Cost-Benefit Analysis of Climate Targets

David Anthoff

Energy and Resources Group

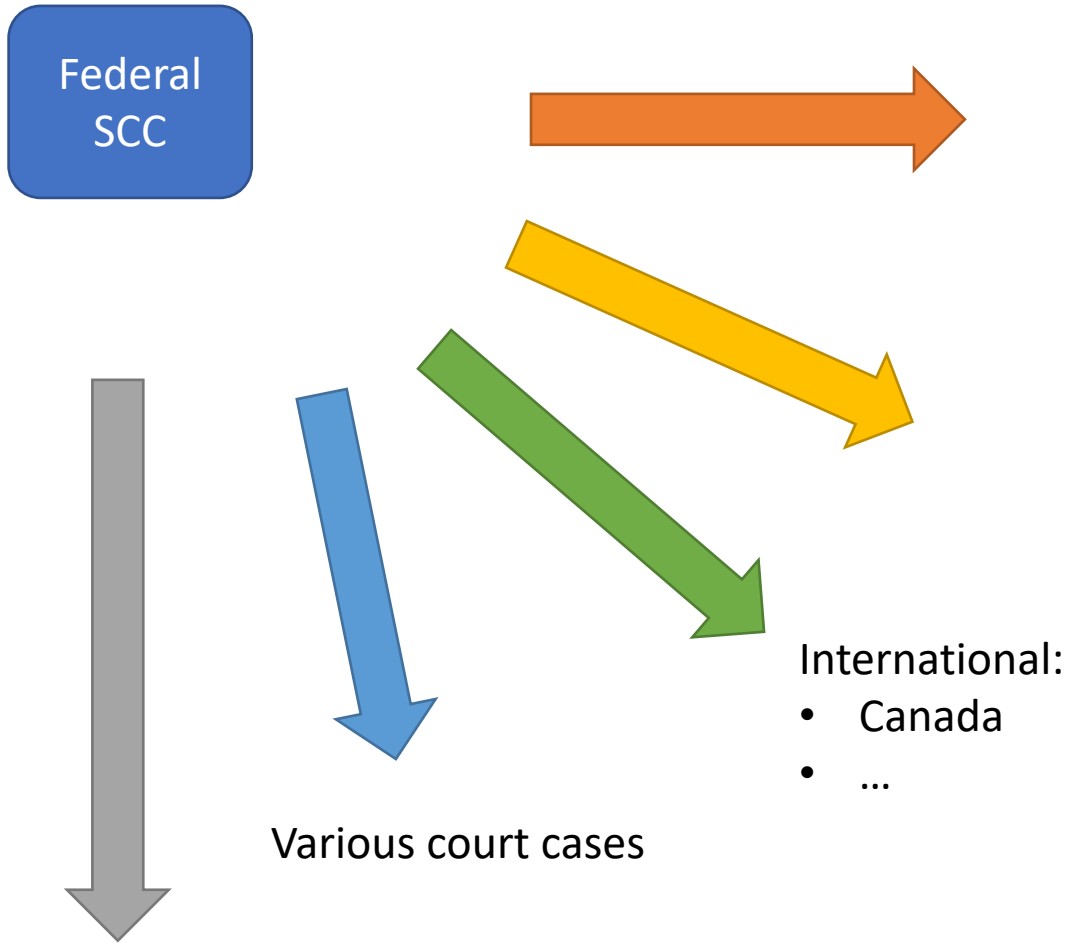
University of California, Berkeley

Outline

- **What does CBA tell us?**
- Should we use CBA for this question? Some cautionary remarks
  - Alternative damage estimates
  - Discounting/ethics
- Implications of imperfect implementation

Cost benefit models

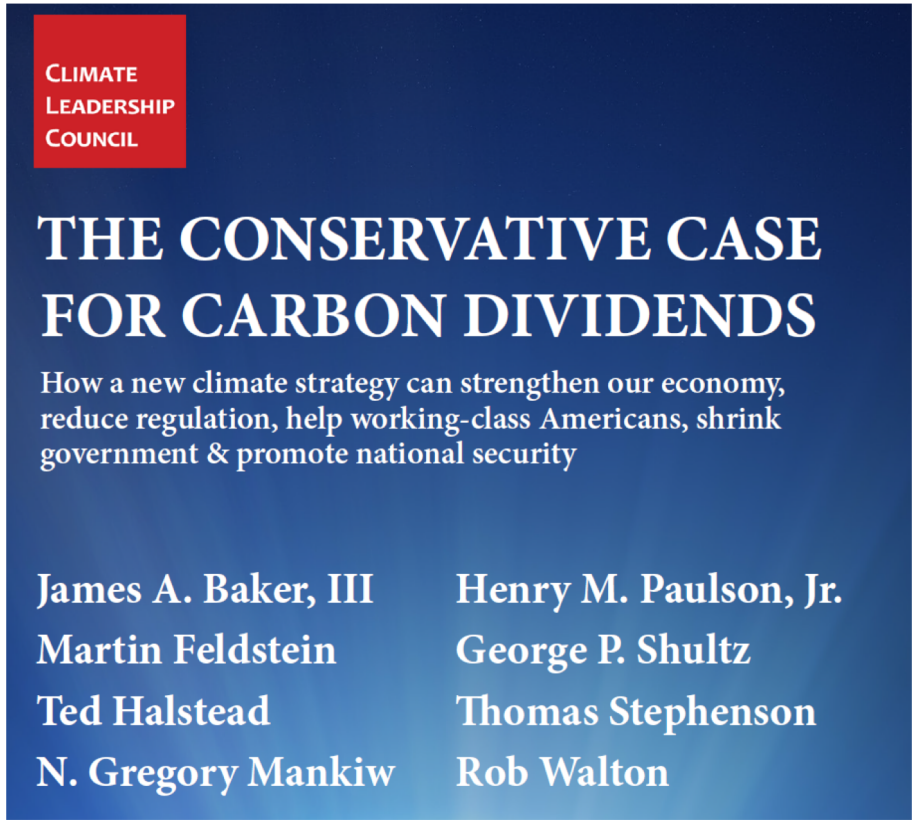
- DICE/RICE  Bill Nordhaus
- PAGE  Chris Hope
- FUND   Richard Tol & me



States:

- Minnesota
- Colorado
- Maine
- Nevada
- Illinois
- New York
- California

Used in dozens of federal regulatory impact assessments (including Clean Power Plan rule)



