International Institute for Applied Systems Analysis
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science for global insight

Required Near-term Climate Actions to Limit Global Warming to 2°C

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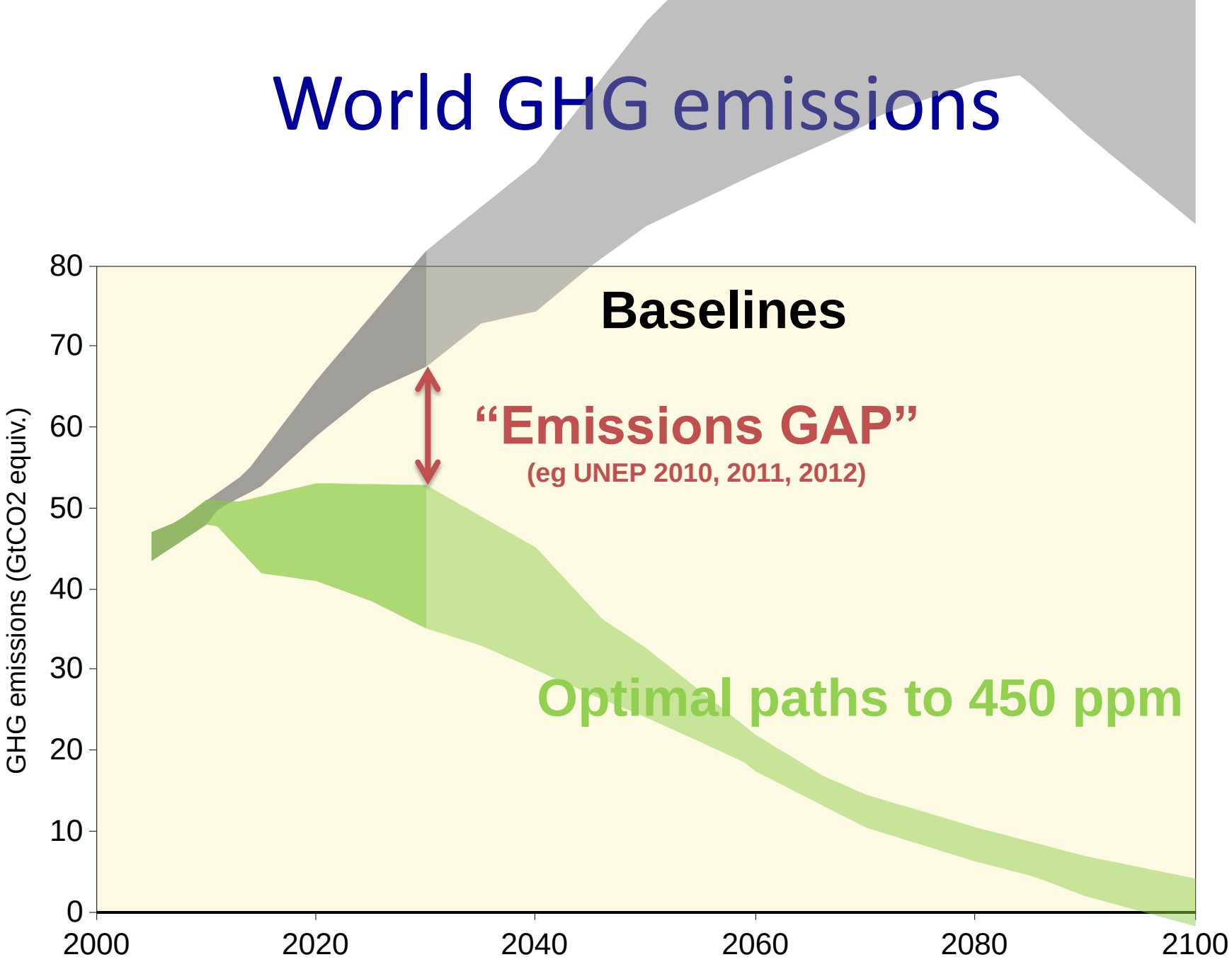
World GHG emissions



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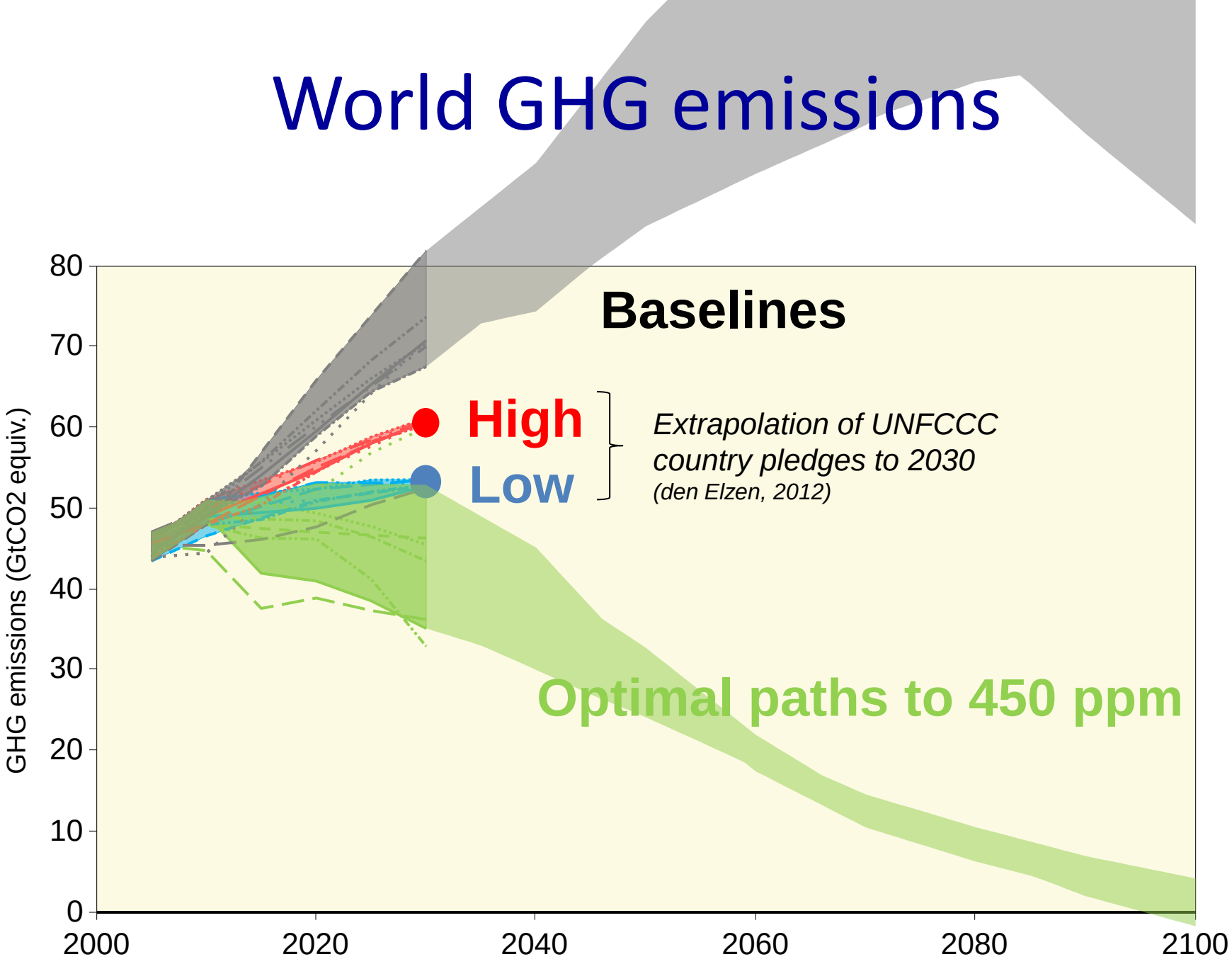
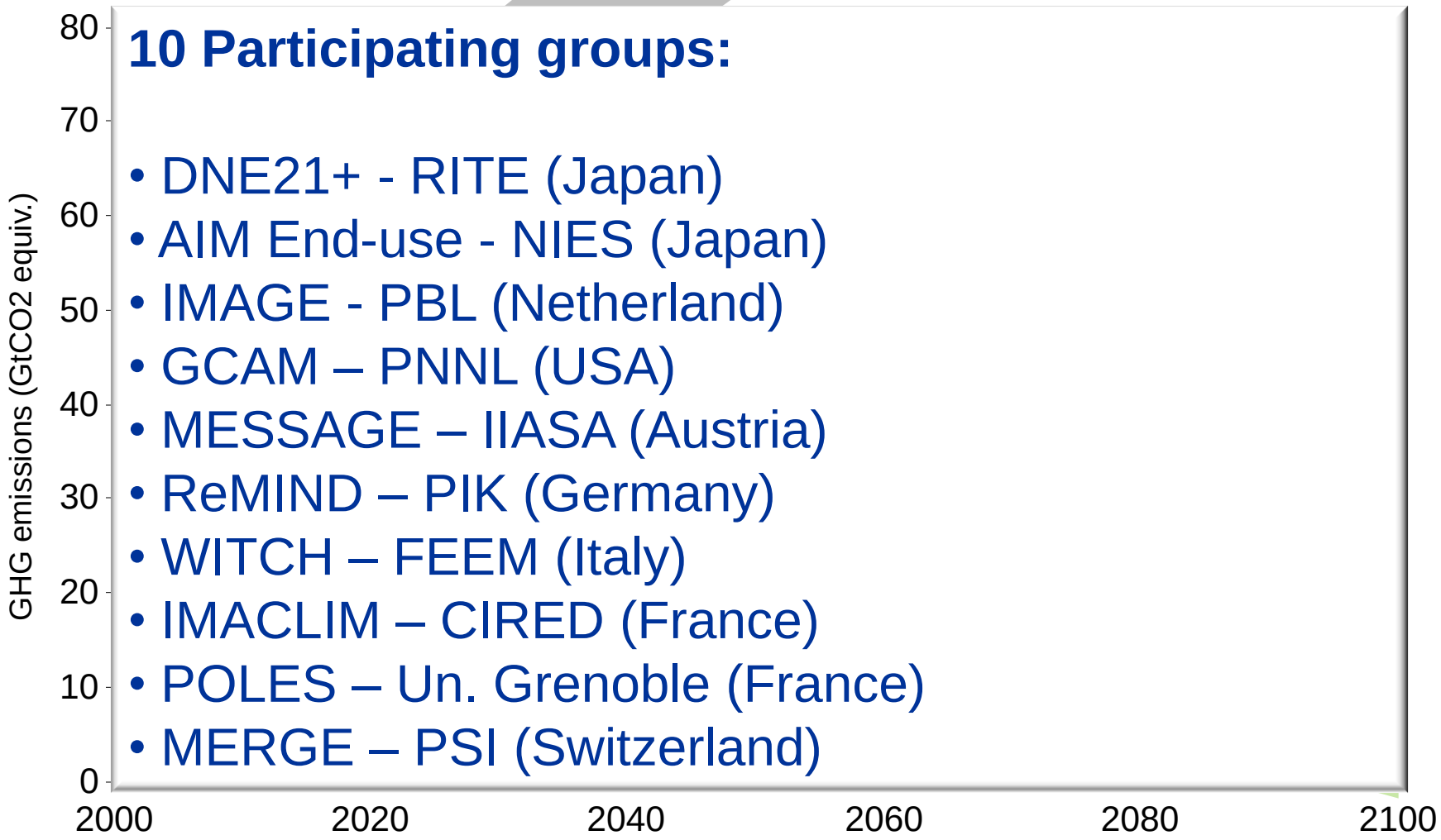


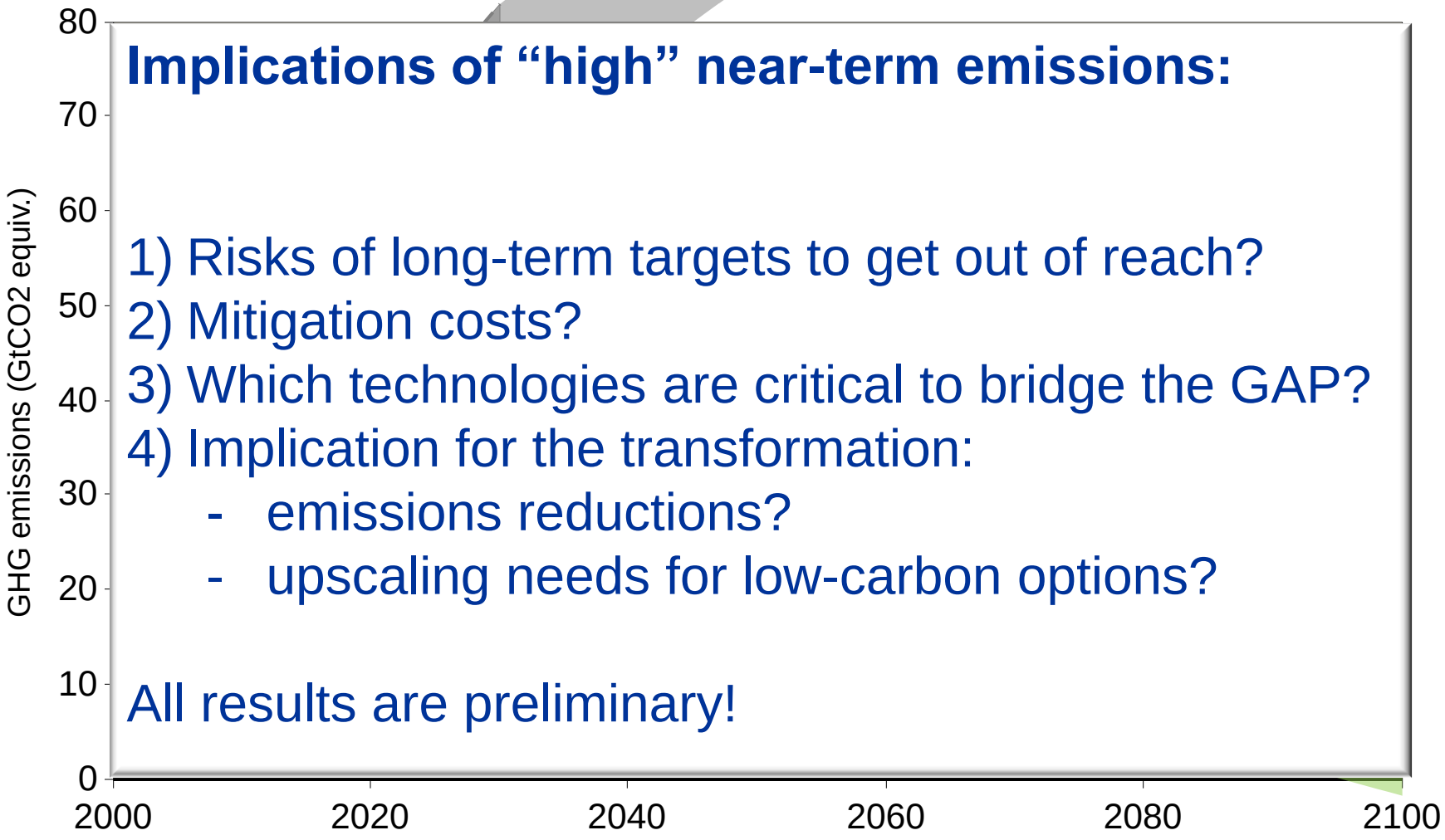
AMPERE Model Intercomparison "Exploring the GAP"



