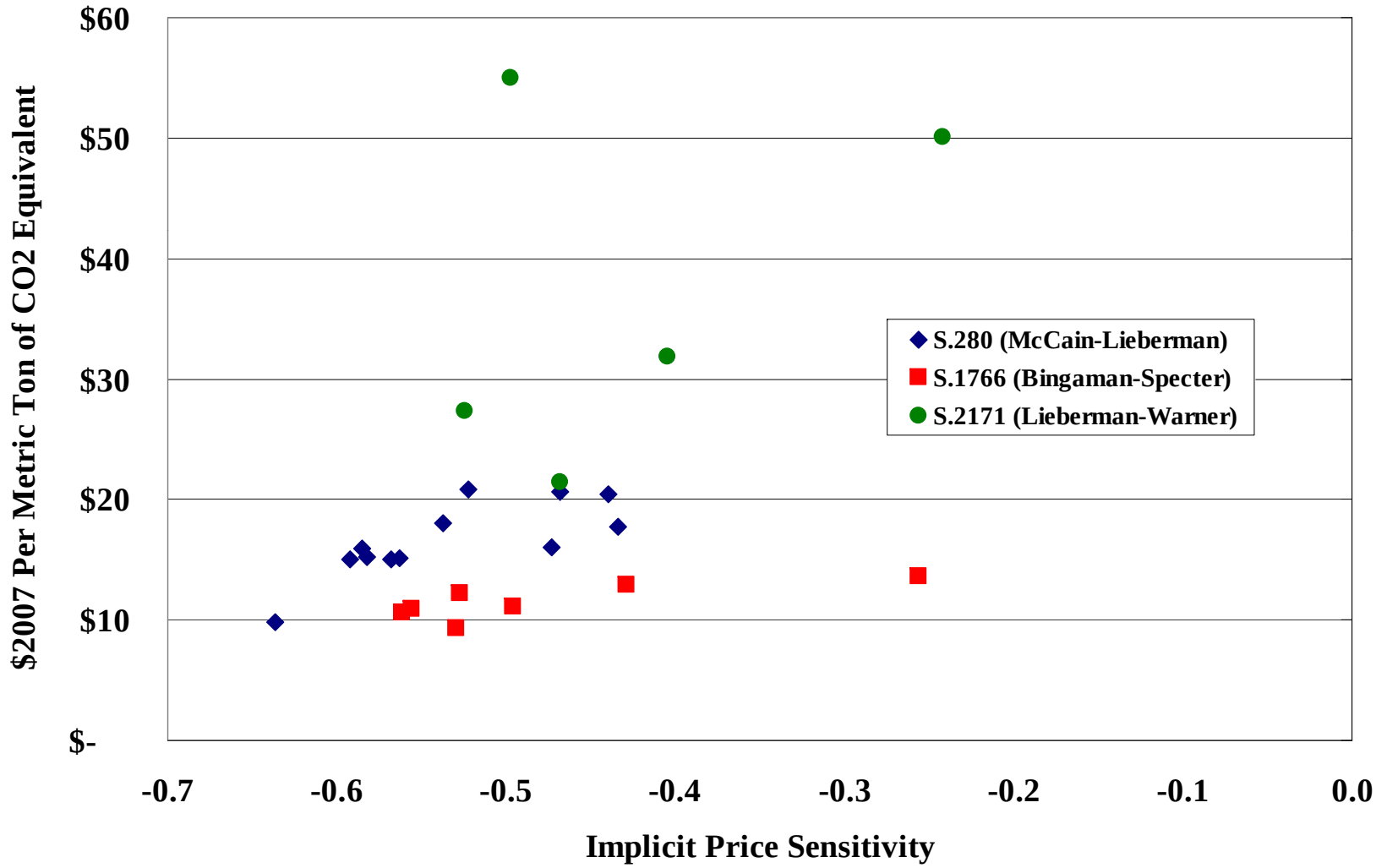
"Typical" Aggregate Responsiveness of CO2 Emissions to Allowance Prices



