



Economic risks vs. Climate risks

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**Climate Change Policy:
Insights from the U.S. and Europe
Paris, 24 March 2009**

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Introduction

- Emission reduction objectives are aimed at reducing climate change risks
- But create economic risks
 - ◆ Abatement costs are uncertain
- Price corridors reduce economic risks...
 - ◆ May help get more countries on board and/or more ambitious policies in place
- ...shift the uncertainty on emissions
 - ◆ *As will be shown, this uncertainty does not increase climate change risks!*



A Quantitative Assessment

- Aim: to see how price caps and floors set at various levels modify the expected costs and environmental outcomes
- With support from France, Germany and the Netherlands





Methodology

- Calculate expected costs of target levels
 - ◆ Calibrate a model with IPCC AR4, *World Energy Outlook* and IEA's *Energy Technology Perspectives*
 - ◆ Take full account of uncertainties using thousands Monte Carlo simulations
- Assess the effects of price corridors
 - ◆ On the economy: expected abatement costs
 - ◆ On the climate, via emissions and concentrations
- *In this presentation, temperature changes committed by 2100 are considered (vs. delta-T by 2050 in the paper)*



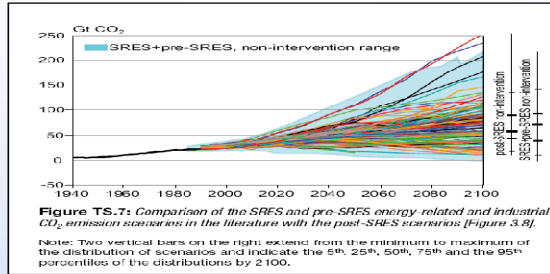
The ACTC Model

- A global aggregate model of economy and energy-related CO₂ emissions
- Halving global emissions by 2050
 - ◆ G8 leaders agreed to 'consider seriously' (2007) and 'share that goal with all UNFCCC Parties' (2008)
 - ◆ From either 1990 or 2005 levels
- Four ten-year periods considered
- Optimal pathway to 2050 on best-guess values
 - ◆ with 5% discount rate
- Abatement cost curves from IEA work
- *In this presentation, additional assumption that emissions are progressively eliminated by 2100*