- FUND → most optimistic
- DICE → middle of the road
- PAGE → most pessimistic

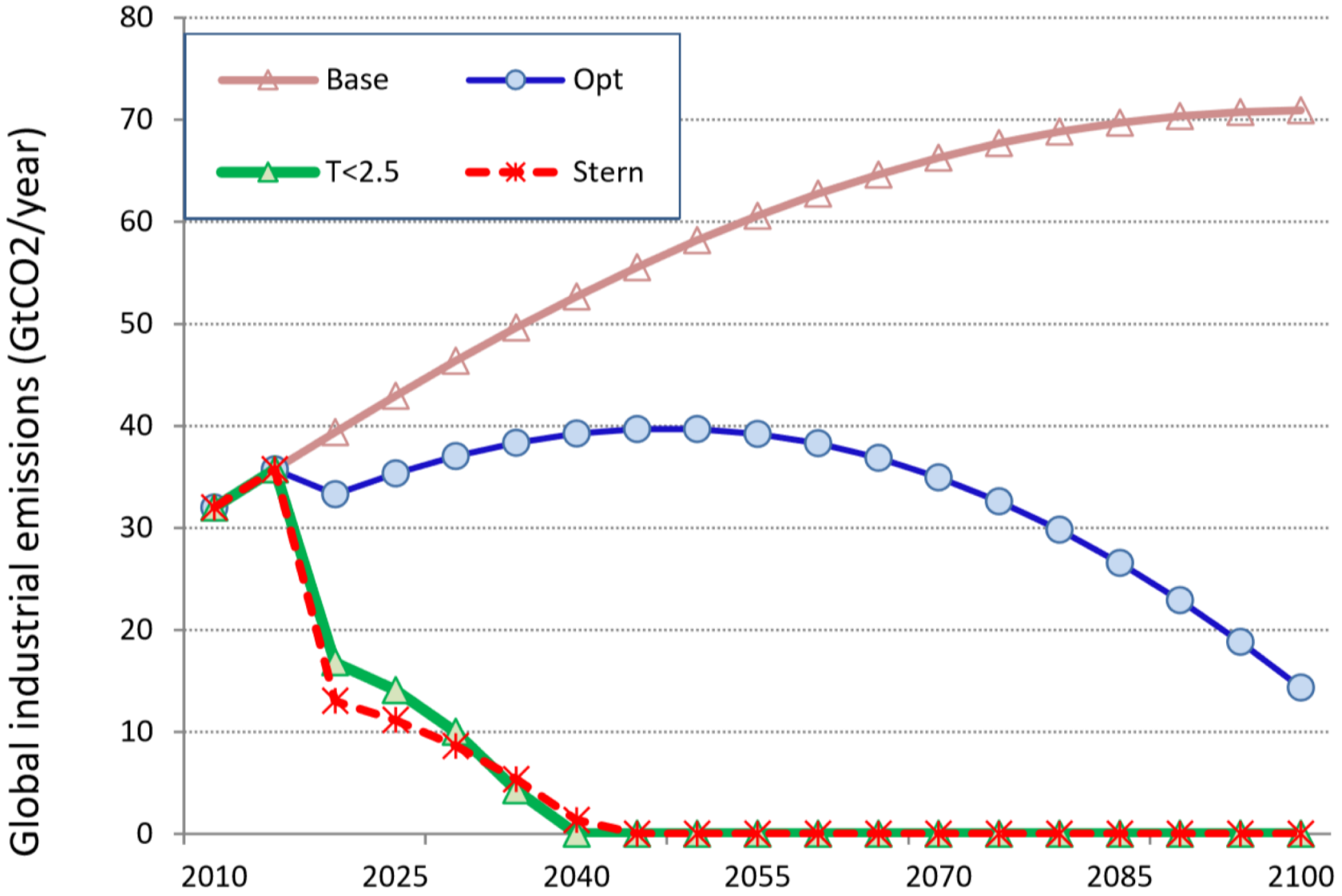


Figure 2. Actual and projected emissions of CO_2 in different scenarios

The two most ambitious scenarios require zero emissions by mid-century.[ii]

Nordhaus (2017)

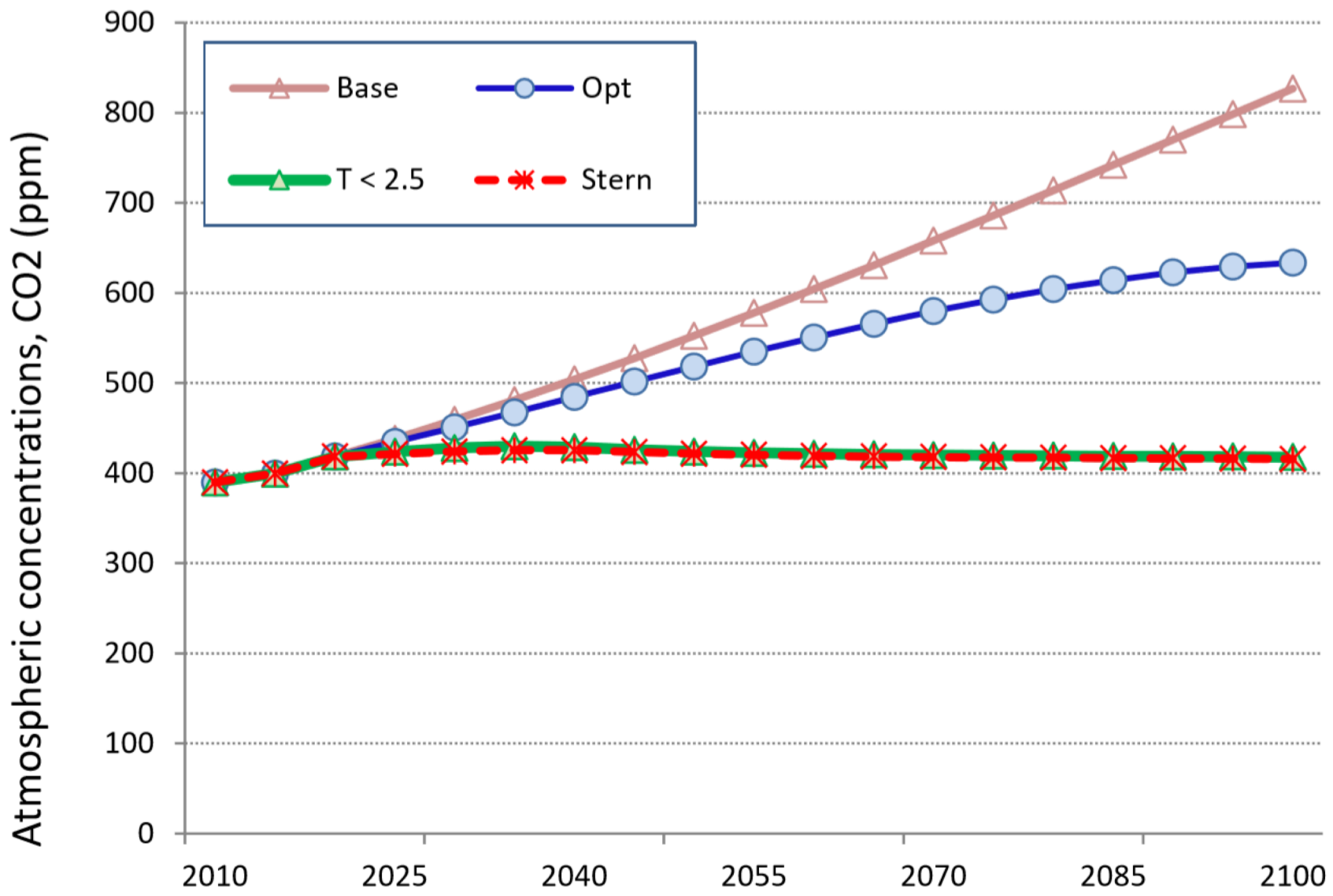


Figure 3.Concentrations of CO_2 in different scenarios

The two most ambitious scenarios require concentrations emissions close to current levels.