10 Participating groups:

- DNE21+ - RITE (Japan)
- AIM End-use - NIES (Japan)
- IMAGE - PBL (Netherland)
- GCAM – PNNL (USA)
- MESSAGE – IIASA (Austria)
- ReMIND – PIK (Germany)
- WITCH – FEEM (Italy)
- IMACLIM – CIRED (France)
- POLES – Un. Grenoble (France)
- MERGE – PSI (Switzerland)

AMPERE Model Intercomparison

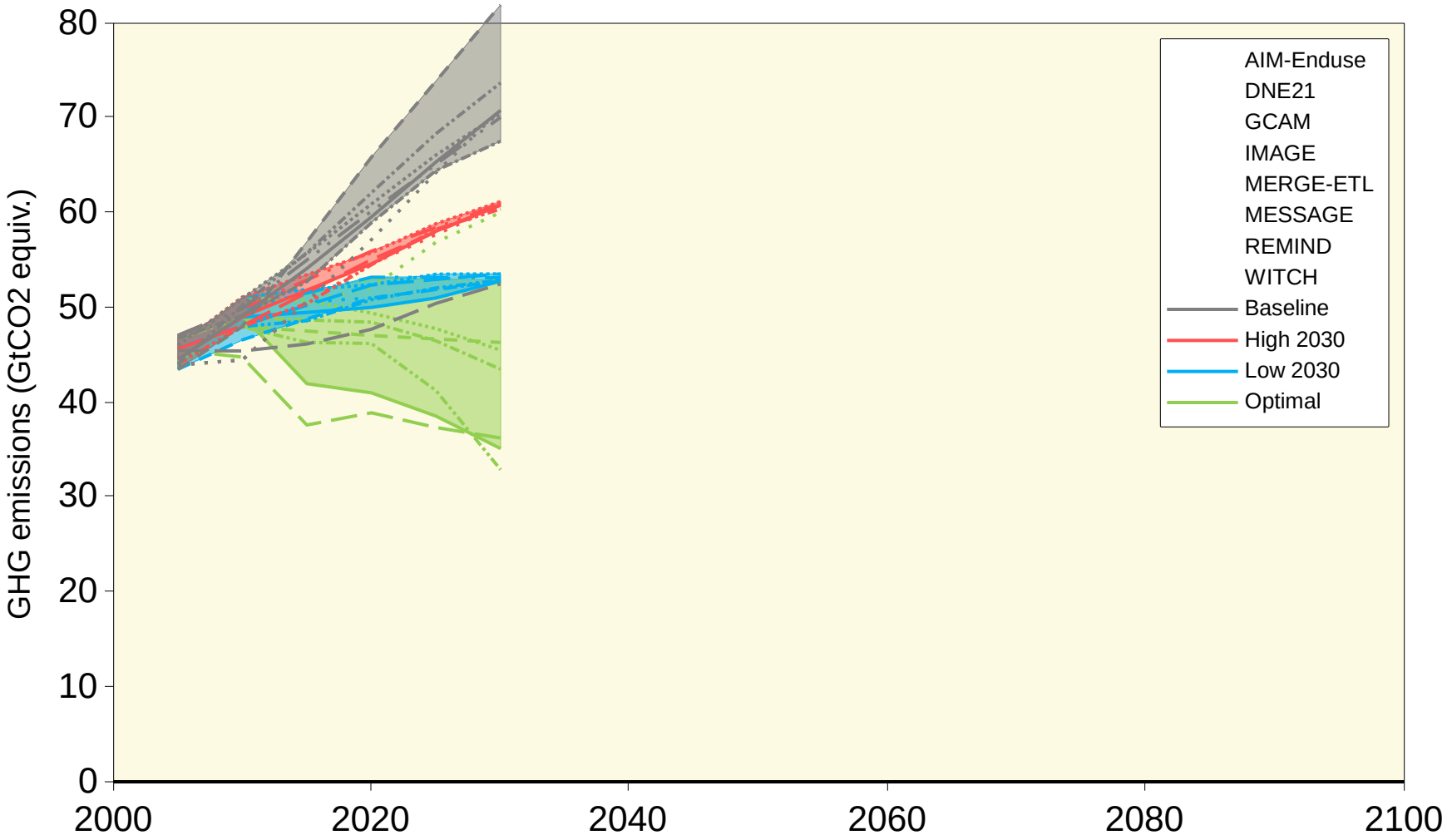


Implications of "high" near-term emissions:

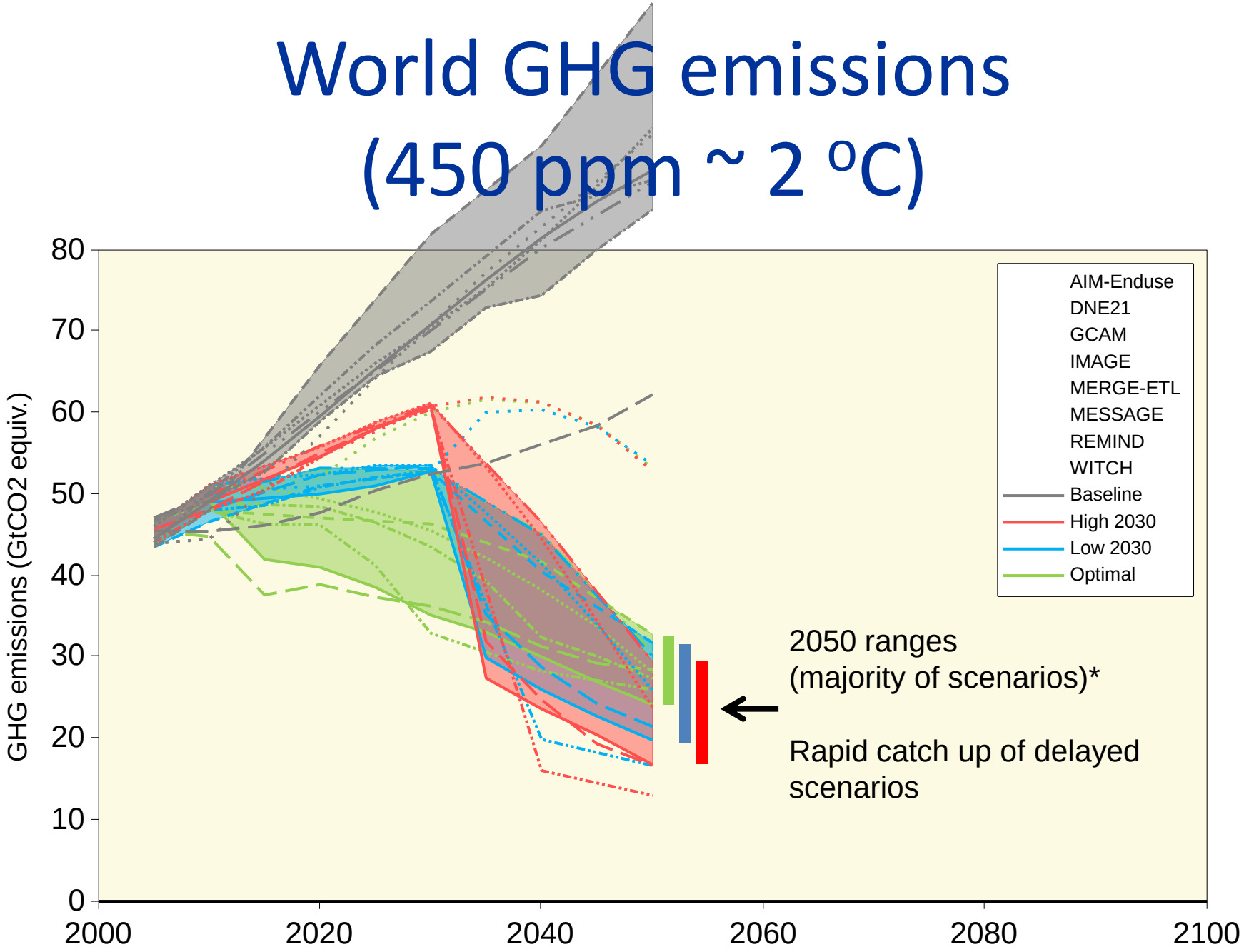
1) Risks of long-term targets to get out of reach?
2) Mitigation costs?
3) Which technologies are critical to bridge the GAP?
4) Implication for the transformation:
   - emissions reductions?
   - upscaling needs for low-carbon options?

All results are preliminary!

World GHG emissions



World GHG emissions (450 ppm ~ 2 ºC)



*focus on long-term GHG models

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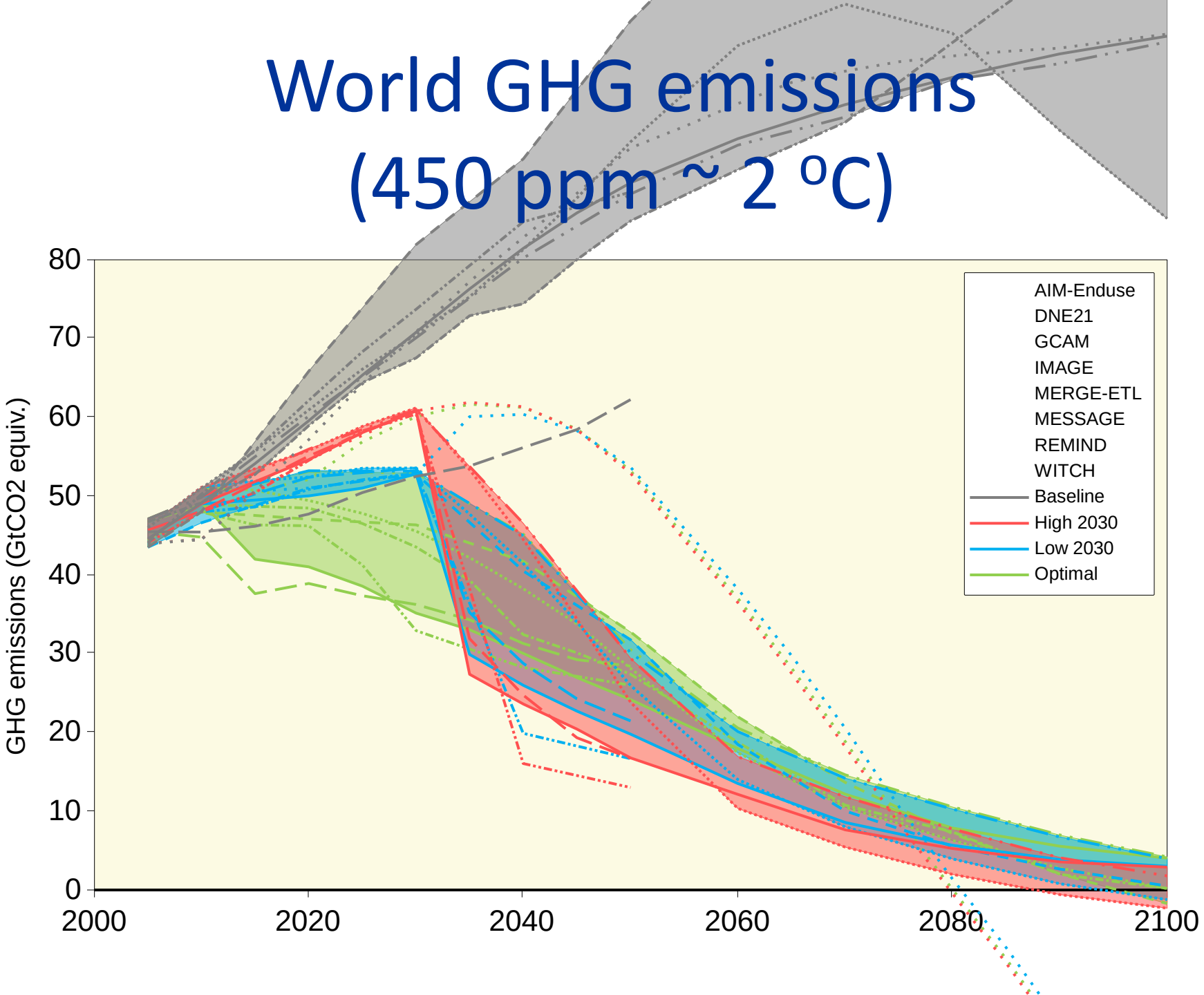