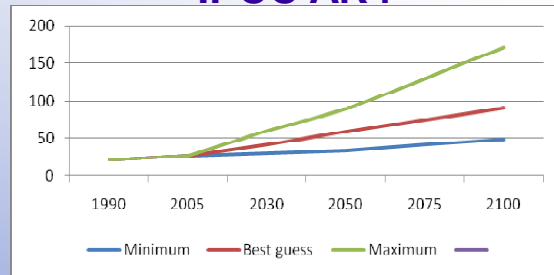


Sources of the ACTC Model

BaU emissions

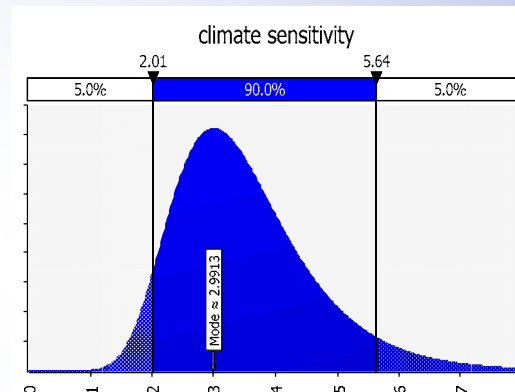


IPCC AR4



ACTC Model

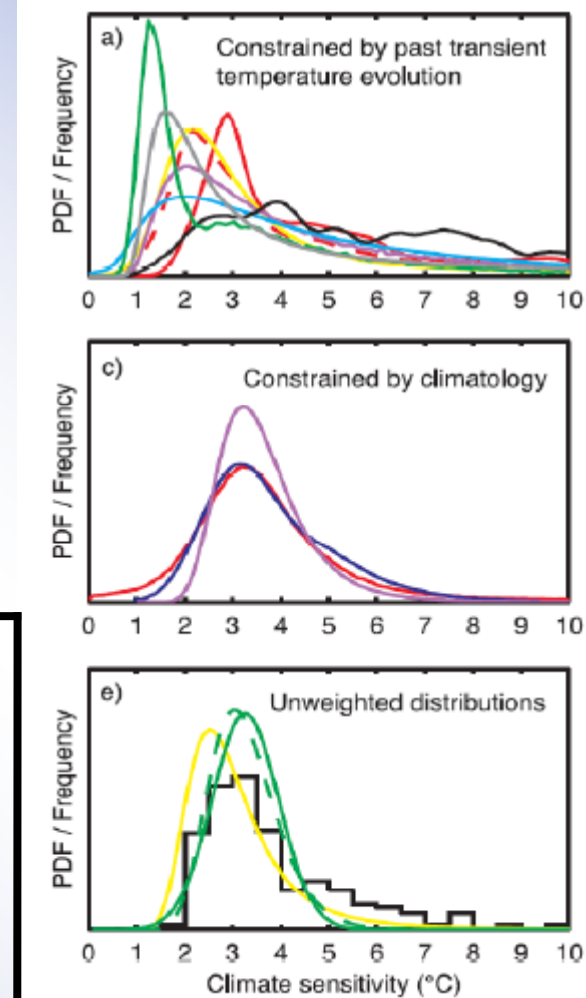
Climate sensitivity



ACTC Model

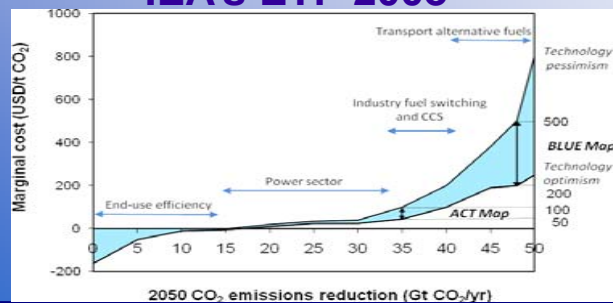
$$\Delta T = s * \frac{\log(C/275)}{\log 2}$$