Nordhaus (2017)

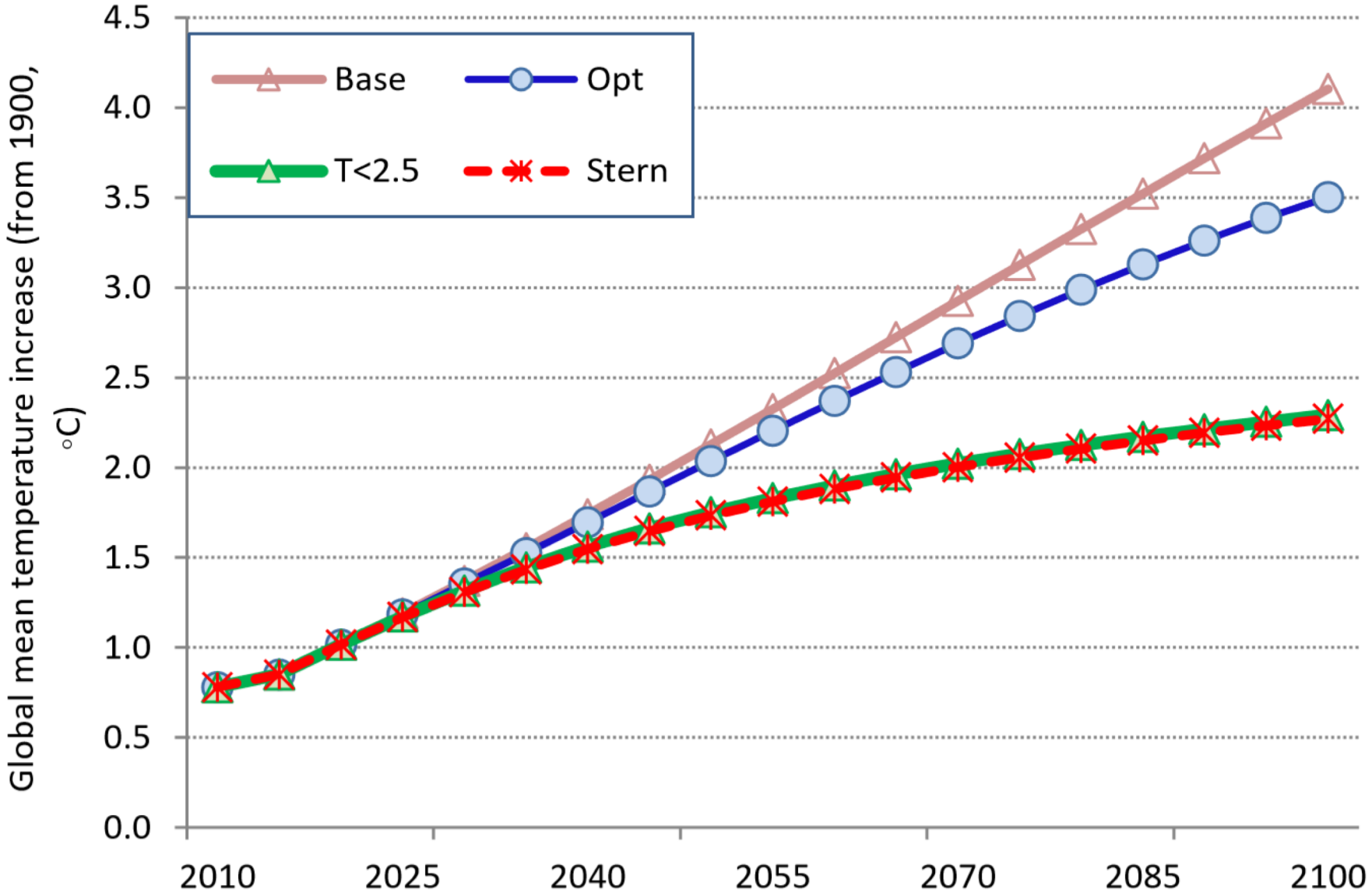


Figure 4. Temperature change in different scenarios

The most ambitious scenarios cannot limit temperature to 2 ½ °C, and the cost-benefit optimum with standard parameters has sharply rising temperatures.[iii]

Nordhaus (2017)

Scenario	Objective	Damages	Abatement cost	Damages plus abatement	Difference from base	
					Objective	Damages plus abatement
Base or business as usual	4,491.07	134.2	0.4	134.6	0.0	0.0
Optimal controls	4,520.56	84.6	20.1	104.7	29.5	29.9
2.5 degree maximum						
Maximum (b)	4,441.32	43.1	134.6	177.8	-49.7	-43.2
Max for 100 years (b)	4,456.81	45.7	117.6	163.3	-34.3	-28.8
Stern Review abatement		46.2	155.7	201.9	na	-67.3