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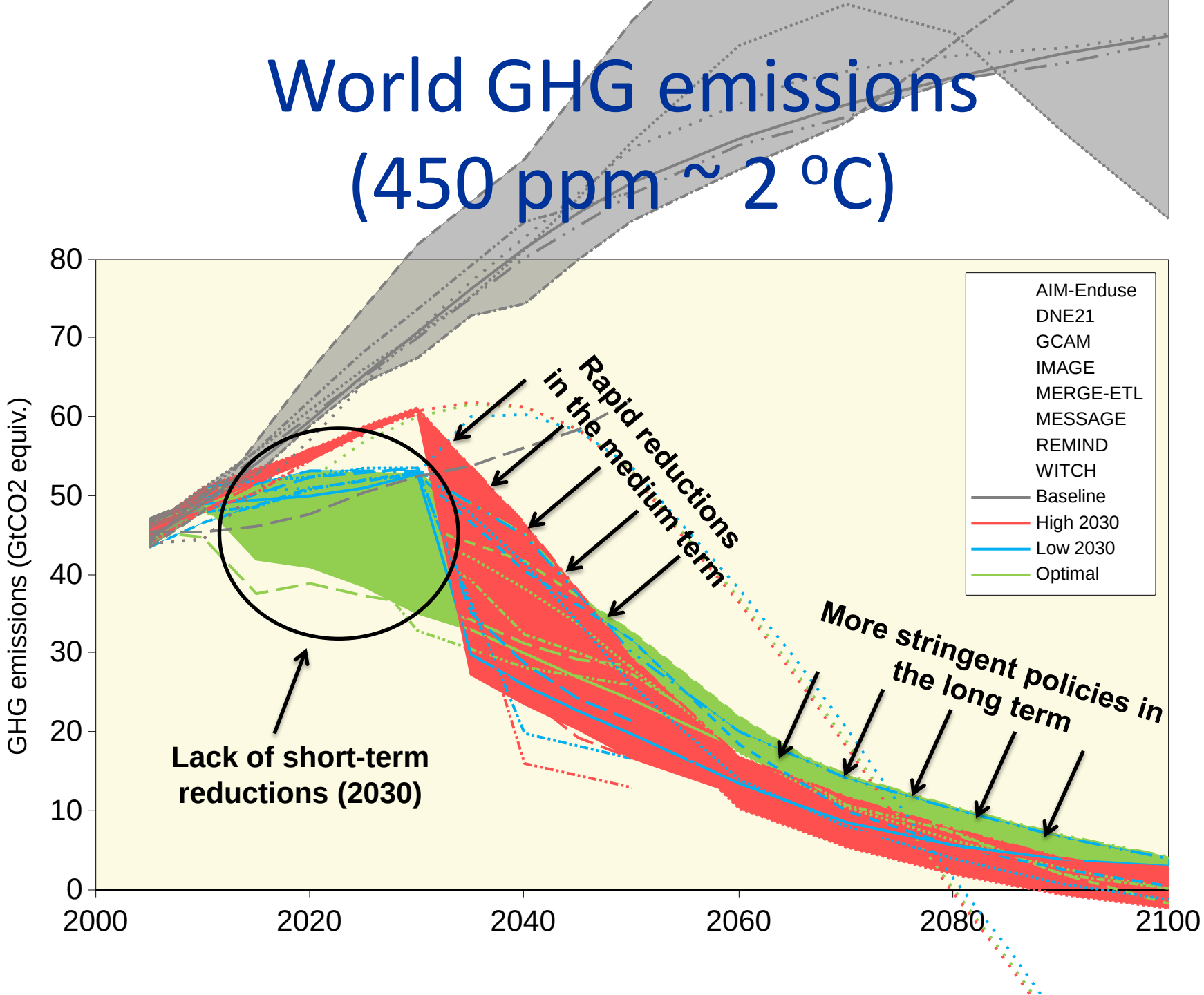
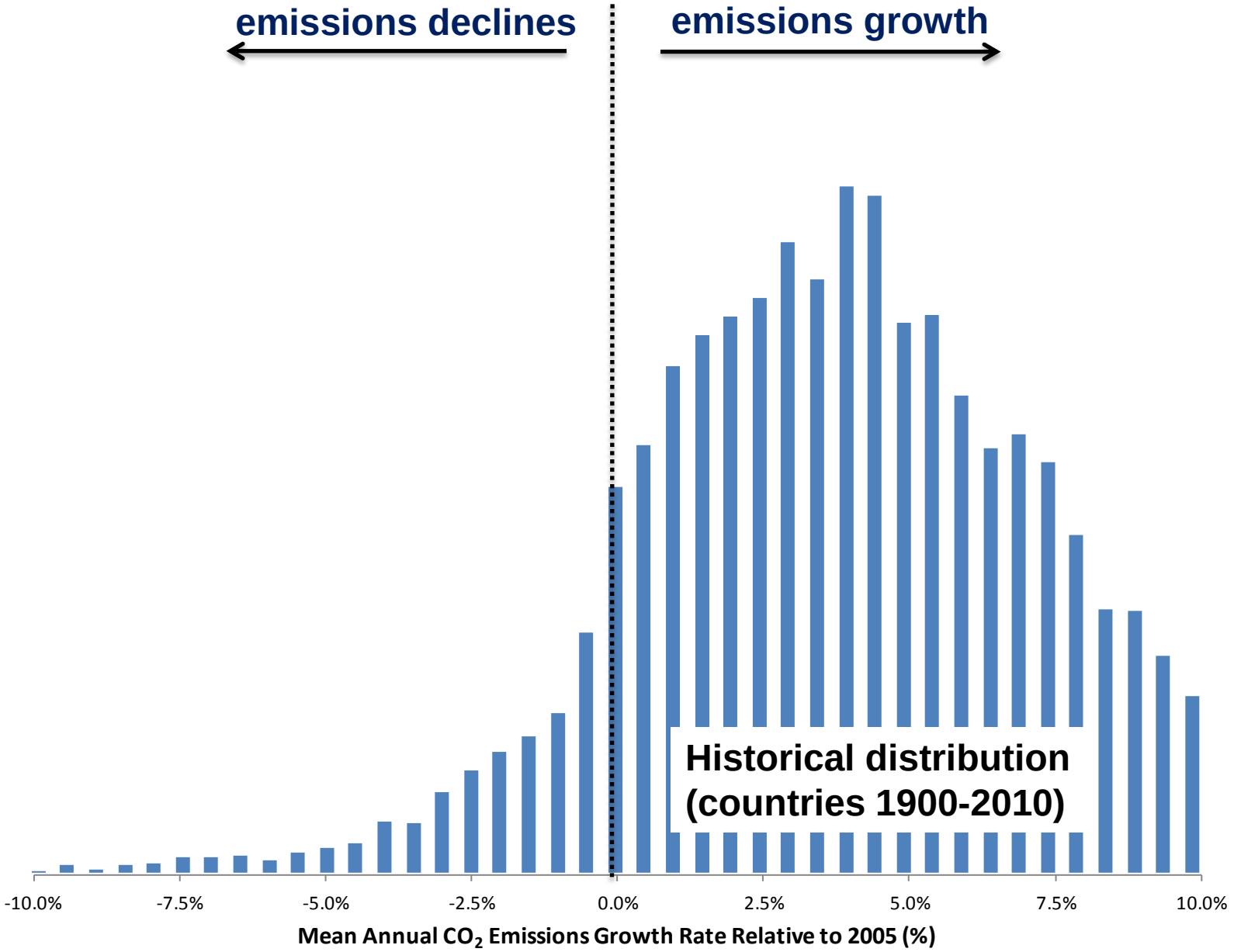


Emissions reduction rates (%/year)



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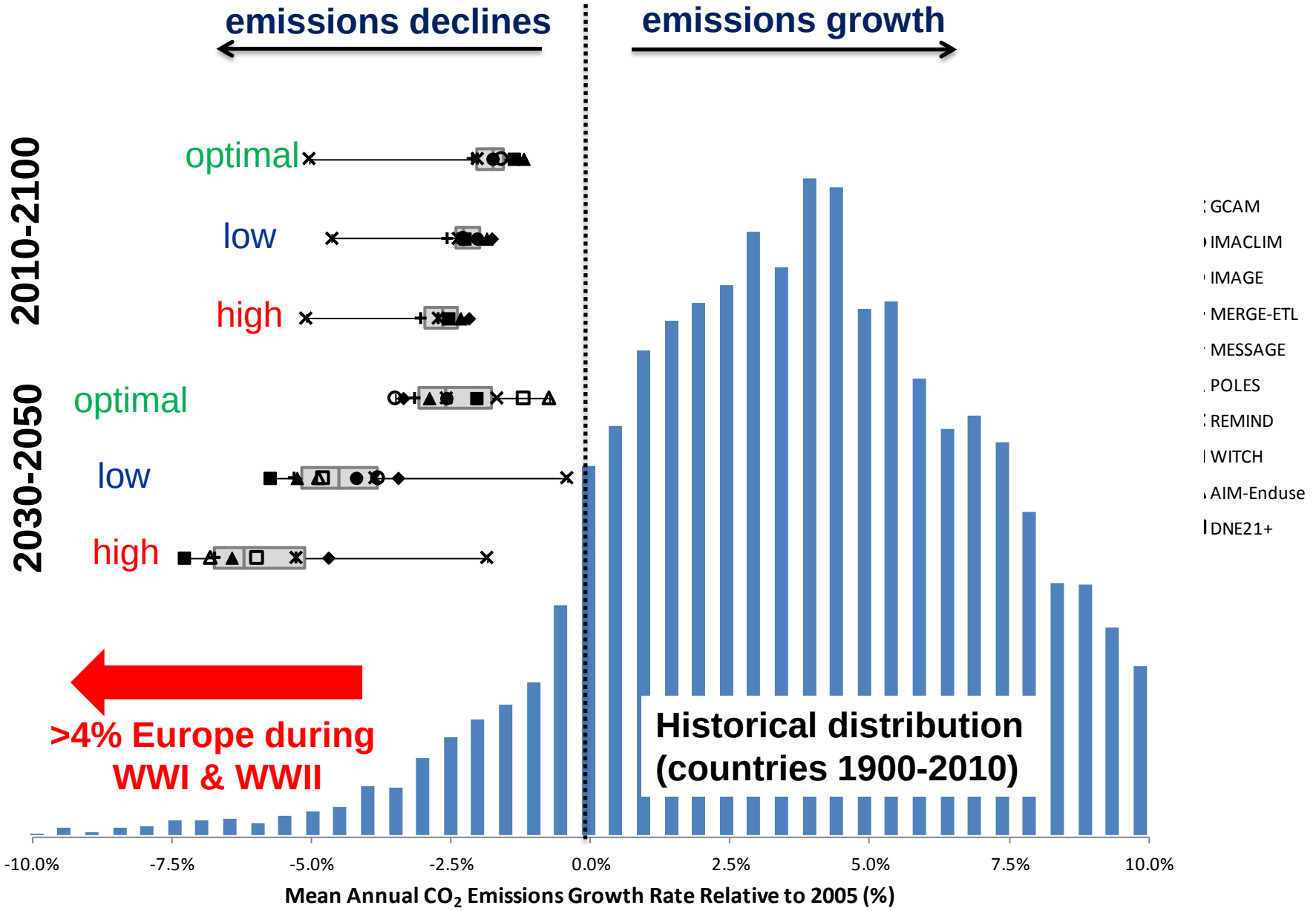

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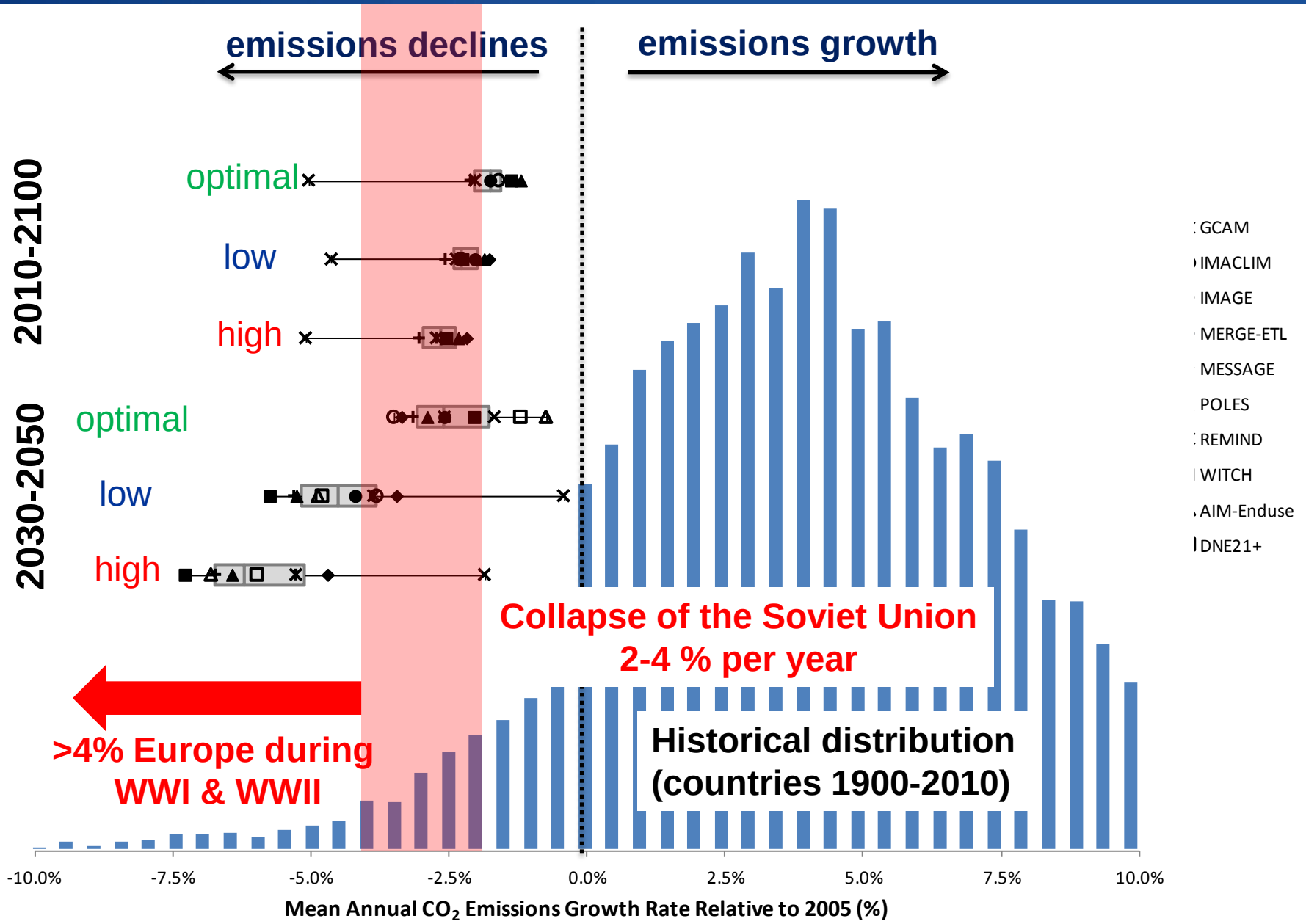

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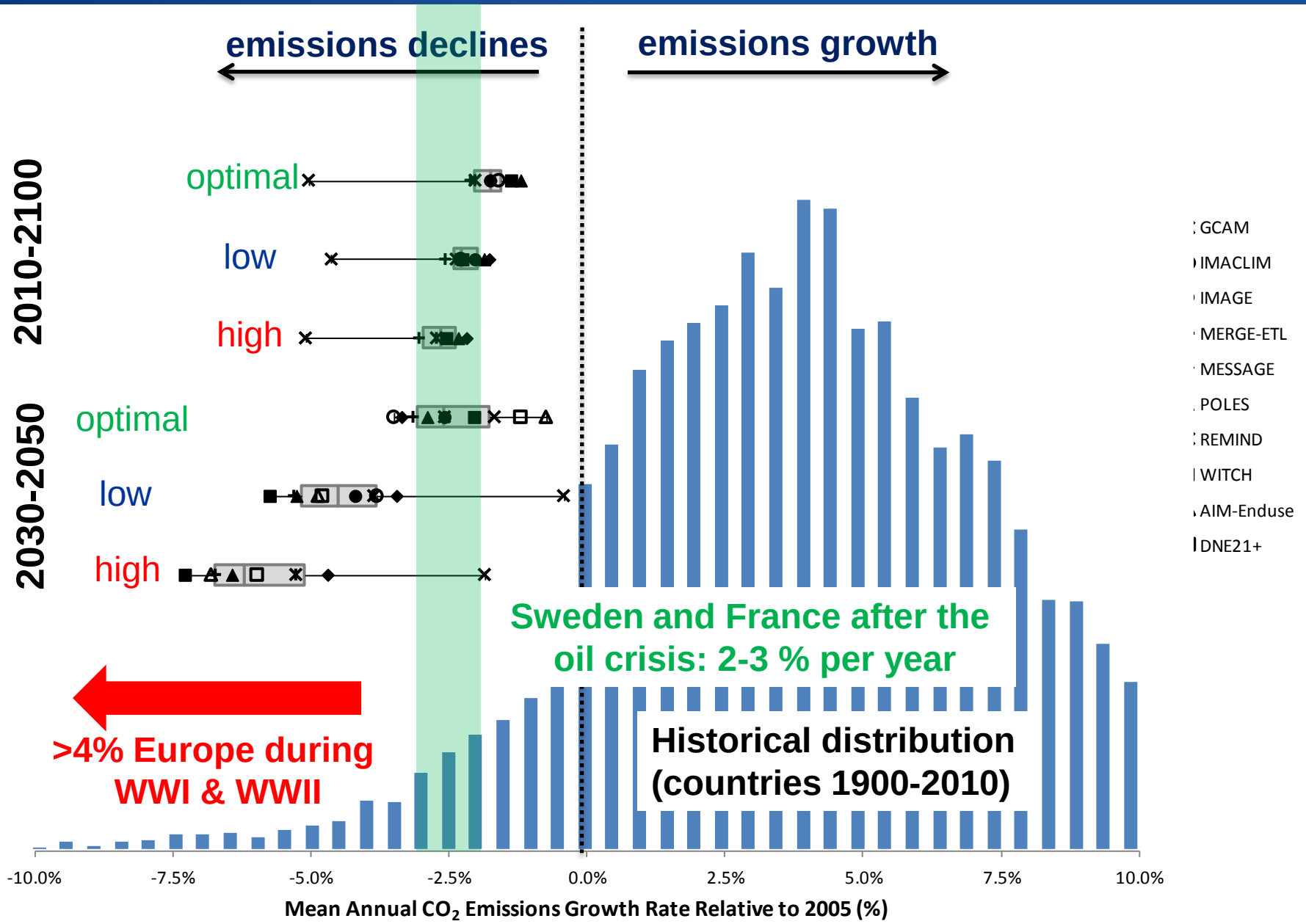