IPCC AR4

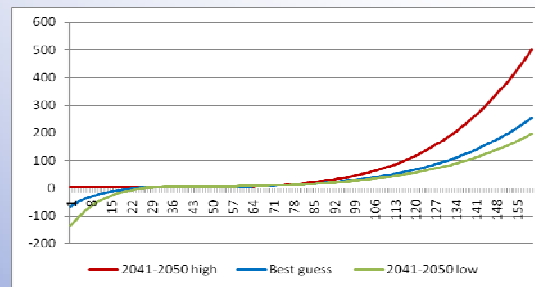


Abatement costs

IEA's ETP 2008

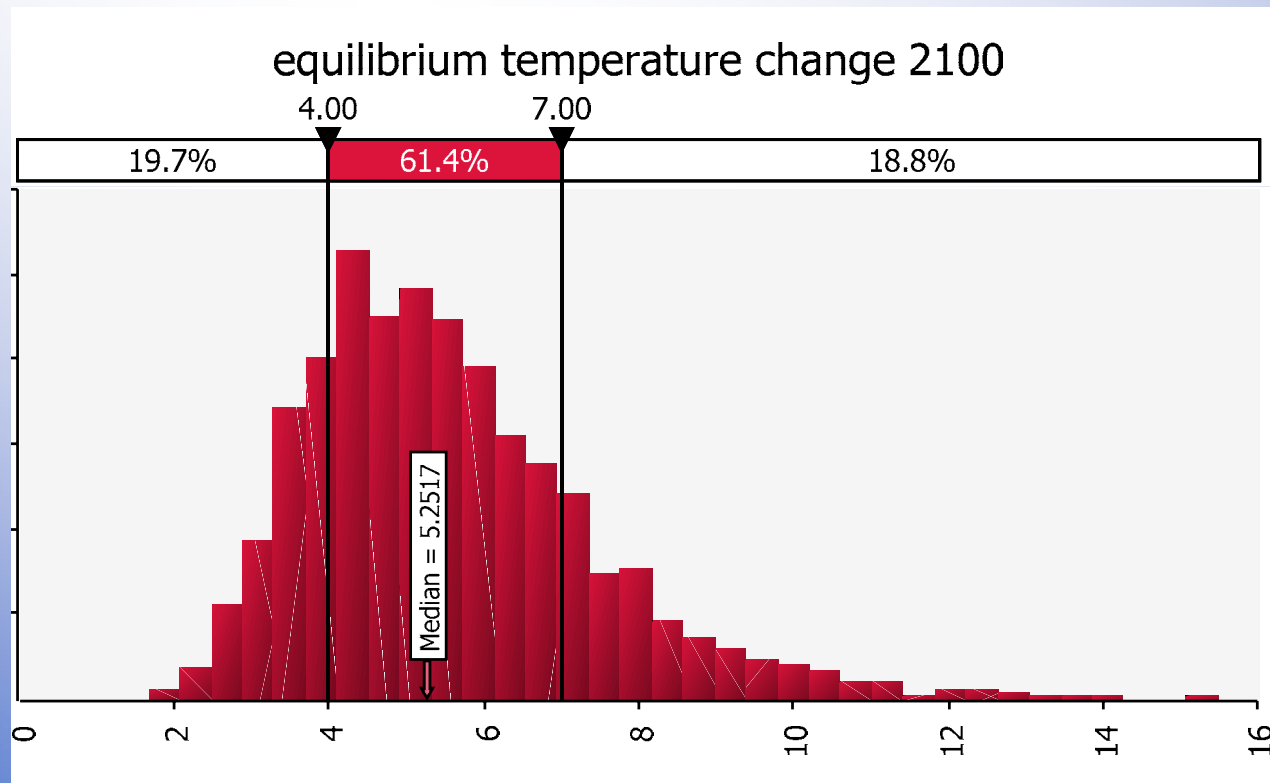


ACTC Model



No policy case

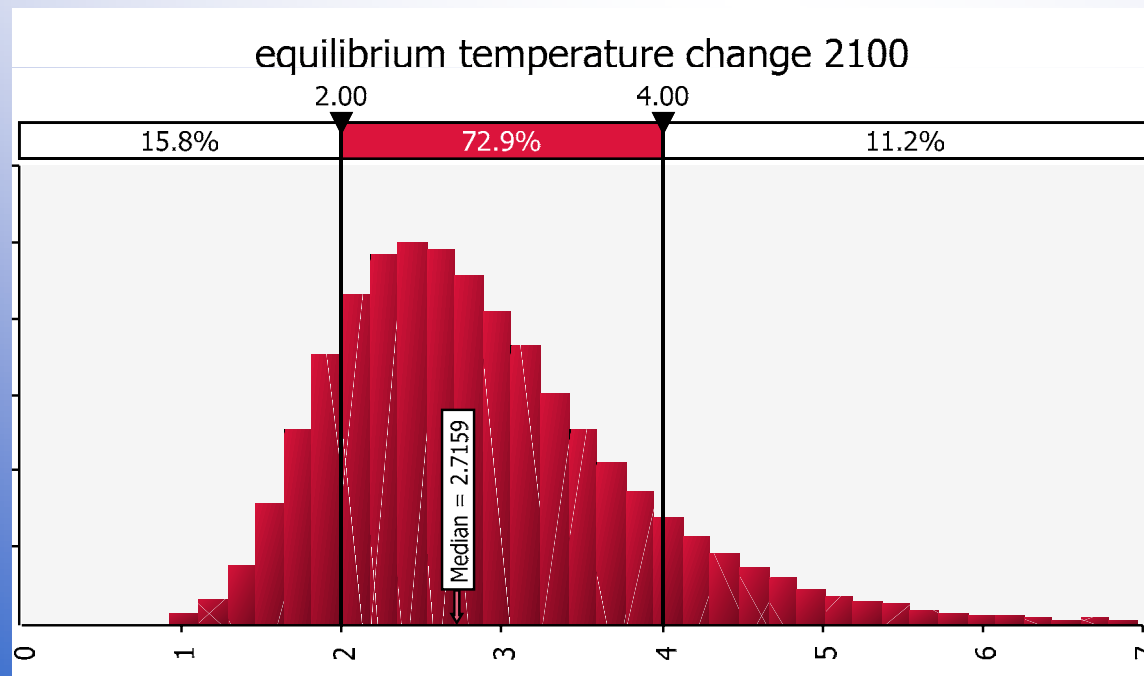
- CO₂ concentration 662 – 1067ppm
- Committed delta-T 5.25°C by 2100





Half of 2005 level by 2050

- Discounted abatement costs USD 7 885 bn
- CO₂ concentration 479 - 484 ppm by 2100
- Committed delta-T 2.72°C by 2100