Determinants of Allowance Prices

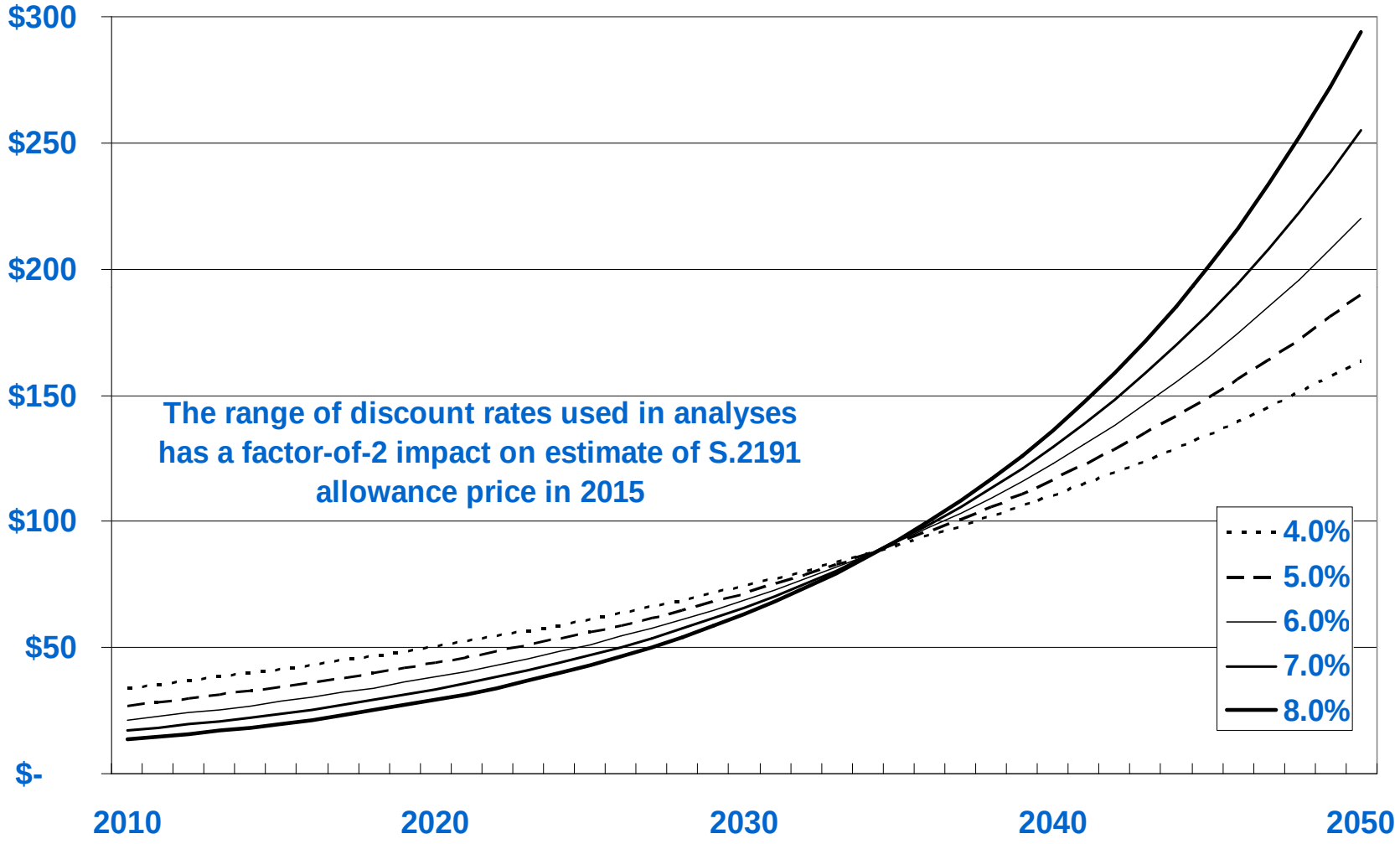
- **Discount rate that allowance holders are assumed to apply to decisions about banking allowances**
  - A lower discount tends to raise the estimated allowance price in early years but lower it in later years (inflection point is an artifact function of period of analysis)
  - Assumptions range from 4 percent (low-risk rate) to 8 percent (return to corporate equity)
  - CBO uses expected long-run non-financial rate of return to corporate debt plus equity—a reasonable measure of risk-adjusted opportunity cost
- **Availability of offsets**
  - Criteria for coordination with other countries' programs ("comparable stringency") rather vague
  - In CBO's analysis of S.2191, moving from no offsets to full domestic and international offsets reduces allowance price in 2015 by roughly 44 percent
- **Availability of technologies**
  - Assumed rapid development/deployment of alternative technologies tends to lower the price; most modelers find modest response of allowance prices to technology subsidies