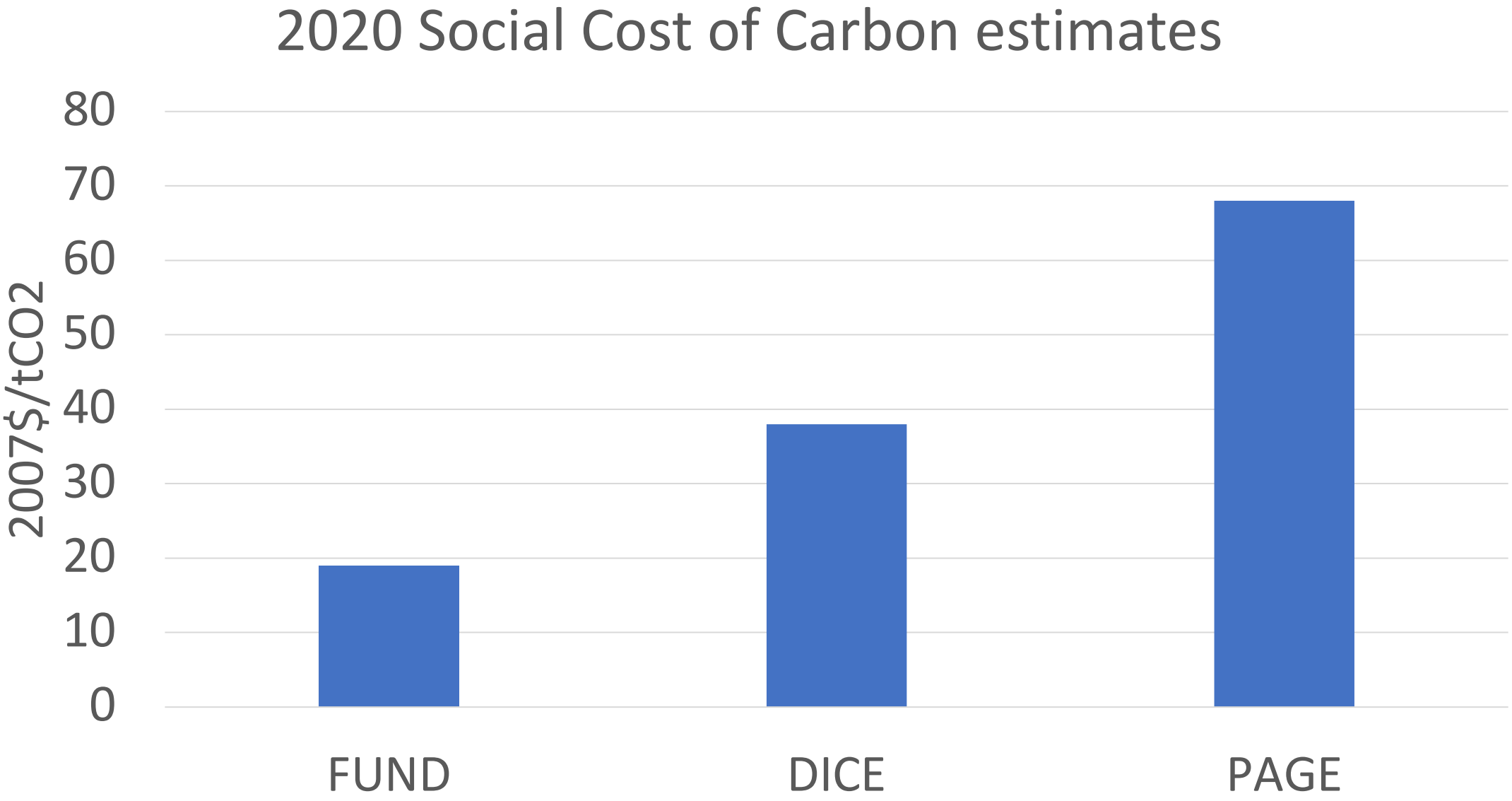
All figures are trillions of US international $ in 2010 prices.

Table 2. Abatement, Damages, and Net Impacts of Different Policy Scenarios, Best-Guess Parameters.[vi]

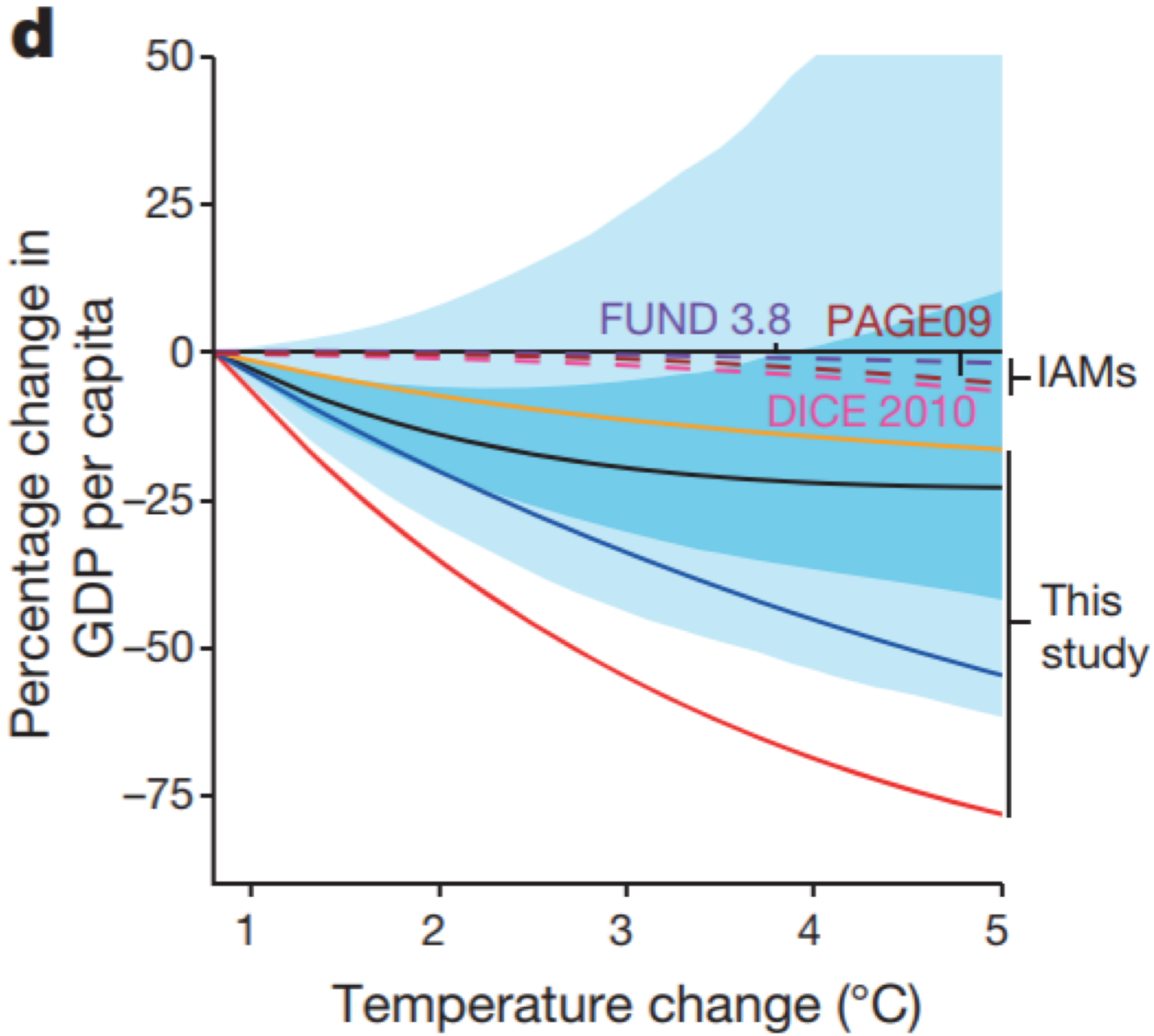
Nordhaus (2017)