**Straight targets.
The uncertainty
mostly reflects
the uncertain
equilibrium
climate
sensitivity**



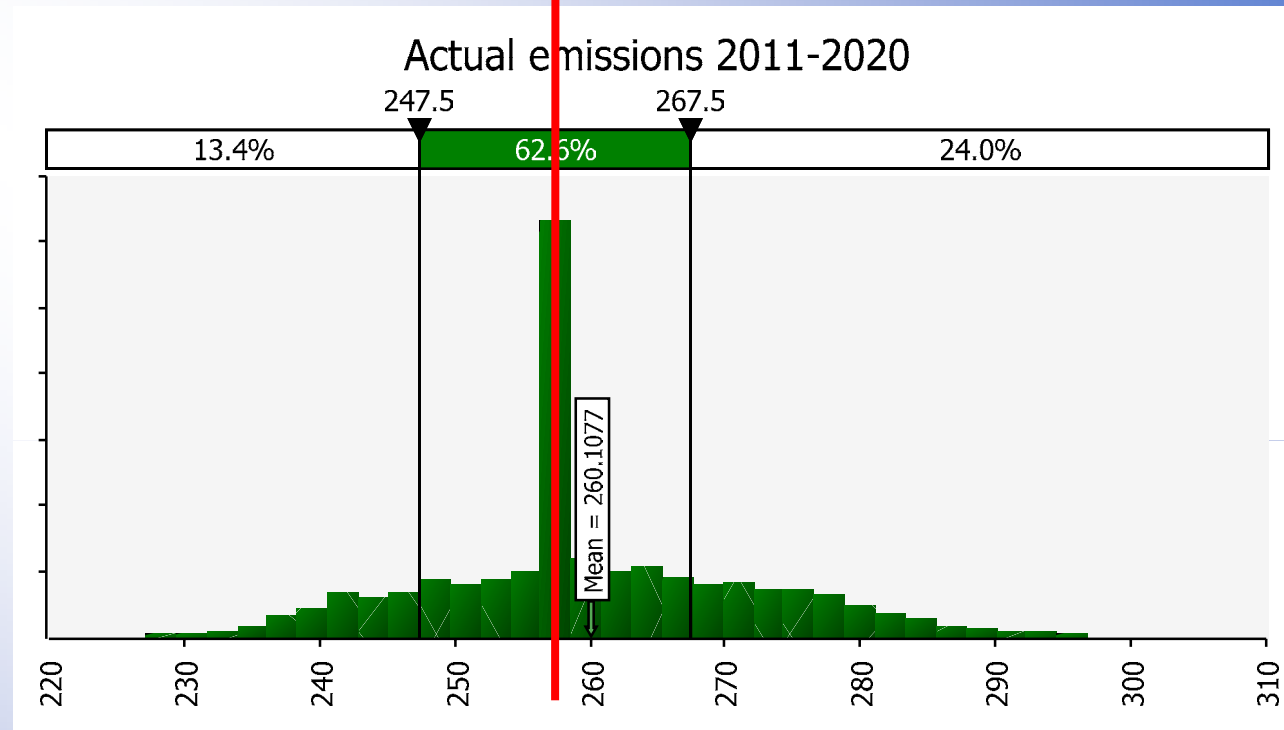
Price caps and floors

- **Price cap: a price paid at the end of the compliance period for emissions beyond the target, defined from the outset**
- **Price floor: reserve (minimum) prices in periodic auctioning**