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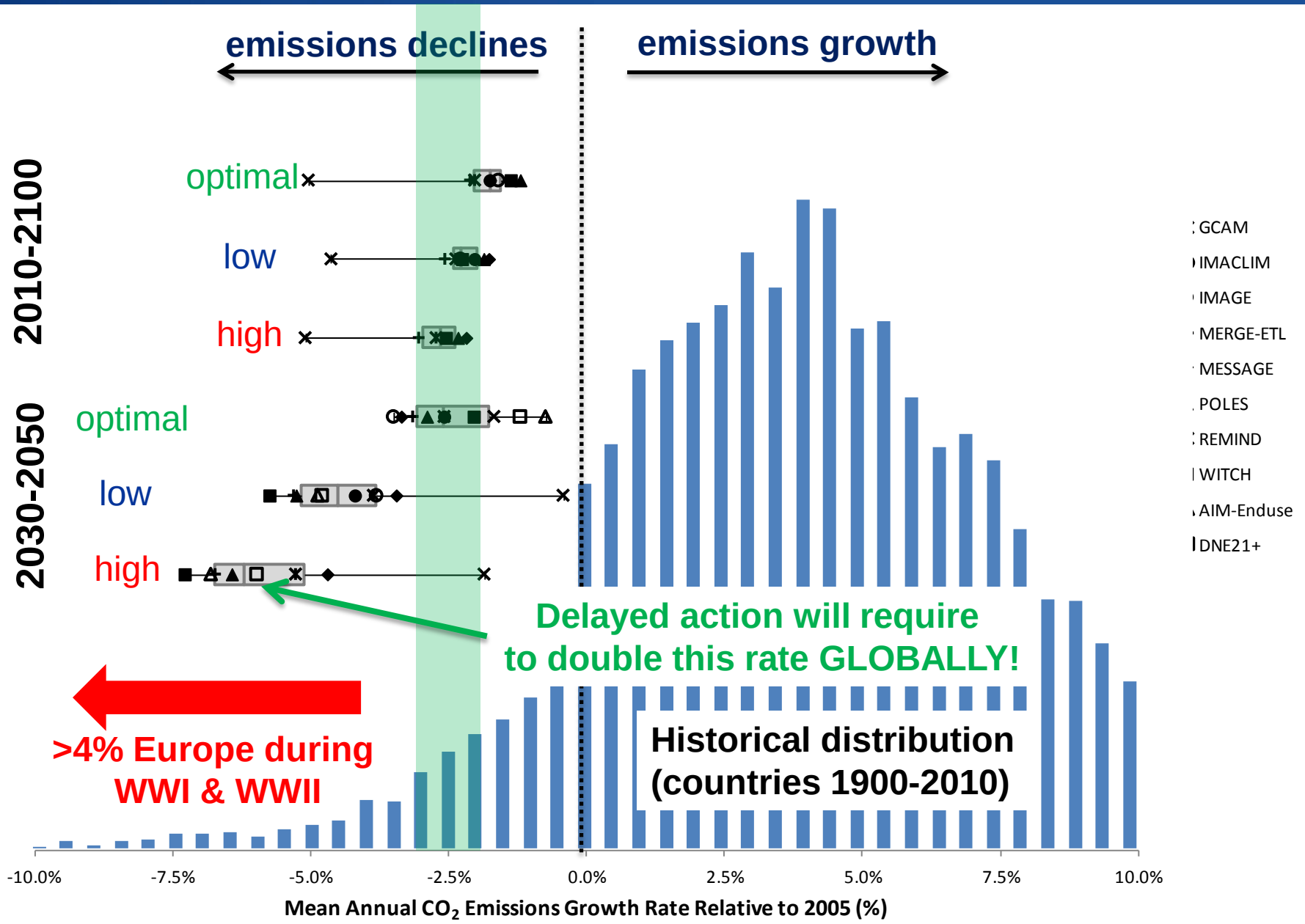
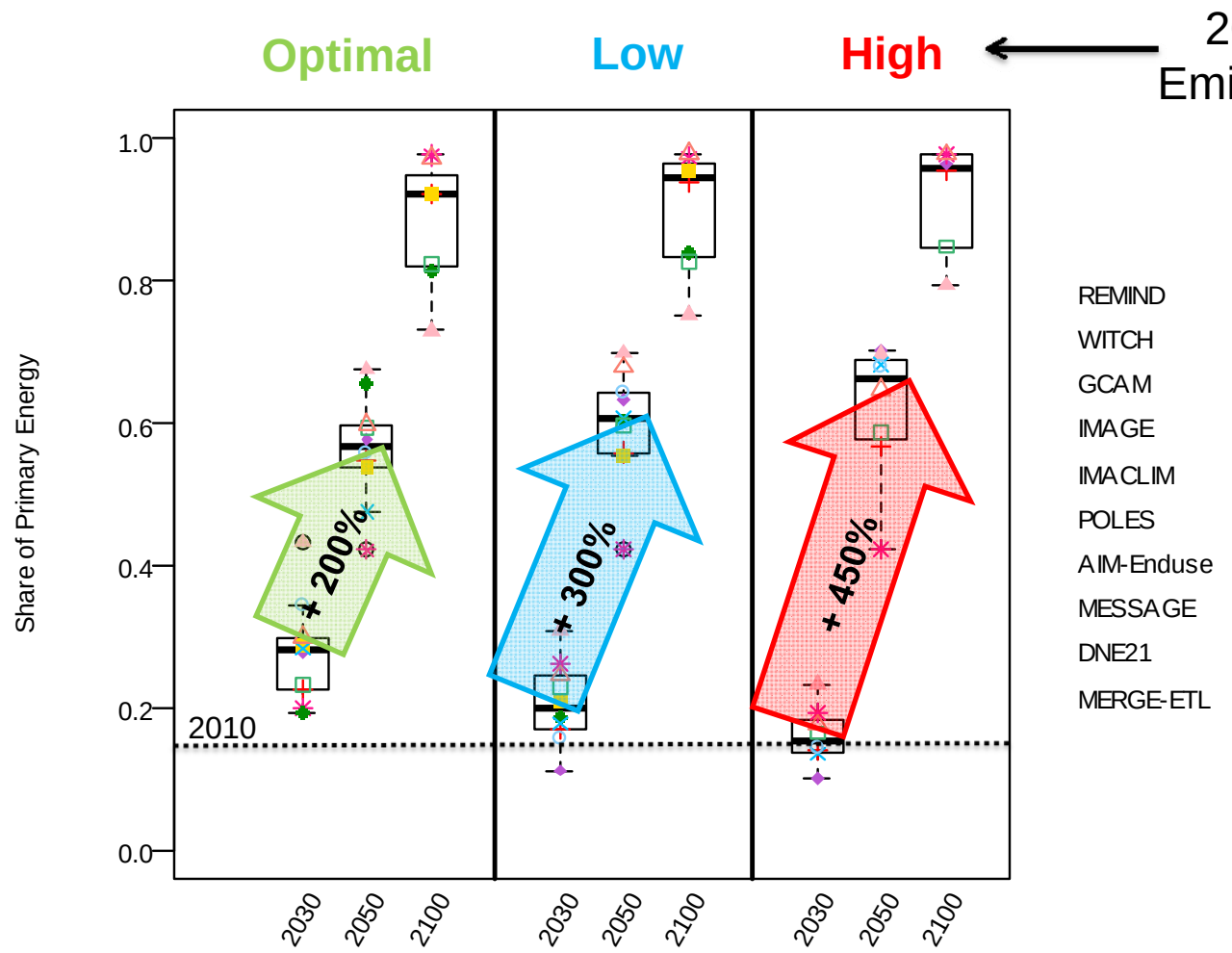


The Speed of the Transformation
Low Carbon Energy Shares

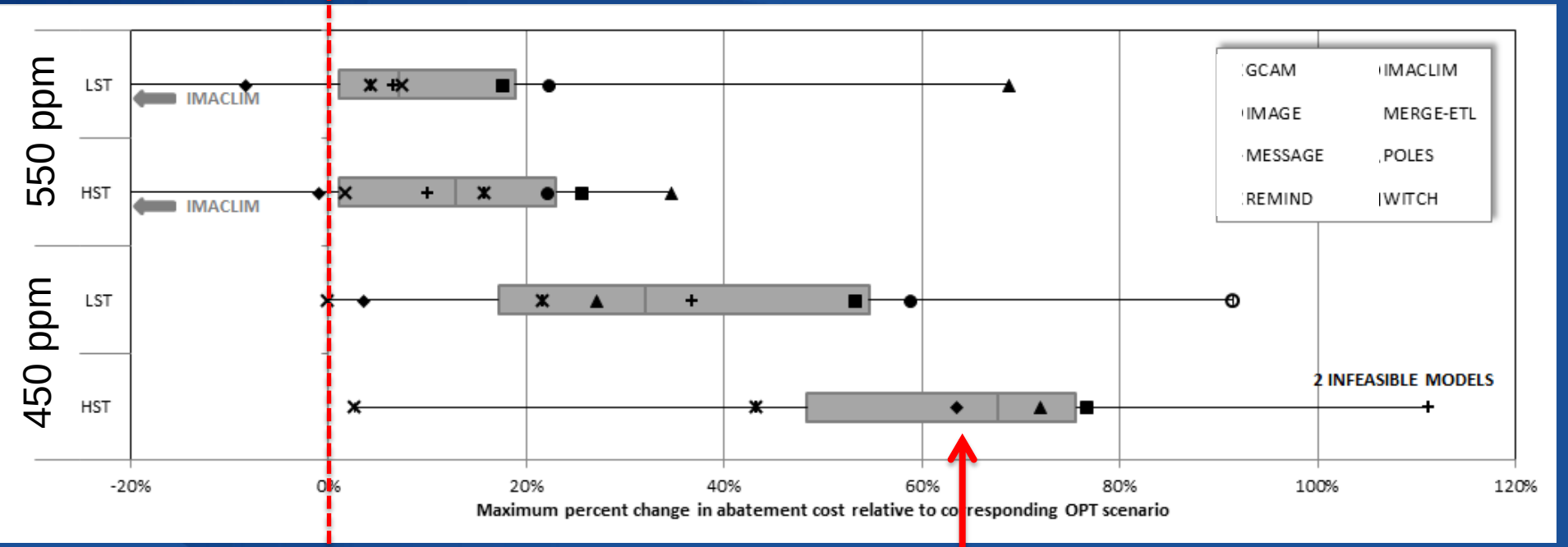


Average Mitigation costs

- Mitigation costs in immediate/optimal policy scenarios are around 2-3% of GDP (wide range: 1-14%)
- Following the pledges to 2030 increases costs on average by about 25% - these are net costs and for the full century (including short-term benefits)
- 17 years pledges = +25% costs for 100 years

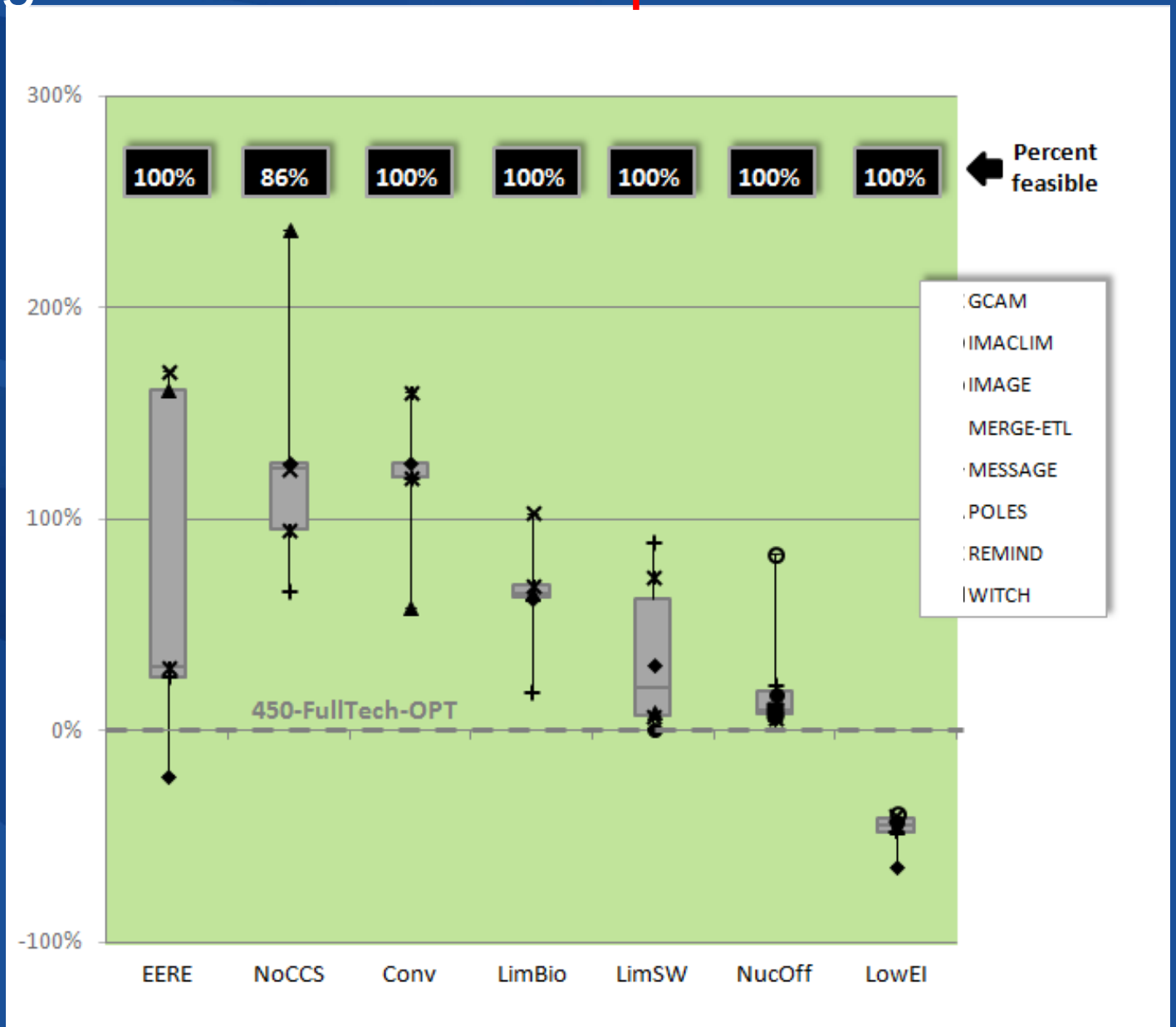
Peak Mitigation Costs (maximum loss over the course of the century)