Outline

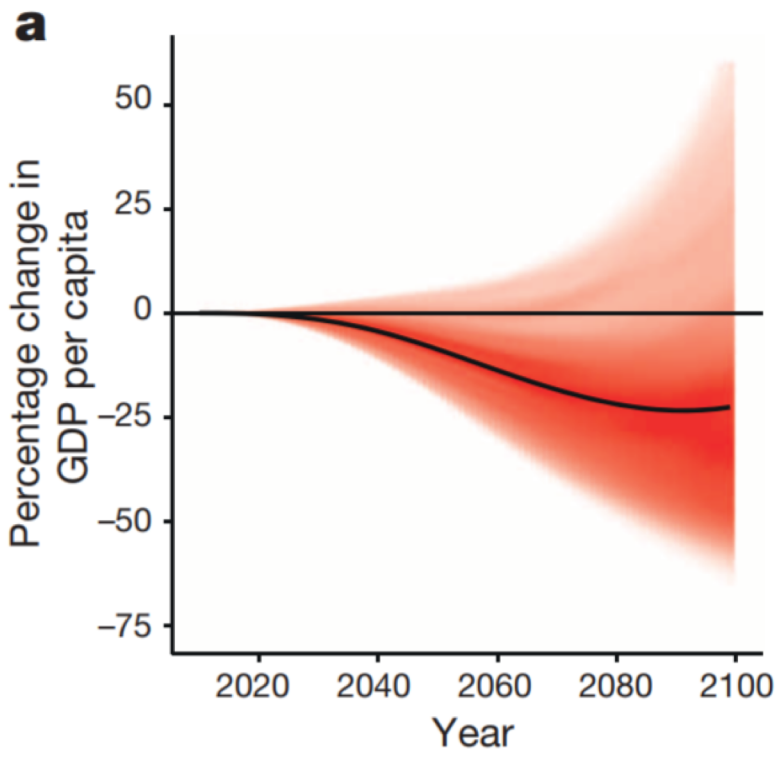
- What does CBA tell us?
- **Should we use CBA for this question? Some cautionary remarks**
  - **Alternative damage estimates**
  - **Discounting/ethics**
- Implications of imperfect implementation