Price cap & floor in 2011-2020

- **Target 95% of 2005 emissions (257.835 Gt CO₂ in 10 years)**



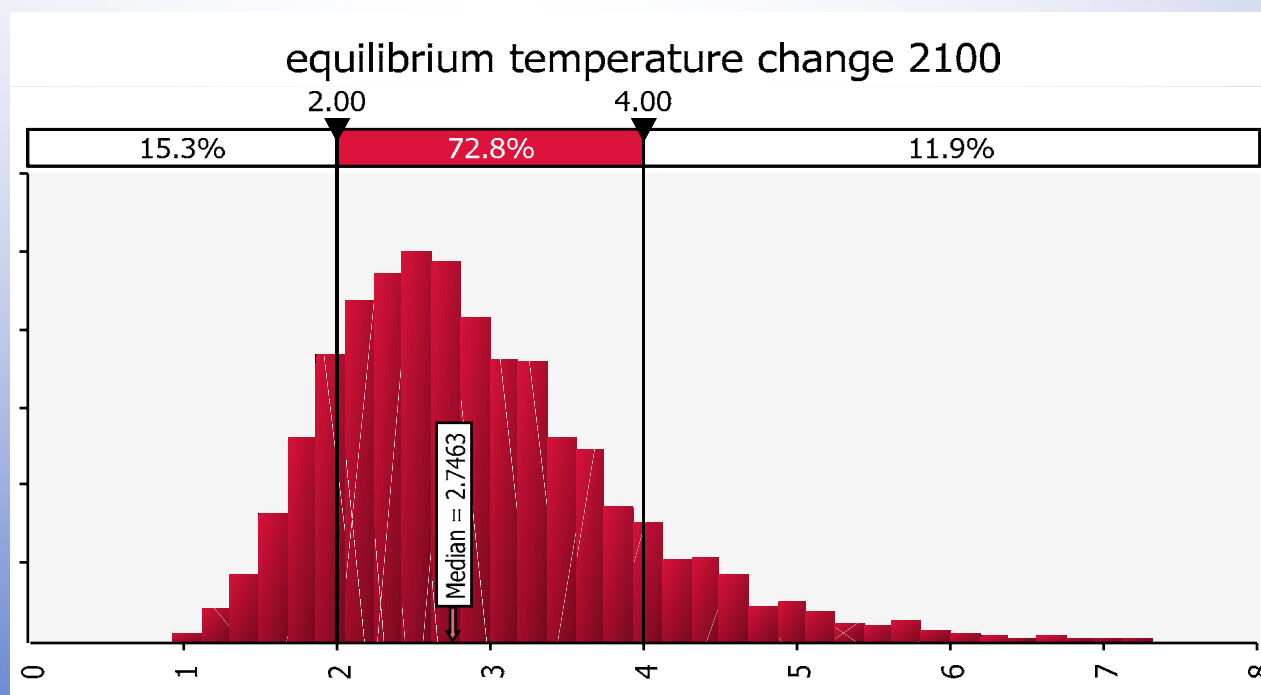
- With a price cap at USD 80 and a price floor at USD 40 expected costs are down from USD 929 to 297 bn
- Mean emissions exceed target by 0.4 Gt CO₂



Half 2005 levels w. caps & floors

(\$ 80 by 2011 to \$ 260 by 2041, floors 1/2)

- Discounted abatement costs USD 2 292 bn
- CO₂ concentration 441 - 528 ppm by 2100
- Committed delta-T 2.75°C by 2100