Cost increase compared to optimal case



50-80% increase of costs due to pledges

The Value of Technology
Mitigation costs in the optimal cases



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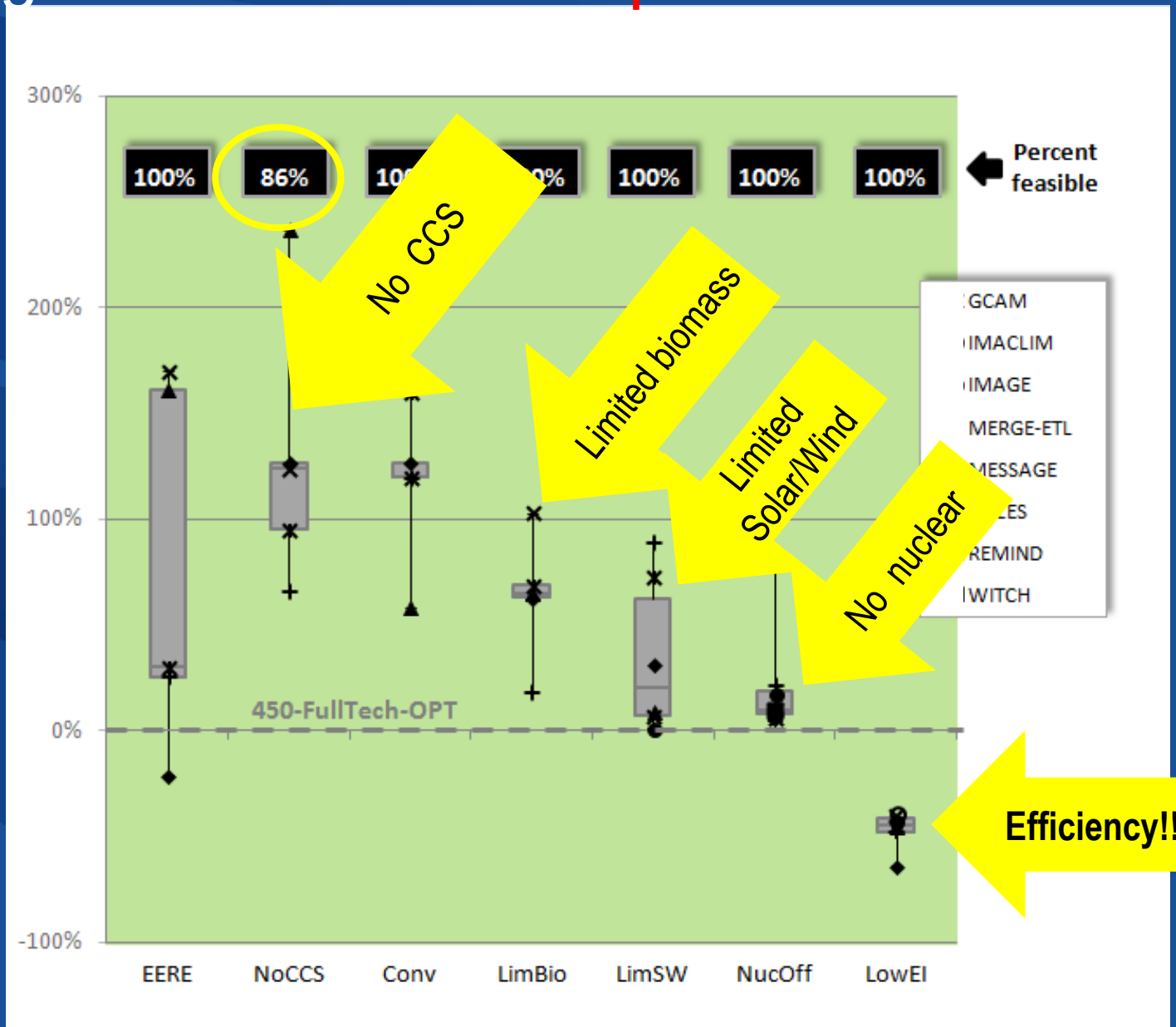
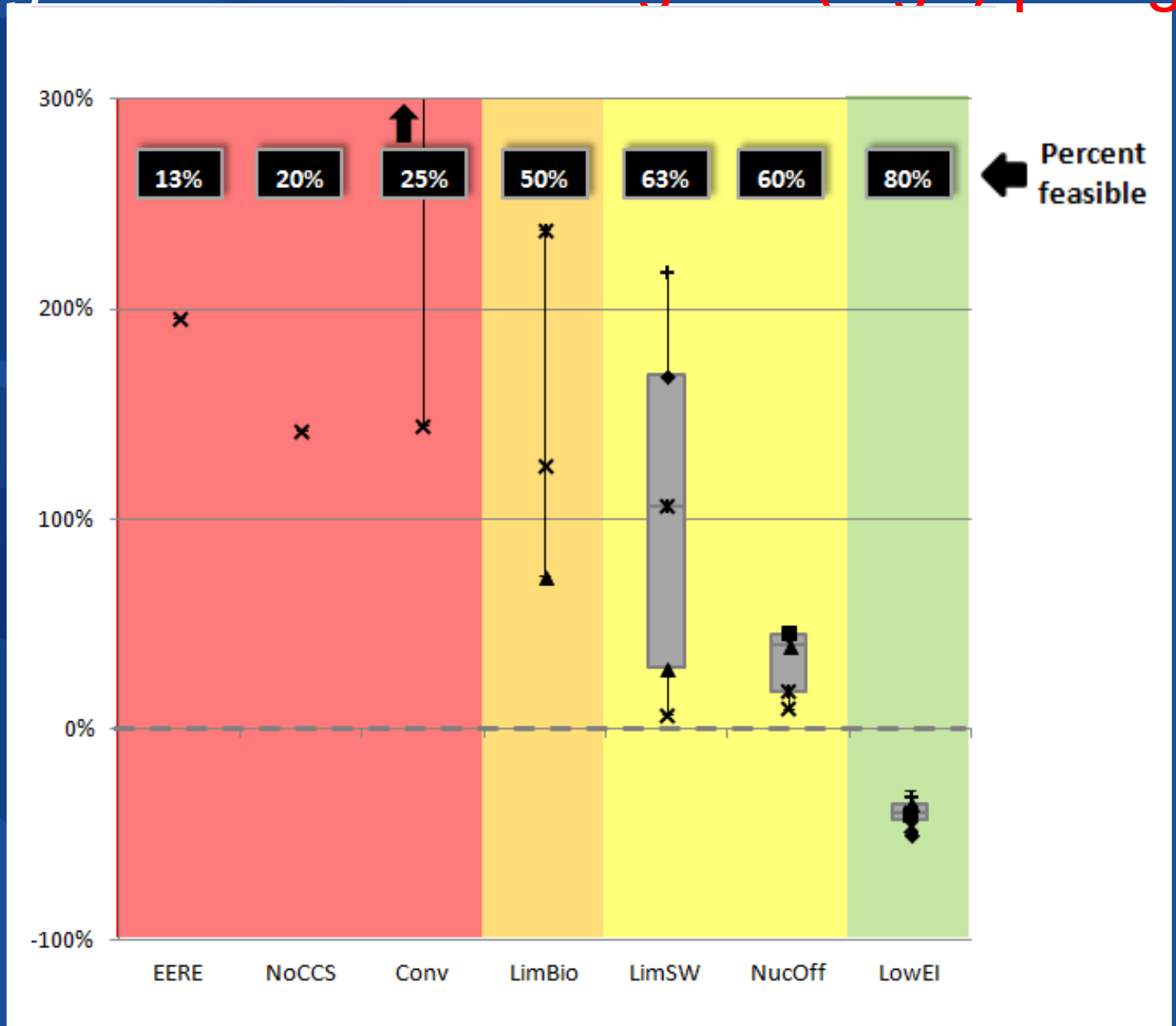
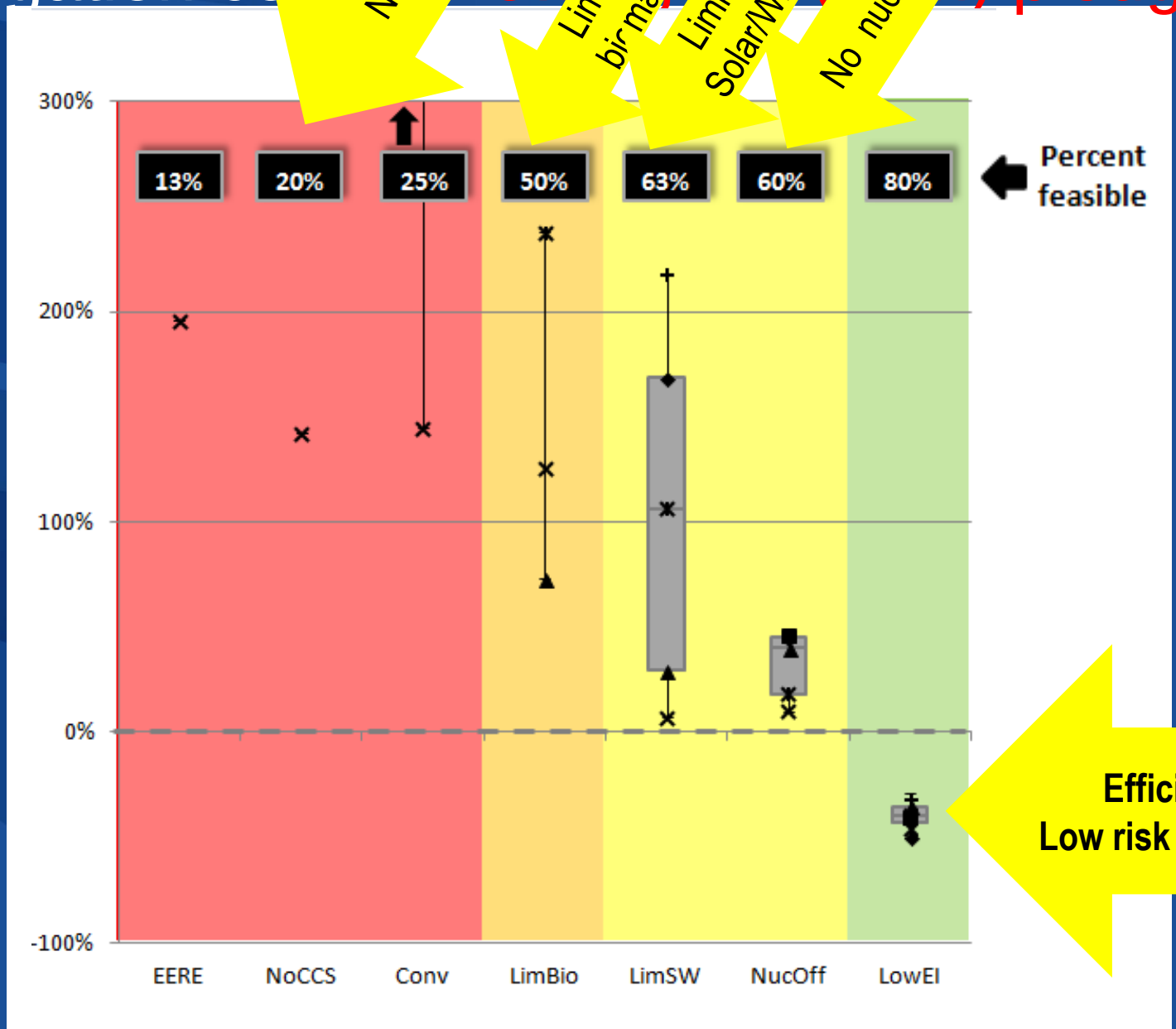


The Value of Technology

Mitigation costs following the (high) pledges



The Value of T[illegible]nology
Mitigation cost[illegible] flowi[illegible] t[illegible] (I[illegible]n) pledges

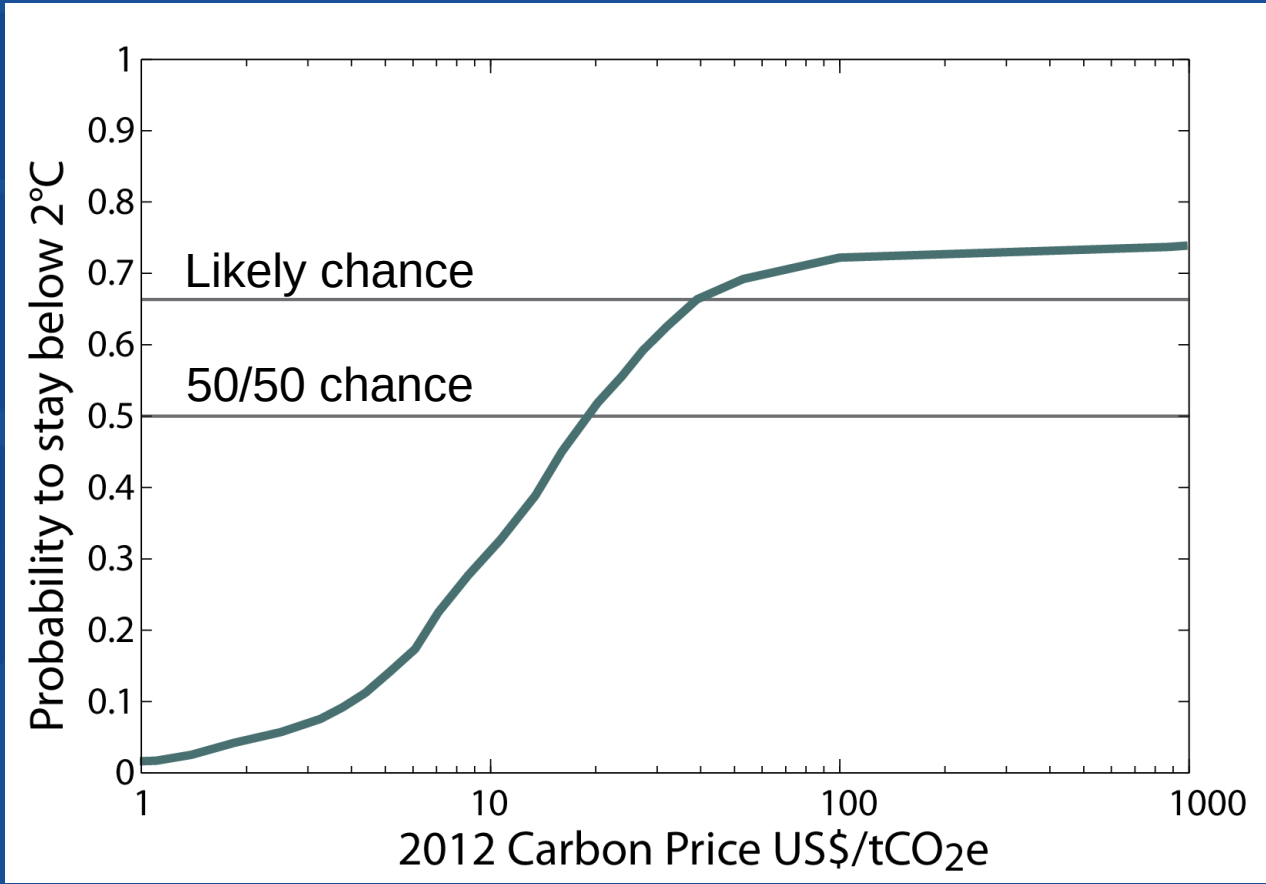


Implications of Pledges to 2030

- 70% of the CO2 emissions budget to 2100 is vented to the atmosphere
- Triple-challenge:
  - Fossil fuel lock-in ~ 50% of today's energy system (additional)
  - Stranded assets in the order of 700 GW coal power plants
  - Acceleration of low-carbon diffusion by more than a factor of 3

Costs-risk Distributions

2°C



Nature 493, 79–83, doi:10.1038/nature11787
Rogelj J., D.L. McCollum, A. Reisinger, M. Meinshausen, K. Riahi