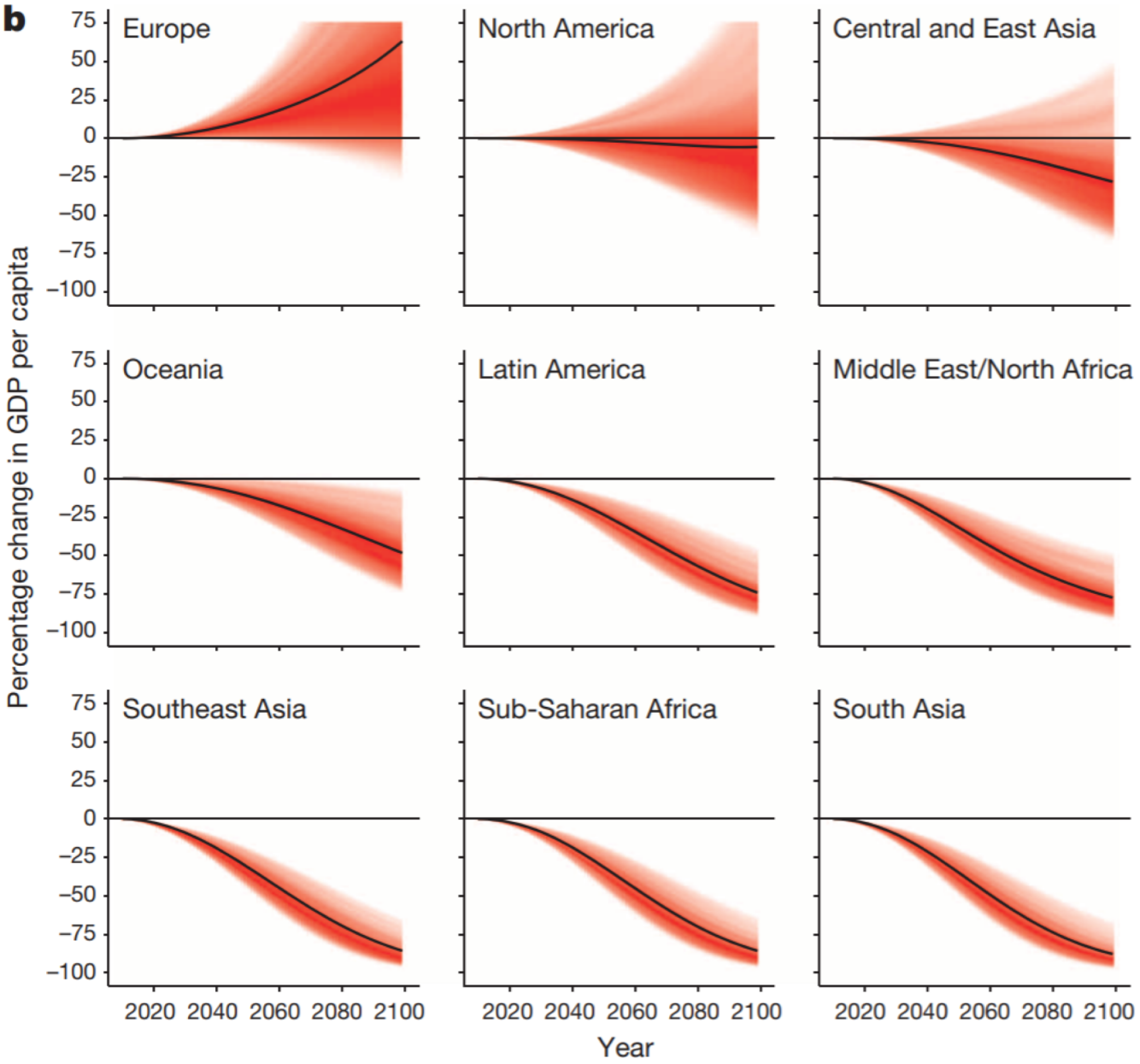

2020 Social Cost of Carbon estimates
2007$/tCO2
80
70
60
50
40
30
20
10
0
FUND
DICE
PAGE

IAWG 2015



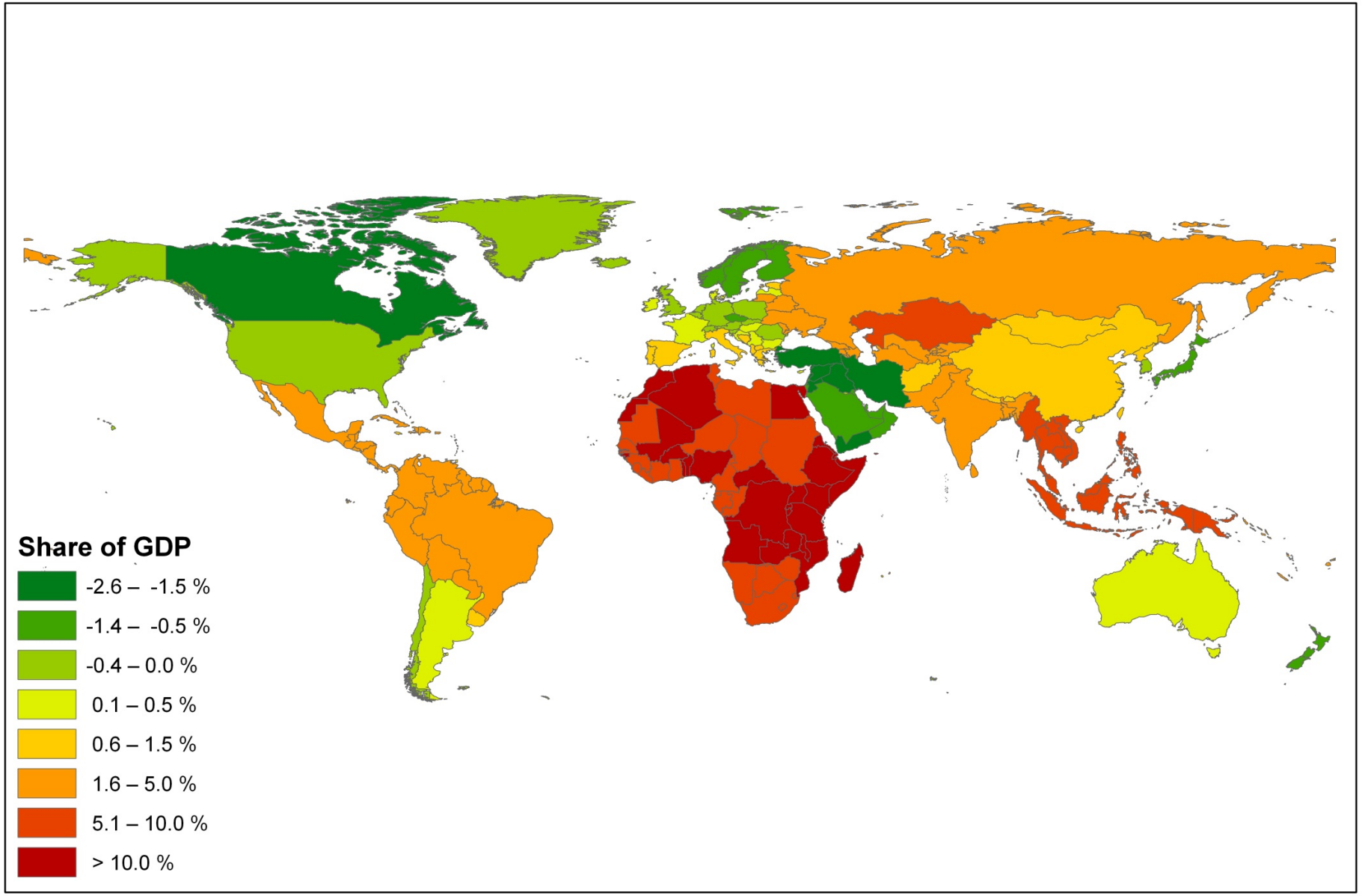
Burke, Hsiang and Miguel (2015)



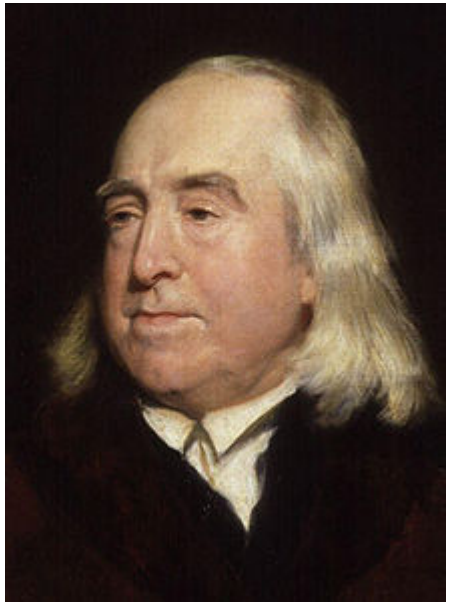


Burke, Hsiang and Miguel (2015)

Climate change damages 2100

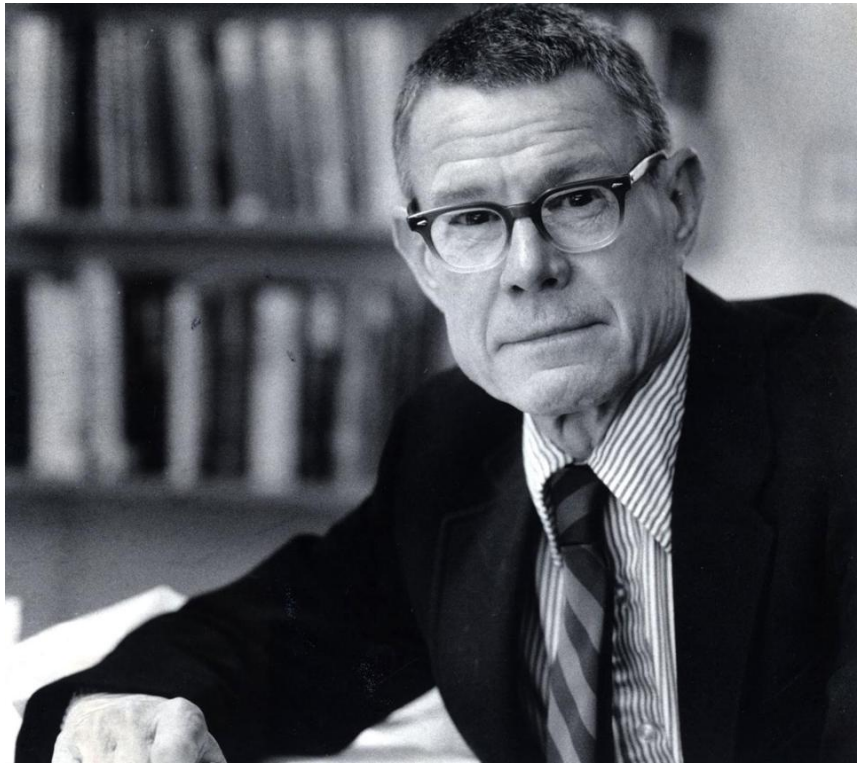


Anthoff et al. (2009)