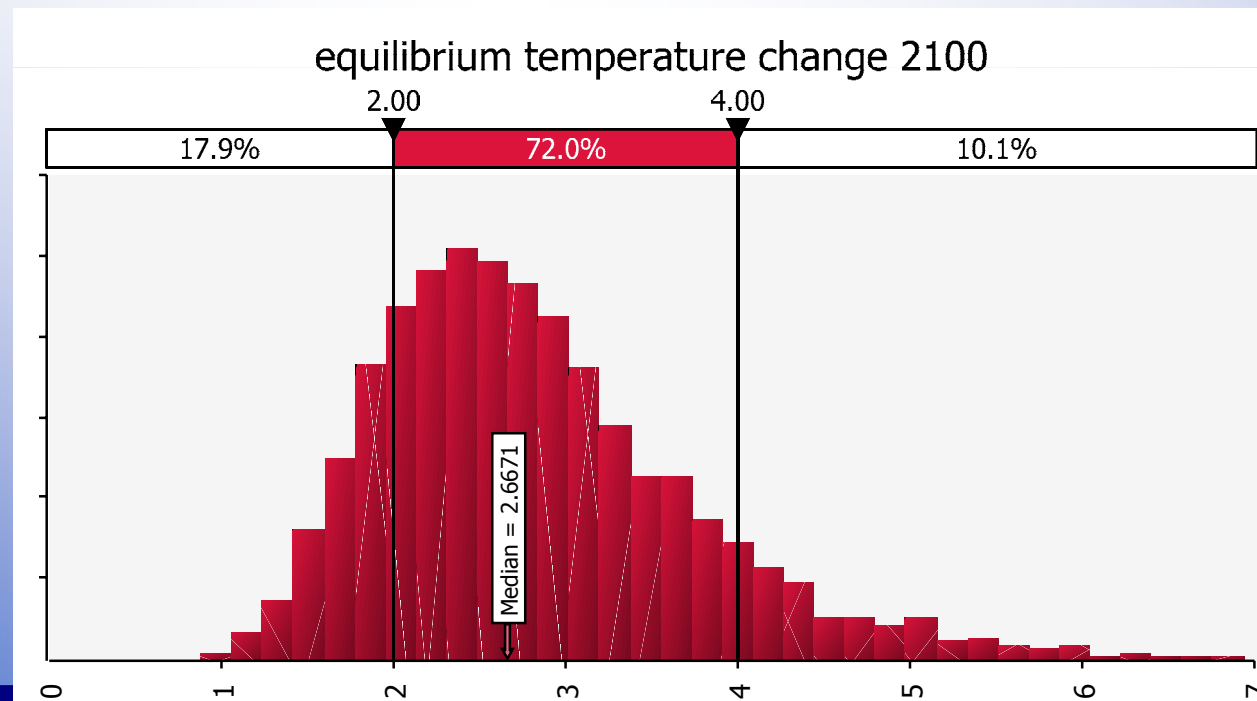




Half 1990 levels w. caps & floors

(\$ 110 by 2011 to \$ 360 by 2041, floors 1/3)

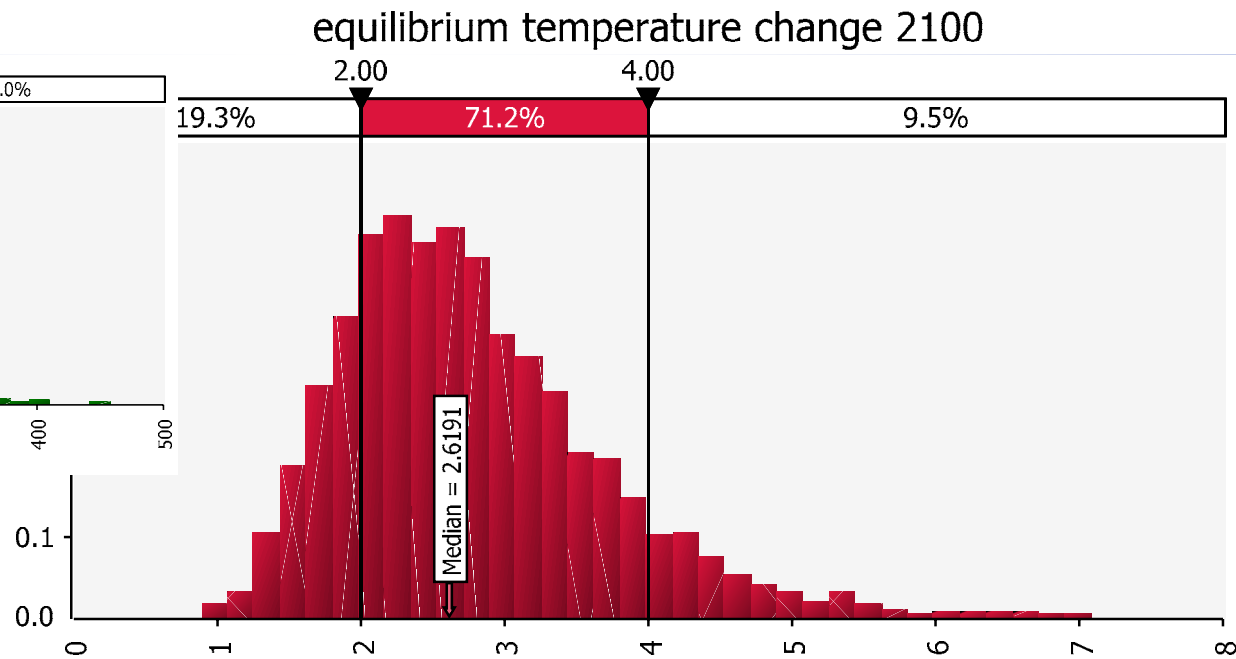
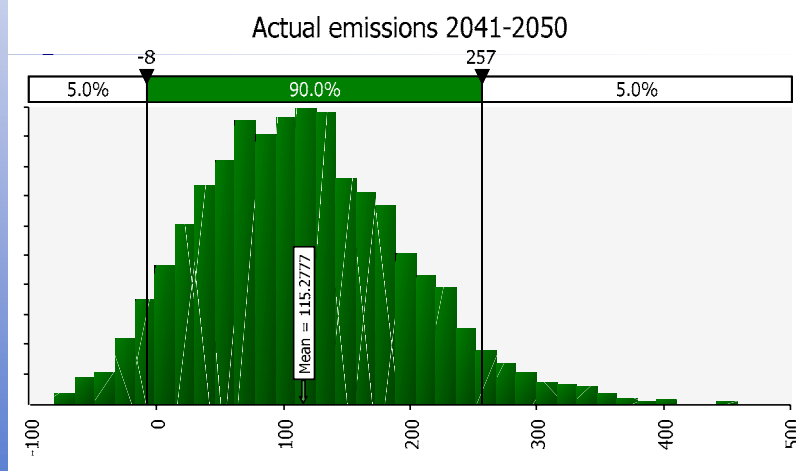
- Discounted abatement costs USD 3 456 bn
- CO₂ concentration 452 - 519 ppm by 2100
- Committed delta-T 2.67°C by 2100