Uncertainty in EIA's Estimates of Mitigation Costs



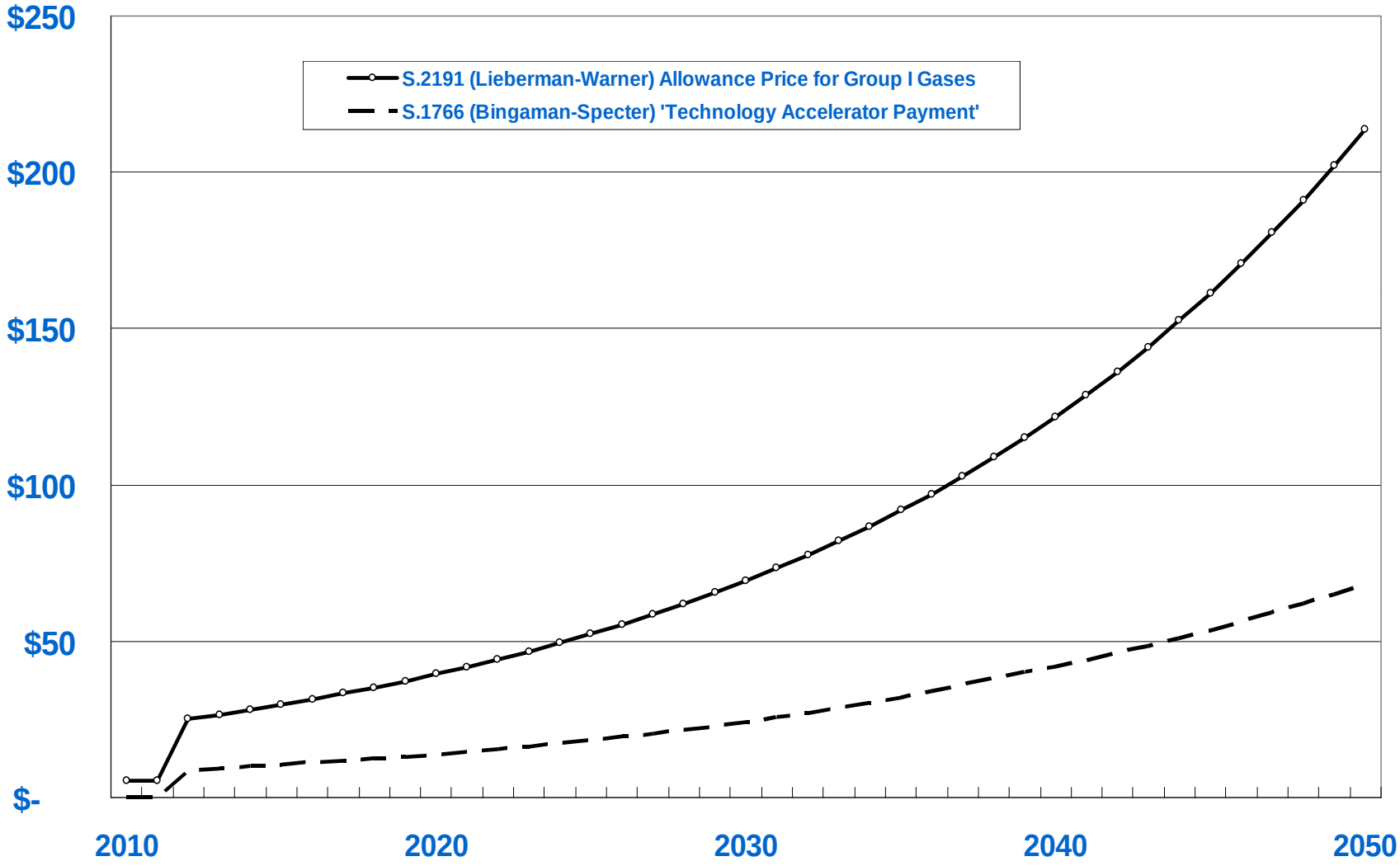
Effect of Discount Rate Assumption on Allowance Price Estimate

($2006 Per Metric Ton of Carbon Dioxide Equivalent)