Jeremy Bentham

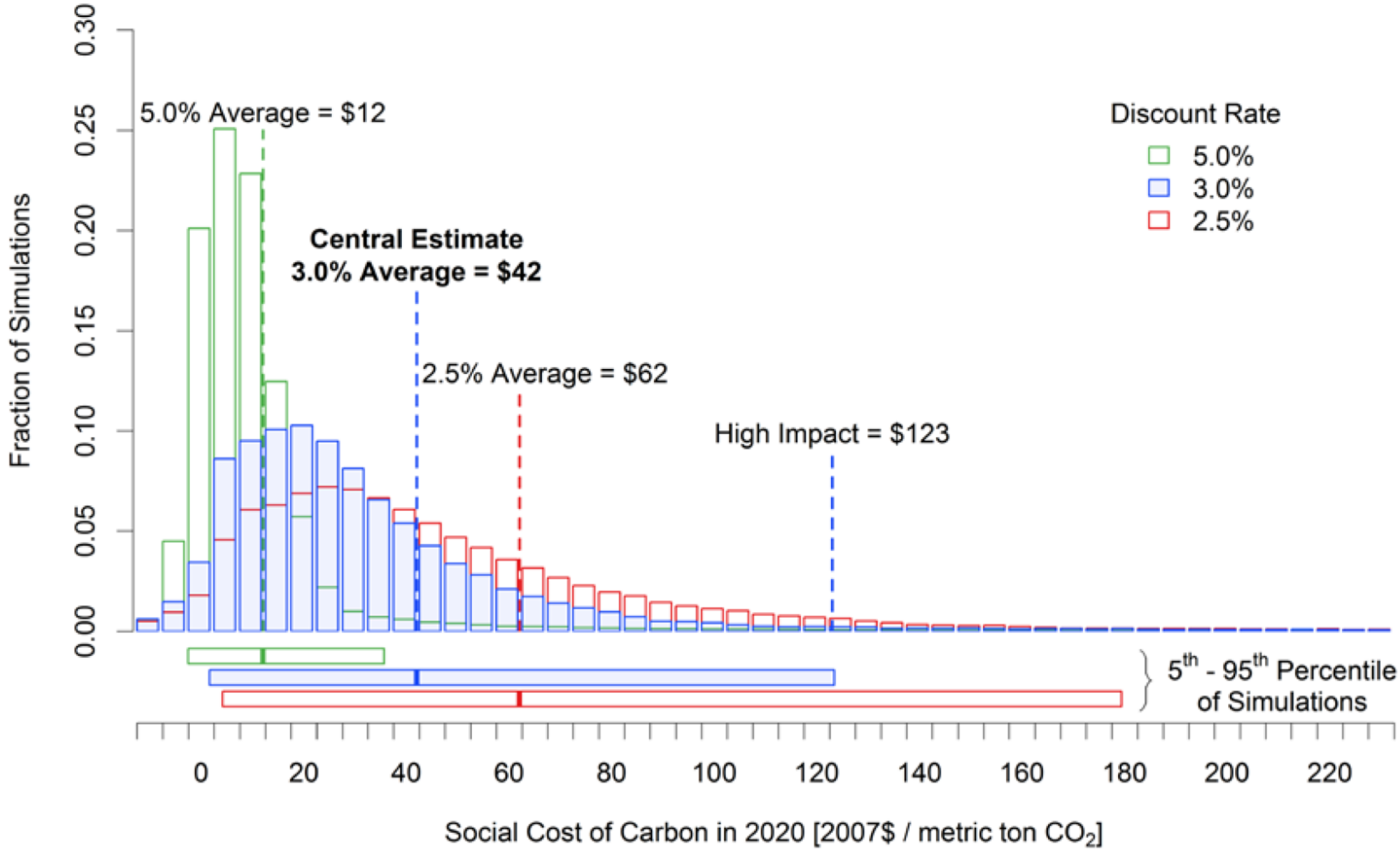
Equity between generations



Tom Schelling

Equity between individuals alive at the same time

Figure ES-1: Frequency Distribution of SC-CO_2 Estimates for 2020[3]



IAWG (2016)