Same with quasi tax (cap>MAC>floor; cap-floor=1\$)

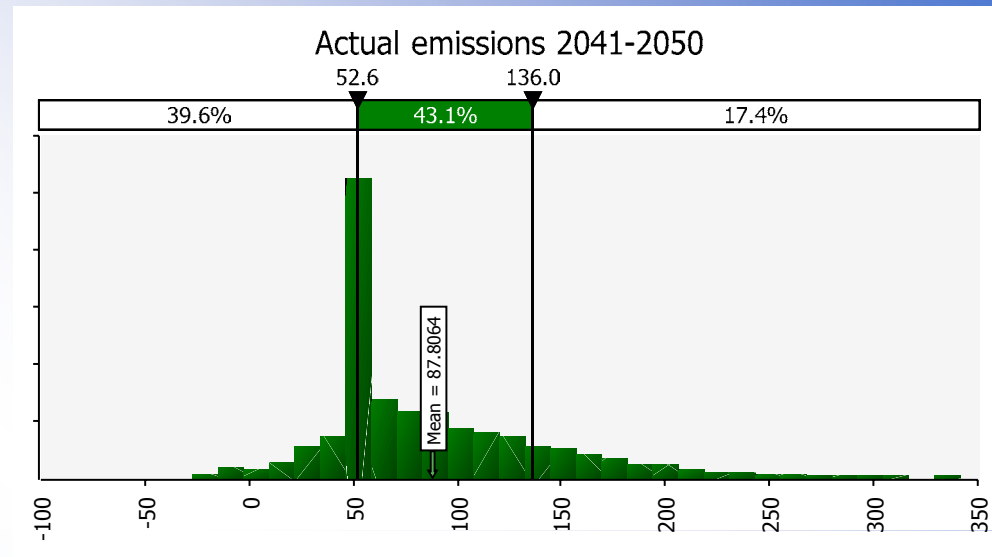
- Discounted abatement costs USD 4 212 bn
- CO₂ concentration 423 - 530 ppm by 2100
- Committed delta-T 2.62°C by 2100





Tighter targets to 2050

- $\frac{1}{4}$ of 1990 levels
- Targets: 24.5 t CO₂ by 2020, 20.4 by 2030, 15.2 by 2040, 5.26 by 2050



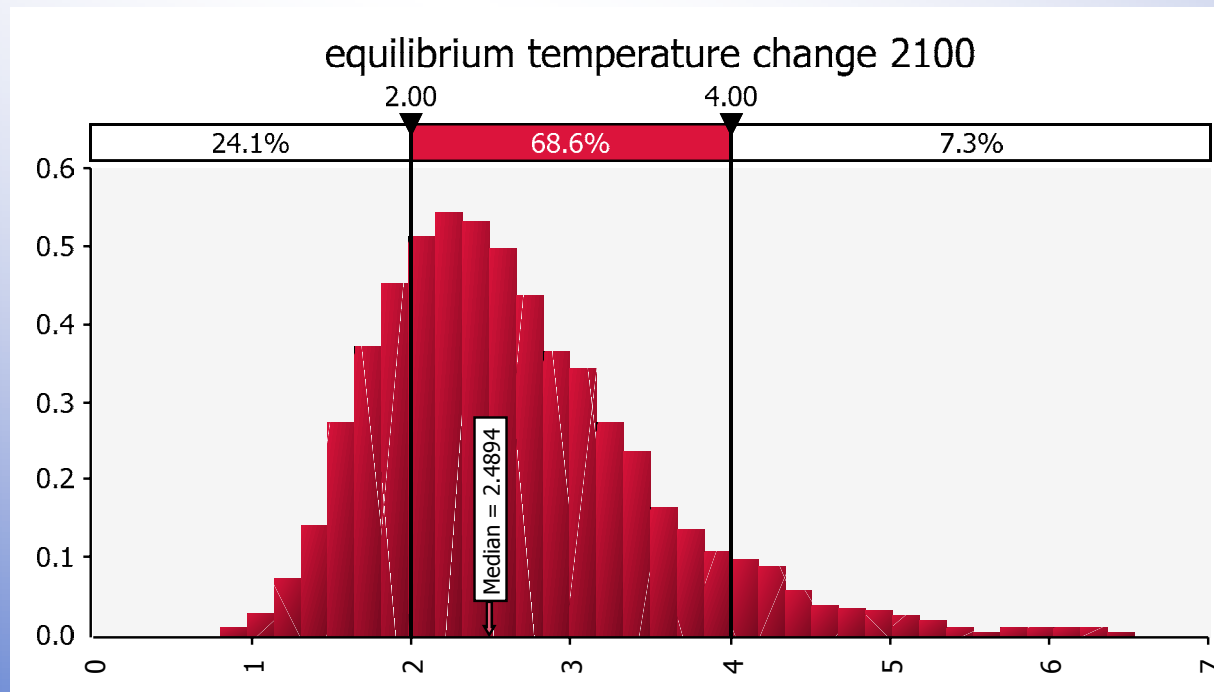
- ◆ Price caps set at USD 150, 240, 360, 600
- ◆ Price floors set at USD 50, 80, 120, 200
- ◆ Mean emissions: 8,8 Gt CO₂/y
- ◆ NPV abatement costs 2011-2050: USD 6 762 bn vs. 7 885 with straight targets 13.5 Gt CO₂