Costs-risk Distributions

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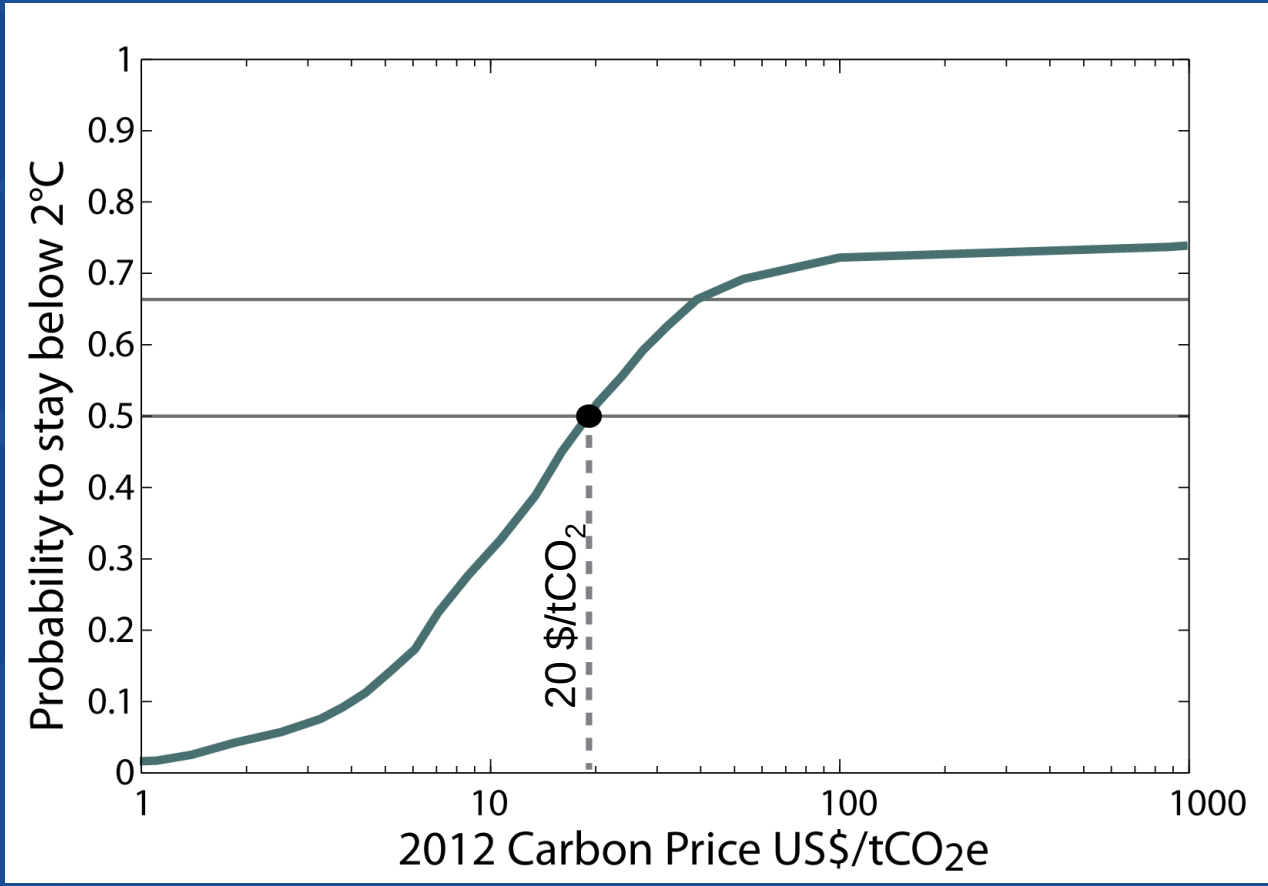

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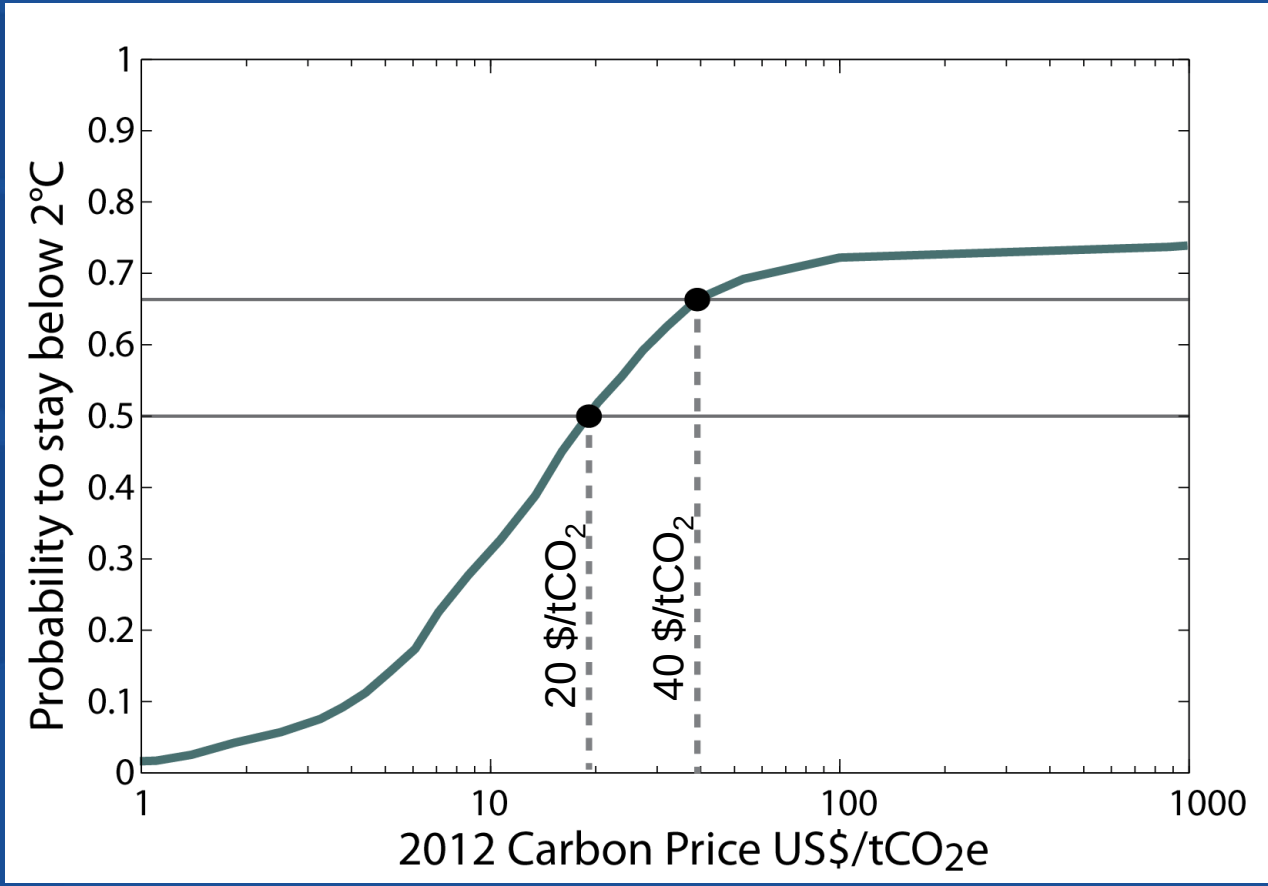
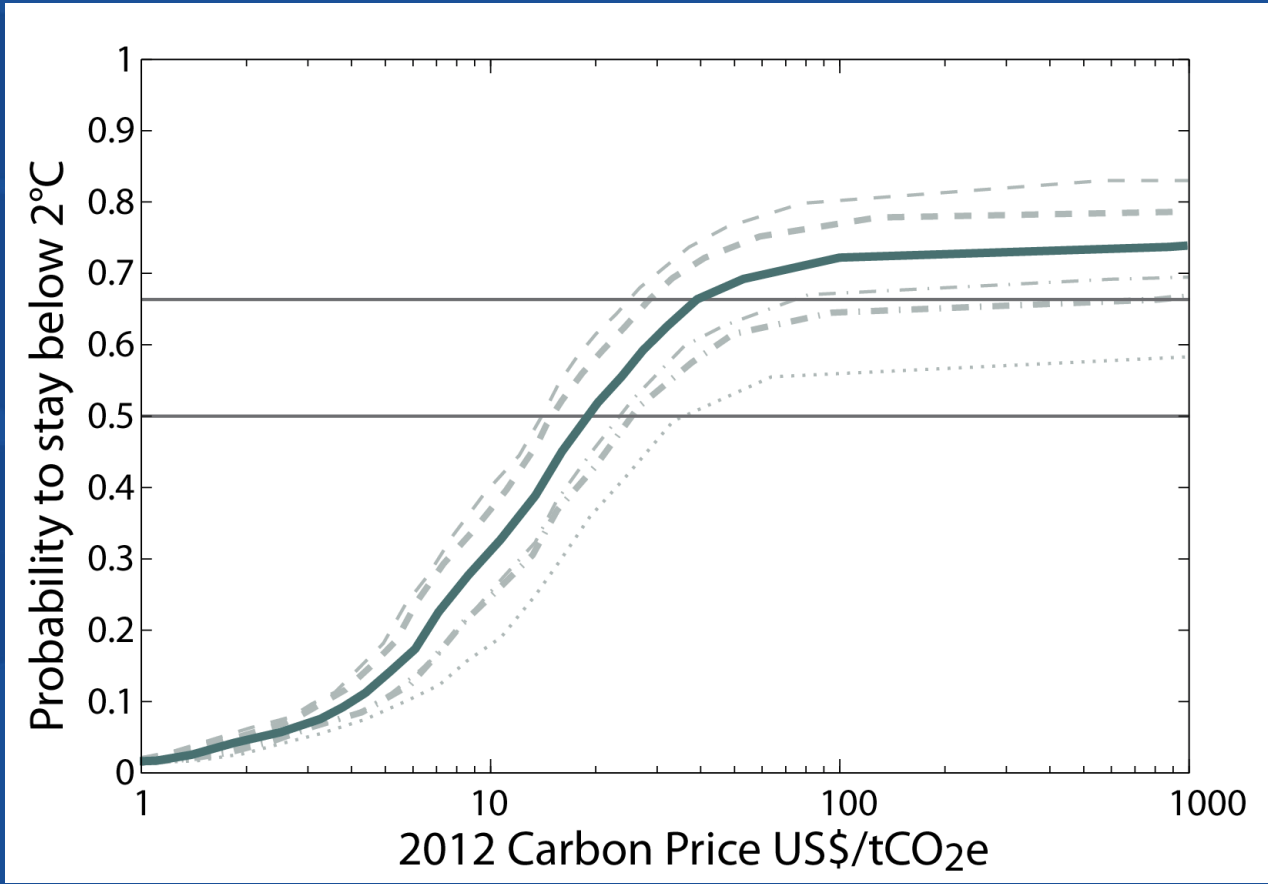


Cost-risk distribution: **technological uncertainty**

2°C



Legend

- Reference full technology portfolio
- Advanced long-term non-CO_2 mitigation
- Advanced transportation
- No new nuclear
- Limited land-based mitigation measures
- No CCS

Intermediate future energy demand
Low future energy demand
High future energy demand

Cases based on:
Global Energy Assessment (Riahi et al. 2012)
Reisinger et al. (2012), Beach et al. (2008), Van Vuuren et al. (2006)

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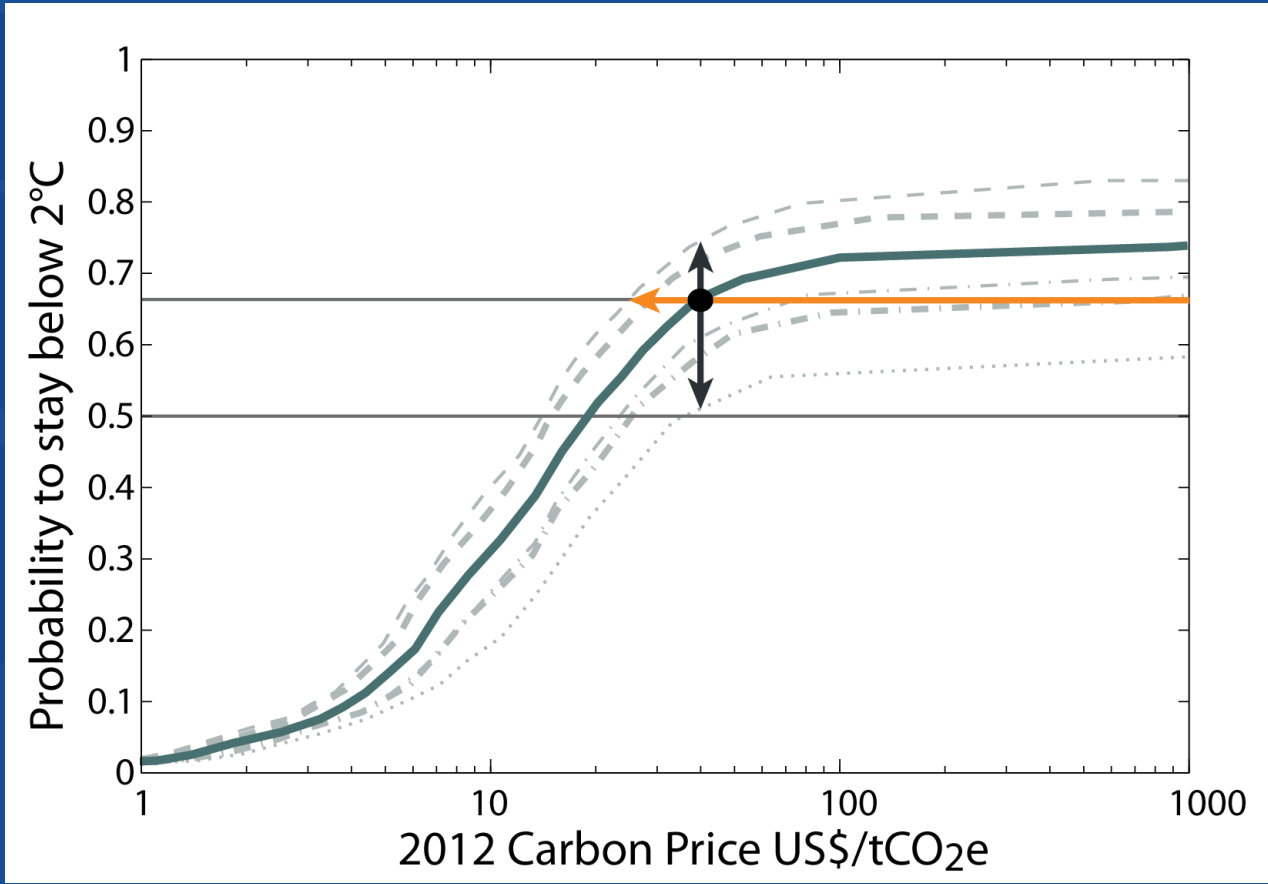

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Cost-risk distribution: energy demand uncertainty