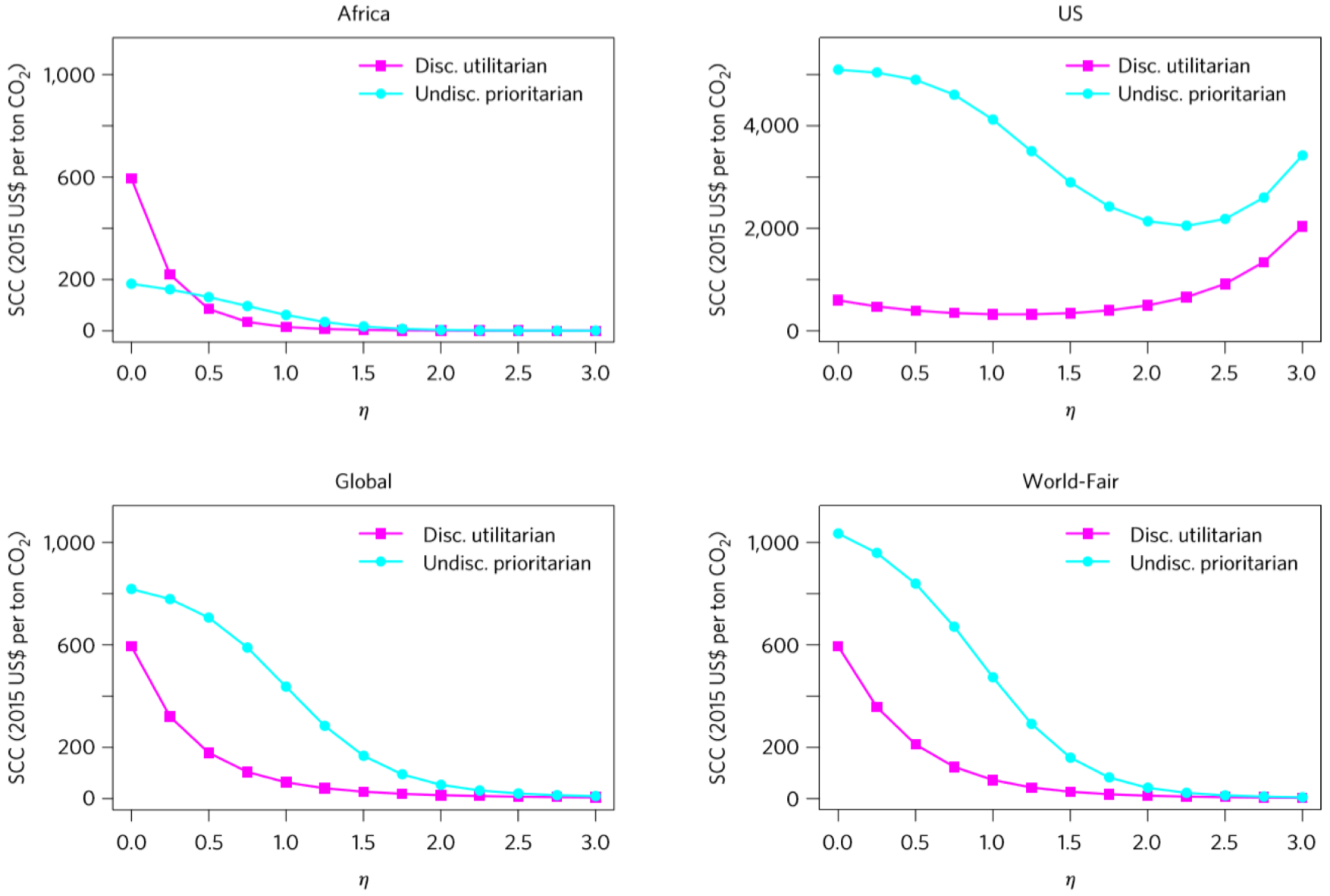


Figure 4 | SCC^{DU} and SCC^{NP} at central parameter values. Each panel contains two line graphs: one showing the effect of η (eta) on the discounted-utilitarian SCC (SCC^{DU}), with ρ held at the central value of 1%; the second showing the effect of η (eta) on the non-discounted prioritarian SCC (SCC^{NP}), with γ (gamma) held at the central value of 1 and c^{zero} at the central value of US$500. This information is displayed for the three normalizations (Africa, US and World-Fair) and for the Global SCC calculation. All results are in 2015 US$.

Adler et al. (2017)

Outline

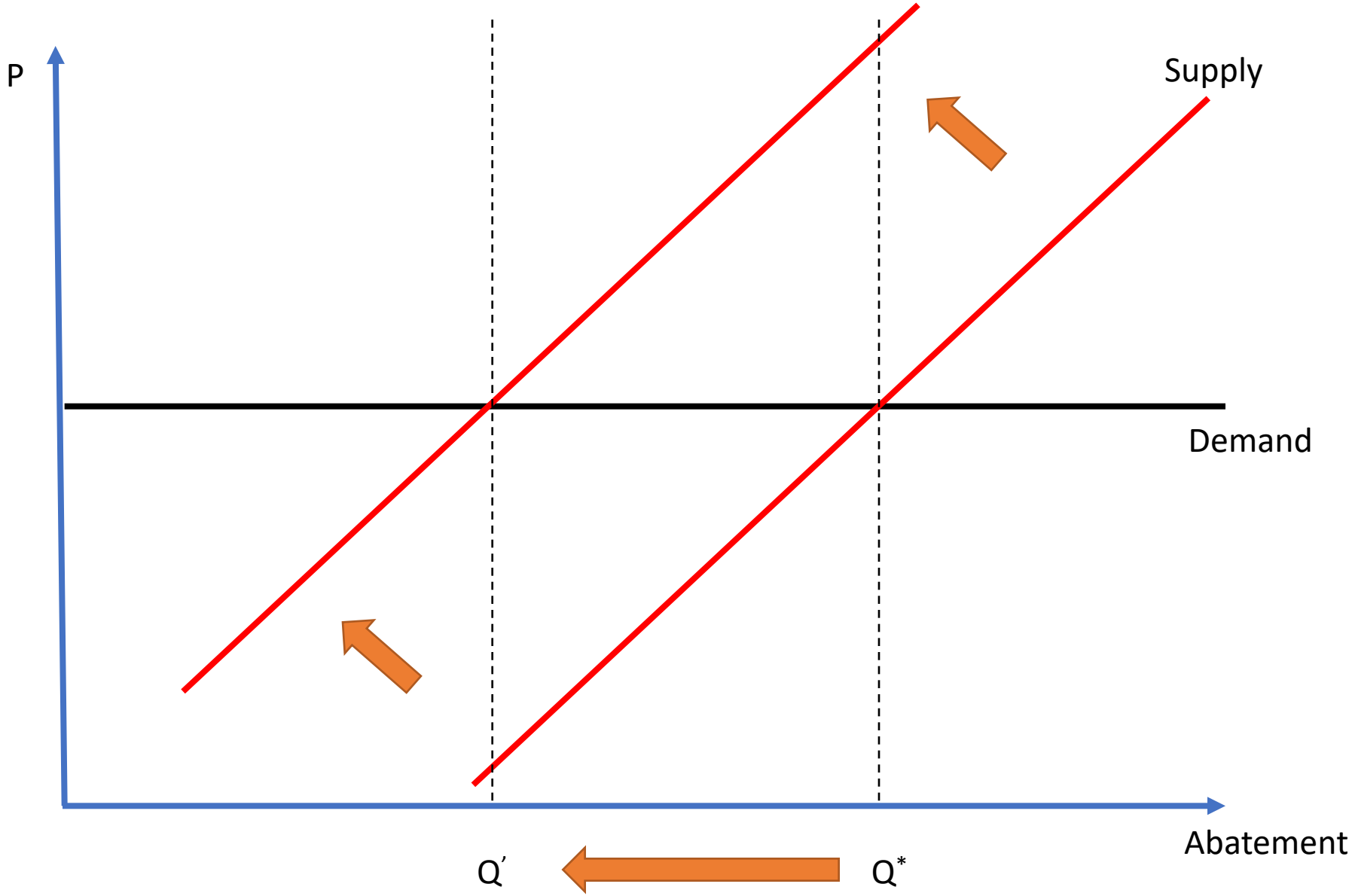
- What does CBA tell us?
- Should we use CBA for this question? Some cautionary remarks
  - Alternative damage estimates
  - Discounting/ethics
- **Implications of imperfect implementation**

Table 6-1. Penalty from Limiting Agreements to Large Countries

A. Fraction of global emissions	
Big five countries	0.528
Big four countries plus WE	0.632
All major (EU plus big nine)	0.749
B. Cost penalty (ratio to complete participation)	
Big five countries	3.16
Big four countries plus WE	2.29
All major (EU plus big nine)	1.68

Note: Big five are United States, China, Russia, India, and Germany. Big four are United States, China, Russia, and India. WE includes only Western European members of EU. Big nine includes big four plus Brazil, Canada, Japan, Mexico, and South Africa. Part A of the table shows the fraction of 2005 global CO_2 emissions that come from the different groups. Part B shows the cost penalty associated with partial participation. For example, if only the big five countries are included, this would cover 53 percent of emissions, and the cost penalty for attaining a given global emissions reduction would be a factor of 3.16.

Nordhaus (2007)


P
Supply
Demand
Abatement
Q'
Q*

Conclusion

- CBA of climate policy is here and being used in US federal climate policy
- There are huge uncertainties associated with this kind of analysis
- CBA type analysis can clarify important trade-offs

Thank you!

anthoff@berkeley.edu

www.david-anthoff.com