Tighter targets w. caps & floors

(\$ 150 by 2011 to \$ 600 by 2041, floors 1/3)

- Discounted abatement costs USD 6 762 bn
- CO₂ concentration 440 – 498 ppm by 2100
- Committed delta-T 2.49°C by 2100



Policy	Target 2050 Price caps Price floors (2011 to 2050)	Abatement costs 2011- 2050 (npv) Min -Av.-Max in % WGP	Warming committed by 2100			
			ppm	°C	<2°C	<4°C
No policy	-	-	662 1067	5.25	-	19.7
1: Half 2005 level	13.6 Gt CO ₂ No price cap	\$ 7 885 bn 0-0.4-5.5	479 484	2.71	15.8	88.8
Half 2005 + price caps & floors	13.6 Gt CO ₂ \$80 to \$260 \$40 to \$130	\$ 2 292 bn 0-0.12-0.19	441 528	2.75	15.3	88.1
Half 1990 + price caps & floors	10.5 Gt CO ₂ \$110 to \$360 \$35 to \$120	\$ 3 456 bn 0-0.2-0.3	452 519	2.67	17.6	89.7
Quasi tax (half 1990)	\$88 to \$342 \$87 to \$341	\$ 4 212 bn 0-0.2-0.3	423 530	2.62	19.3	90.5
Tight target +price caps & floors	5.26 Gt CO ₂ \$150 to \$600 \$ 50 to \$200	\$ 6 762 bn 0-0.35-0.5	440 498	2.49	23.7	92.9



Some conclusions

- Price caps and price floors significantly reduce cost uncertainty
- Price-driven variations in emissions have little influence on policy outcomes (temperature changes)
 - ◆ If price cap and price floor levels are commensurate with the ambition of the policy
 - ◆ Building up CO₂ concentrations smoothes emission changes
 - ◆ The uncertainty on climate sensitivity by far exceeds the uncertainty on emission levels
- Tighter targets with price caps & price floors entail lesser economic risks and similar climate results



Additional remarks

- **Differences with Pizer's work (2002)**
 - ◆ Discount rate not uncertain in this study
 - ◆ No 'optimal' abatement level sought for here
 - ◆ But 'best use of a given amount of money'
- **Reduced expected abatement costs**
 - ◆ Result from 'where to' flexibility
 - ◆ Not only from time flexibility
 - ◆ Time flexibility might be imperfect substitute for price caps and floors



More conclusions

- **Climate risks: mitigation action makes an enormous difference by 2100**
- **Economic risks:**
 - ◆ Taxes similar to permits with price corridors
 - ◆ Both dominate straight targets
 - Do actual taxes actually perform as quasi-taxes?
 - Political economy of taxes vs. cap-and-trade
- **Short term certainty on emissions is less important than long term policy ambition**
 - ◆ *Better be approximately right than exactly wrong!*



Possible future work

- Could extend the analysis to all GHG
- Could assess the impacts of reduced price volatility on investors' behaviour
- Could analyse concrete issues in implementing price caps and floors
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