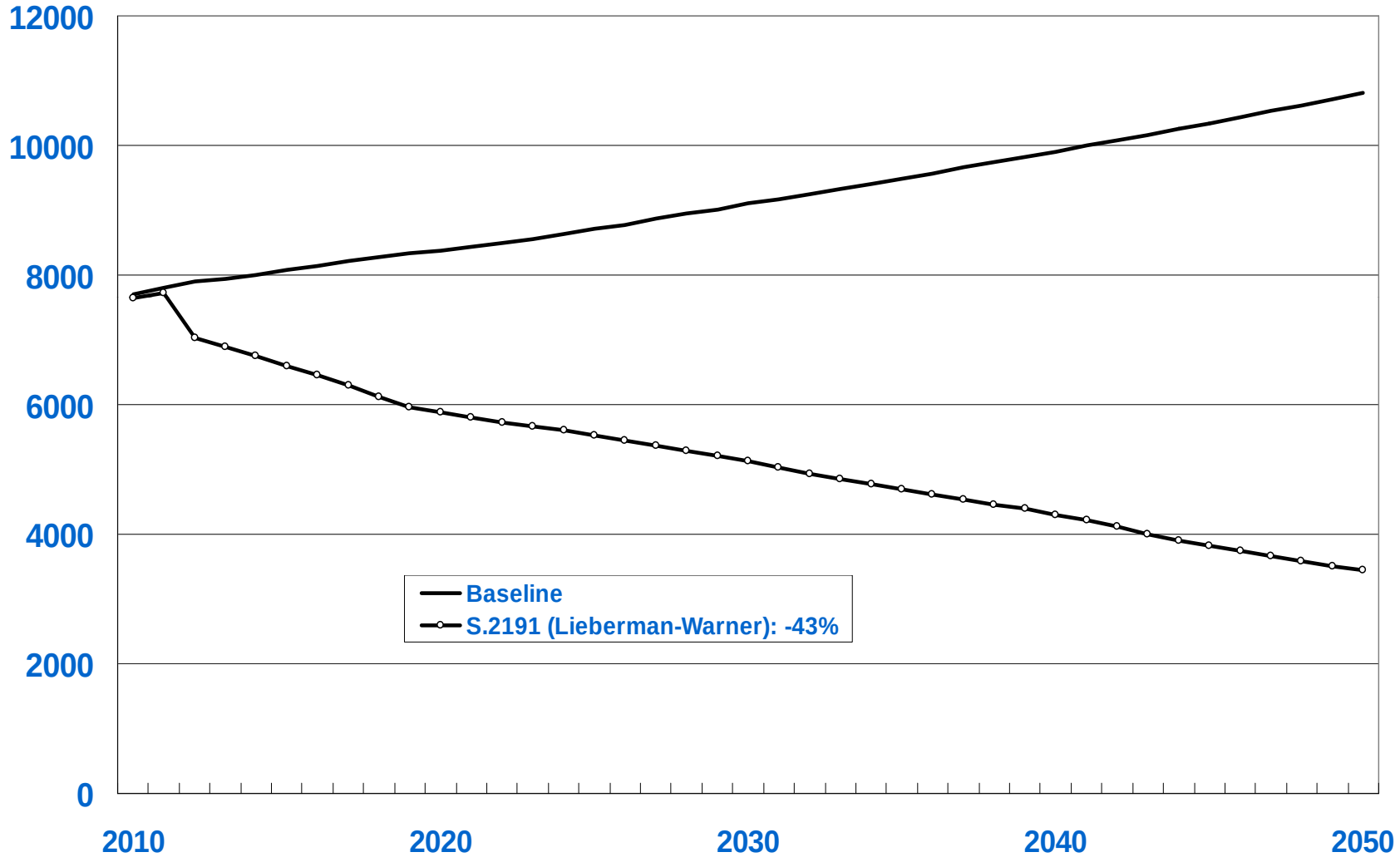
Emission Allowance Price

($2006 Per Metric Ton of Carbon Dioxide Equivalent)



Total Greenouse Gas Emissions

(Millions of Metric Tons of Carbon Dioxide Equivalent)



Comparison of Estimates

- MIT's recent estimate of allowance price in 2015 is about 65% higher than CBO's
  - EPPA model's has greater price responsiveness but:
  - Higher baseline emissions
  - Much lower discount rate
  - Fewer offsets
- CRA's MRN-NEEM model yields an estimate about 70% higher than CBO's for 2015
  - Mainly due to a much lower discount rate
- EPA's analysis using IGEM and ADAGE yields estimates ranging from 38% to 266% of CBO's for 2015
  - Depends on model, baseline, technologies, and offsets
  - One model is more responsive than CBO's analysis; the other less so
- CATF's estimate for 2015 using NEMS model is 56% of CBO's
  - Much higher discount rate
  - International offsets