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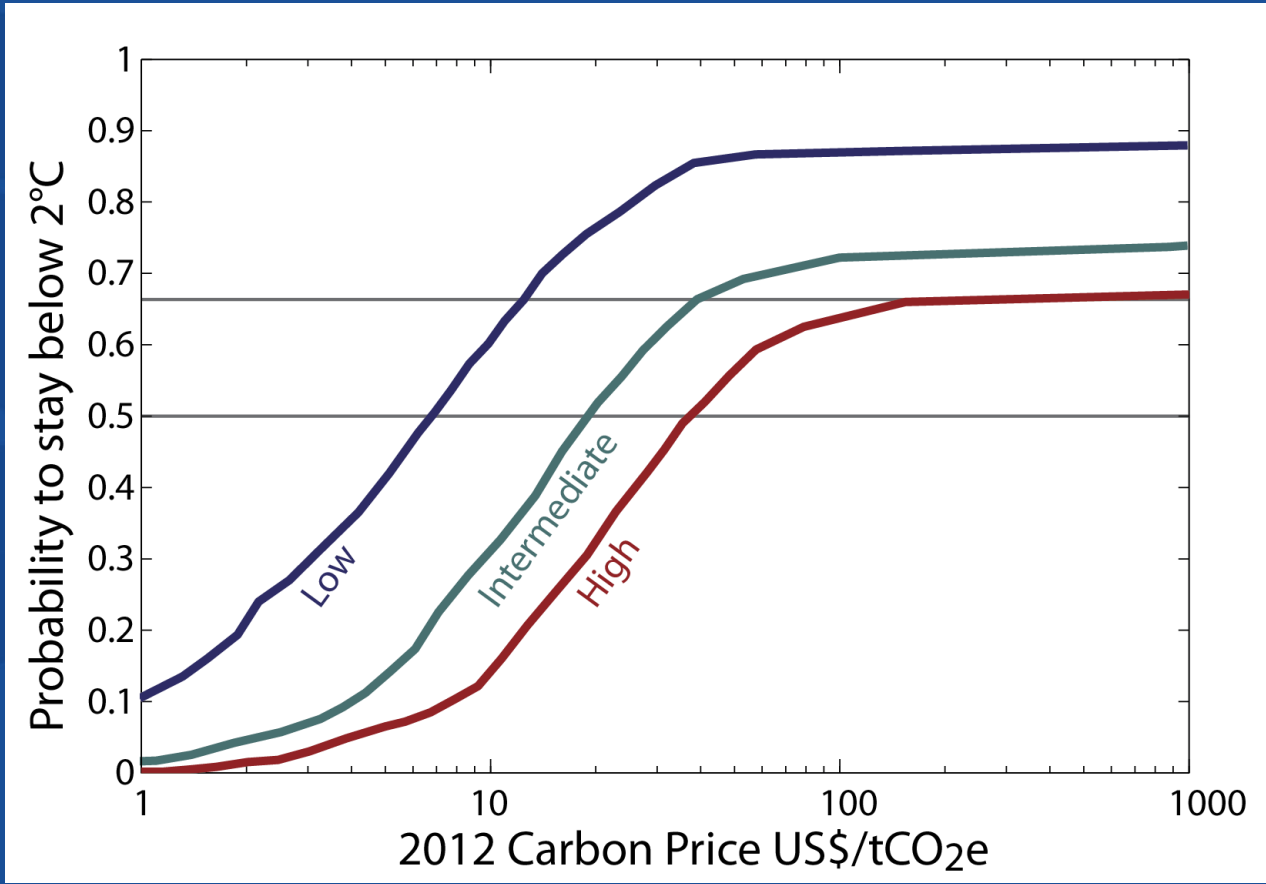

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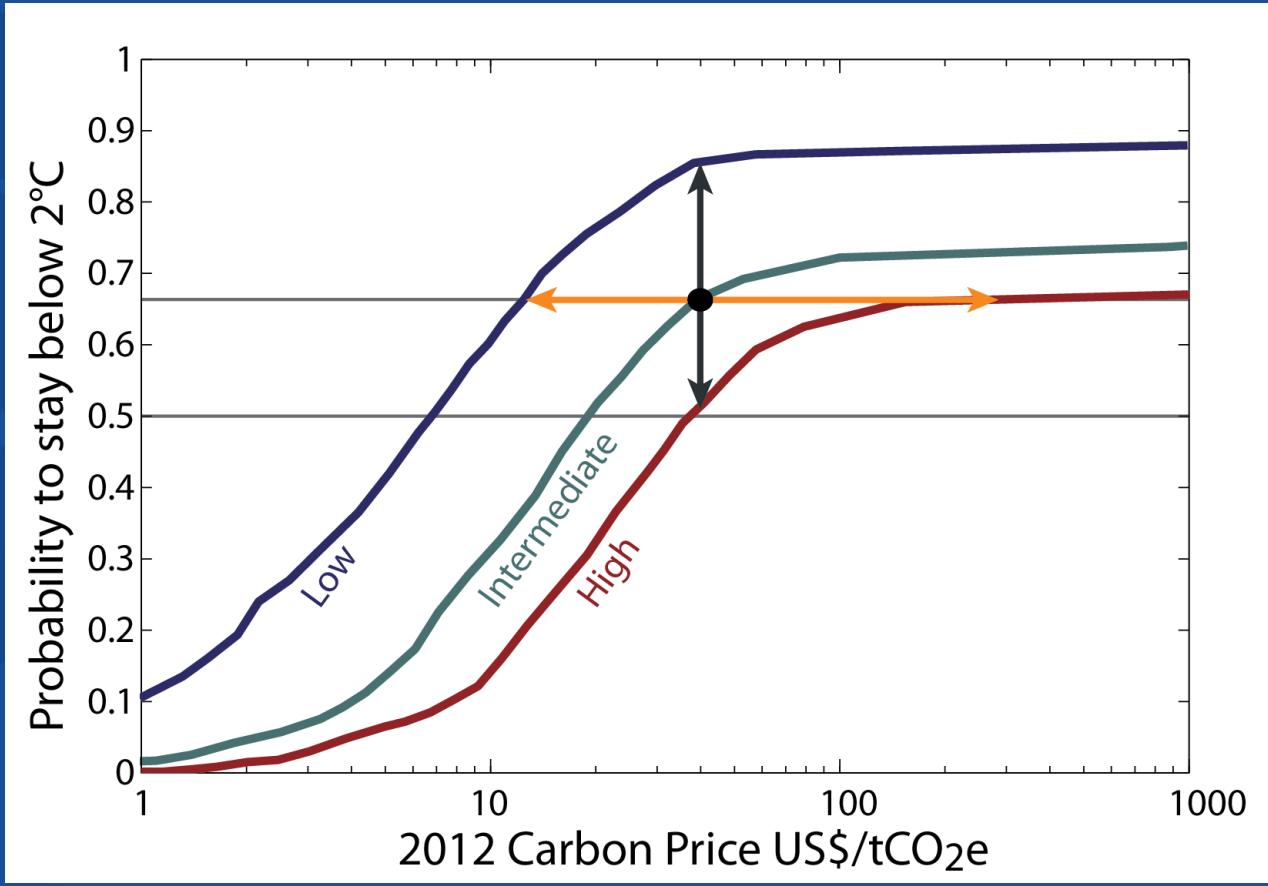

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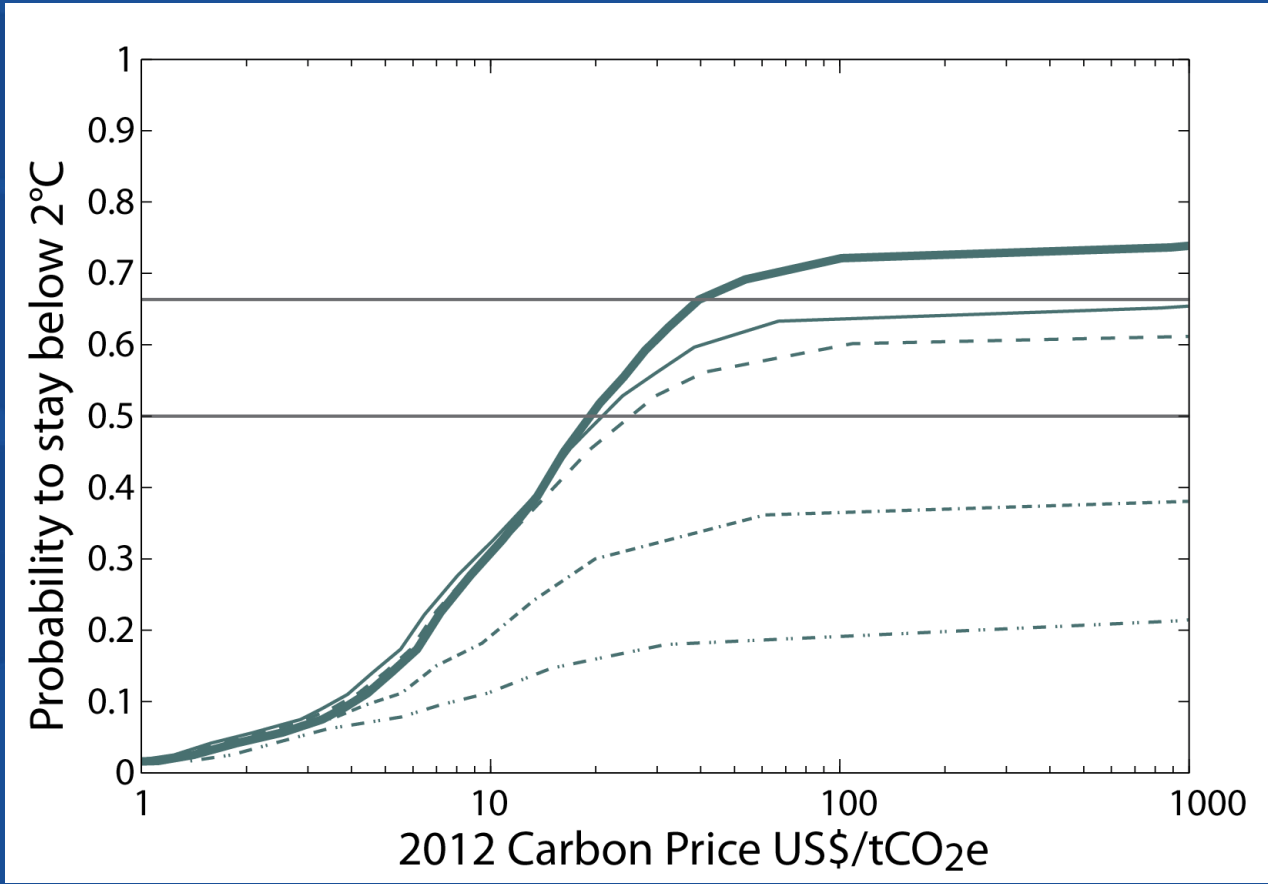
Cost-risk distribution: political (delayed action)

2°C



Legend

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- Delayed action until 2015
- Delayed action until 2020
- Delayed action until 2025
- Delayed action until 2030

Intermediate future energy demand
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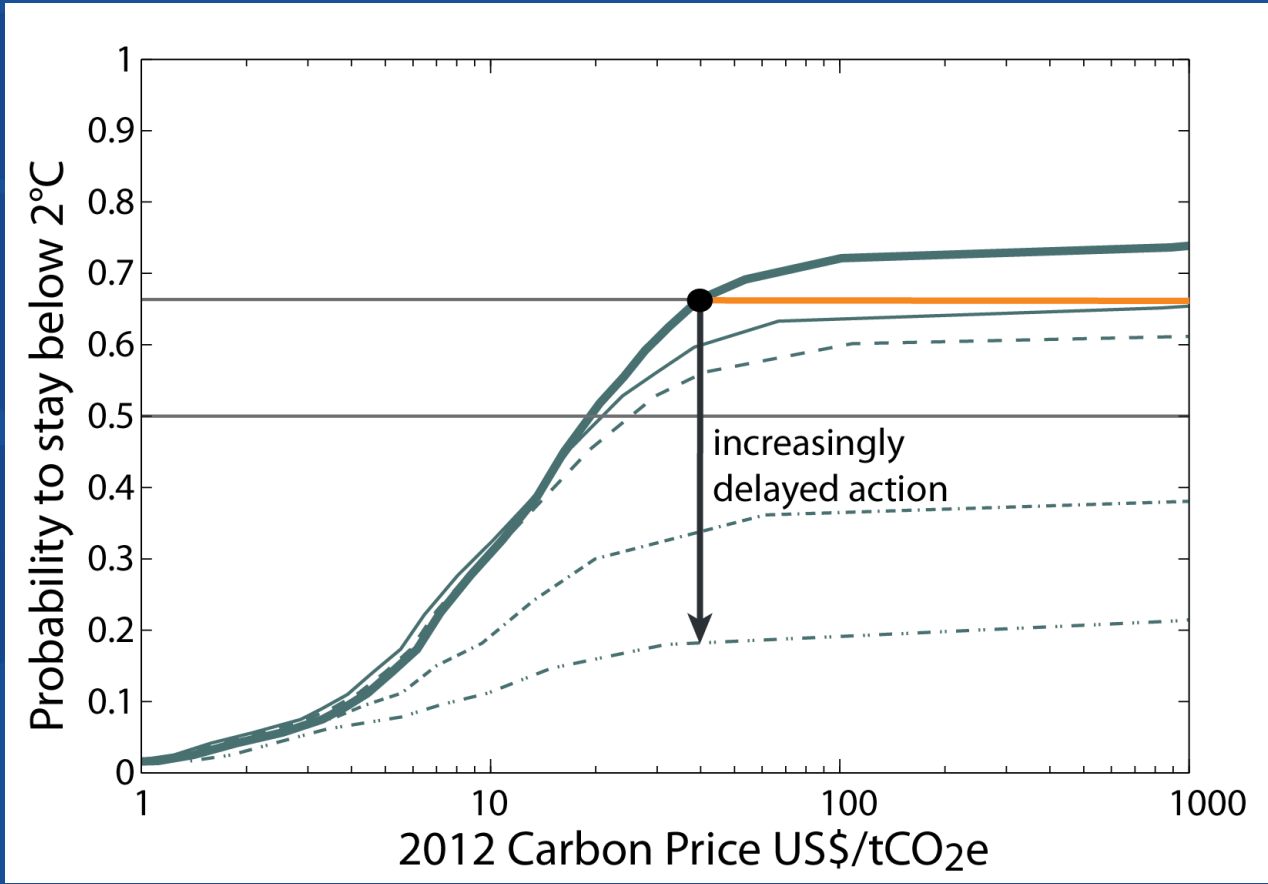
MESSAGE in "myopic" run modus

Cost-risk distribution: political (delayed action)

2°C



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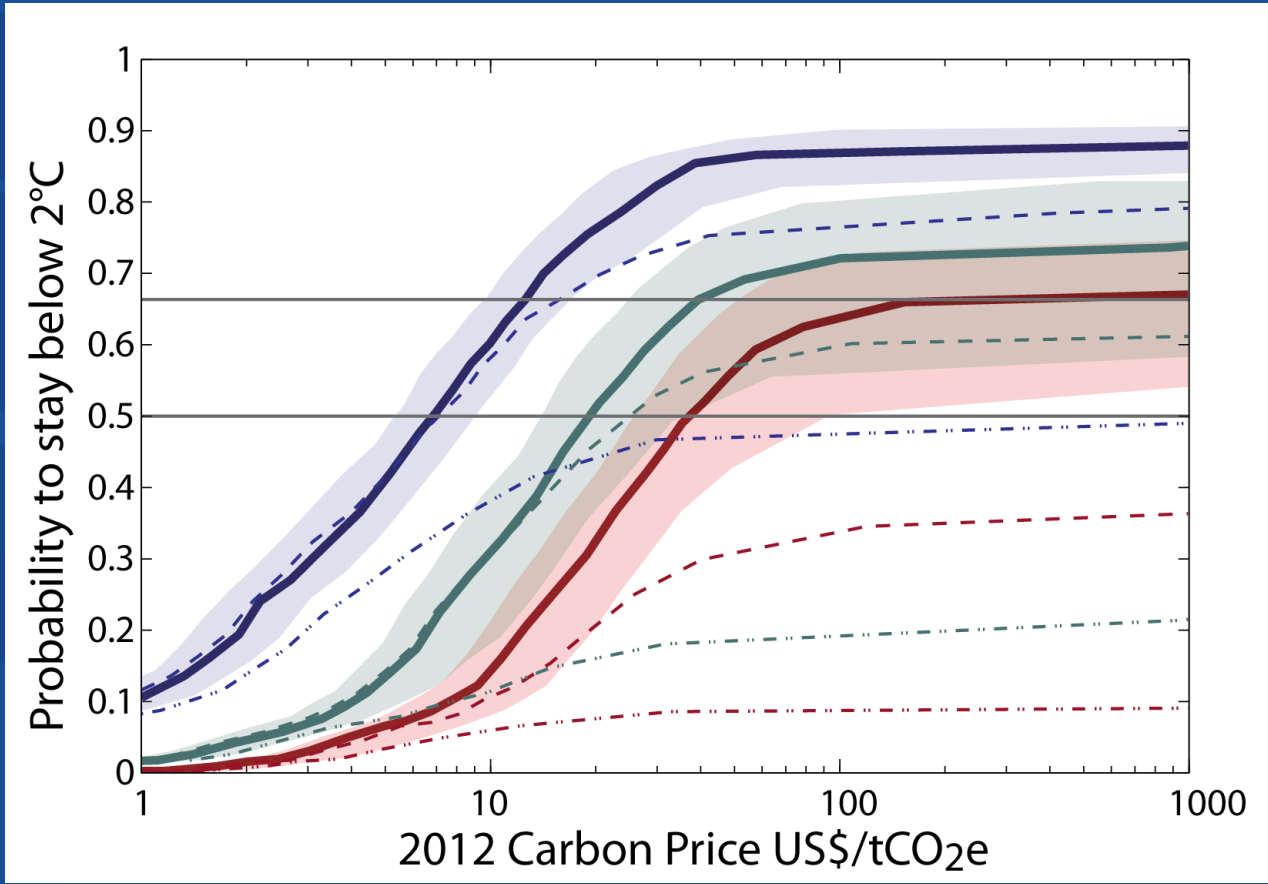
MESSAGE in "myopic" run modus

Uncertainty ranking

2°C

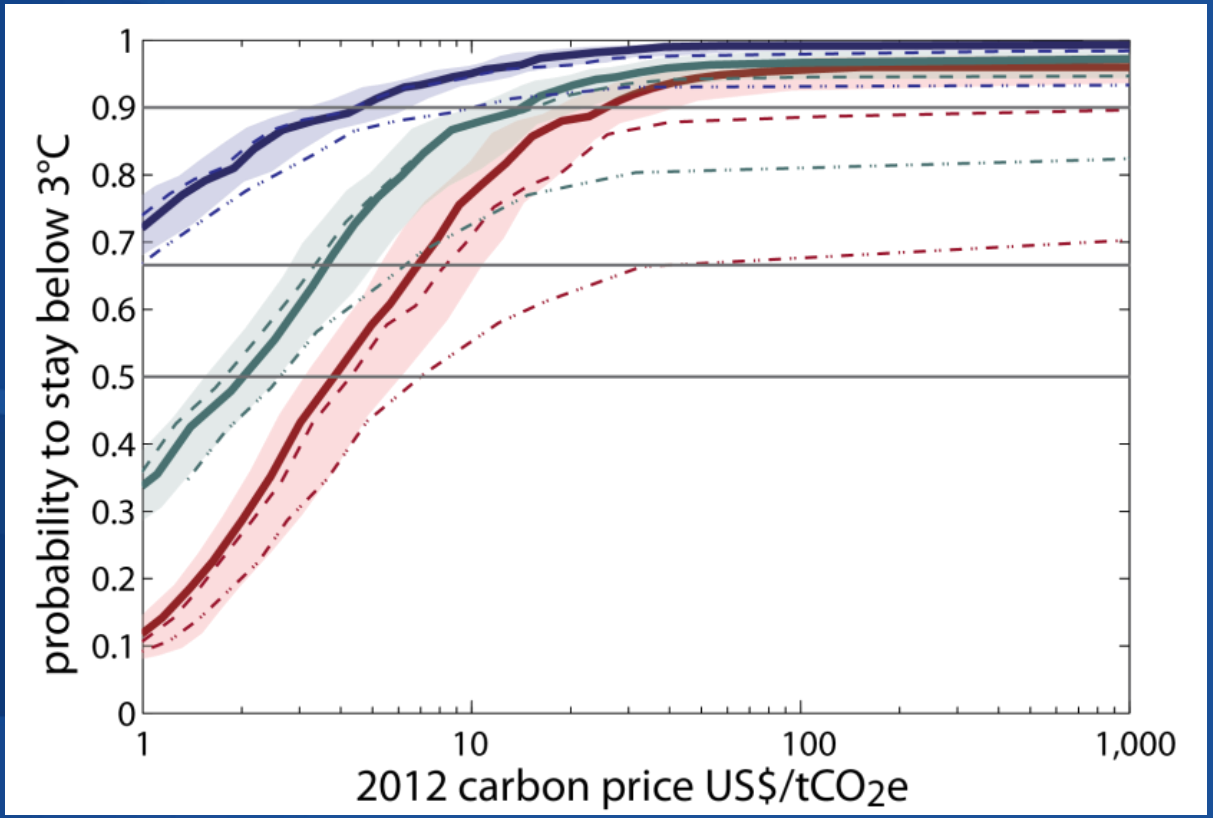
1. **Political (delayed action)**
2. **Geophysical**
3. **Social (energy demand)**
4. **Technological**

Note: demographic and economic uncertainties not explicitly assessed.



SUPPLEMENTARY SLIDES

Backup slides



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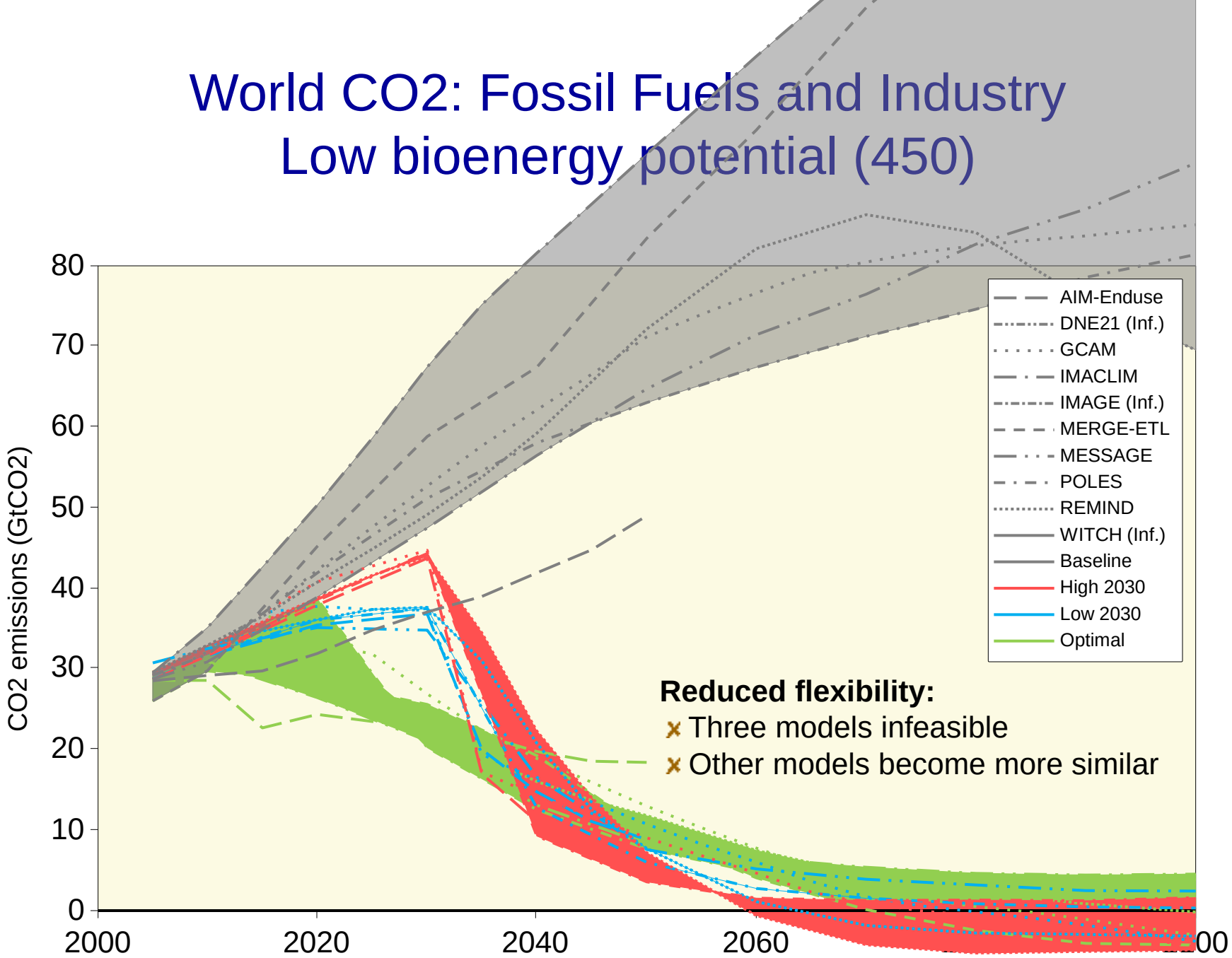
World CO2: Fossil Fuels and Industry
Low bioenergy potential (450)



Uncertainty ranking Results

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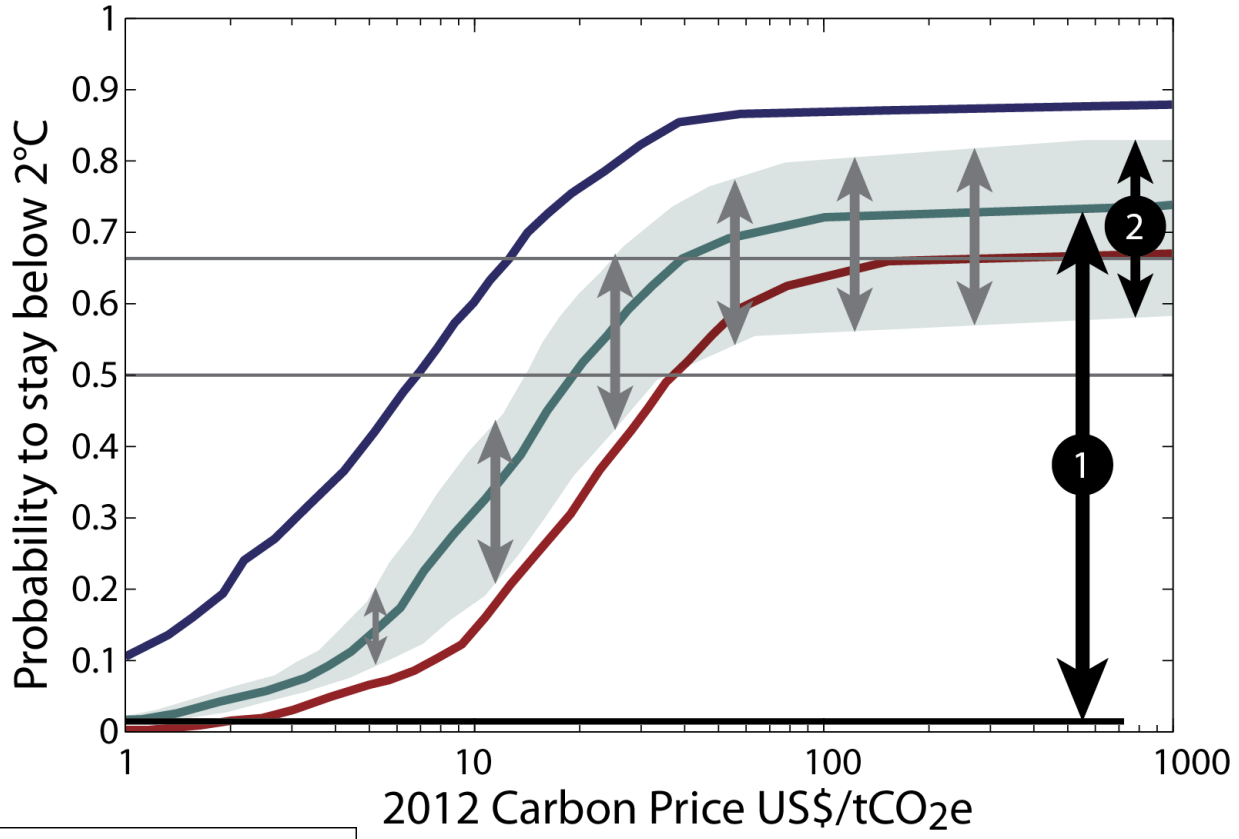

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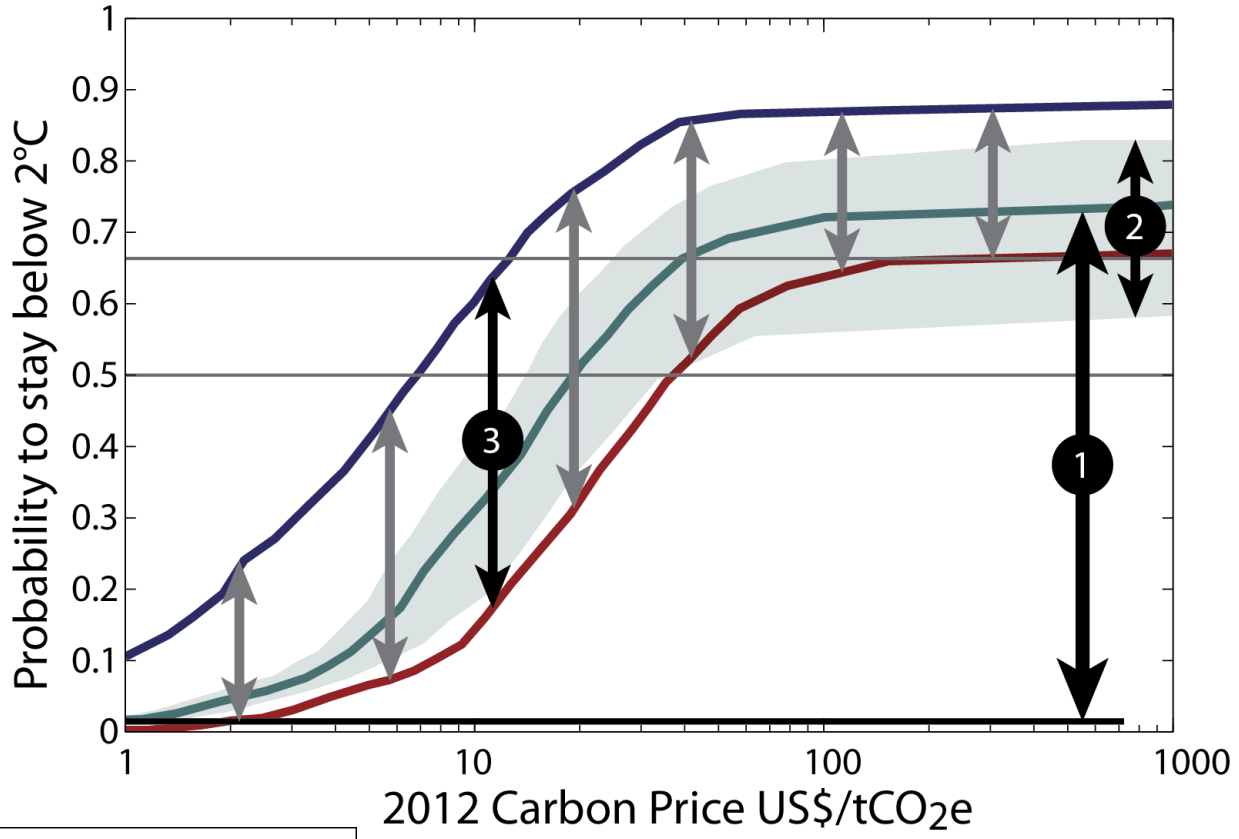

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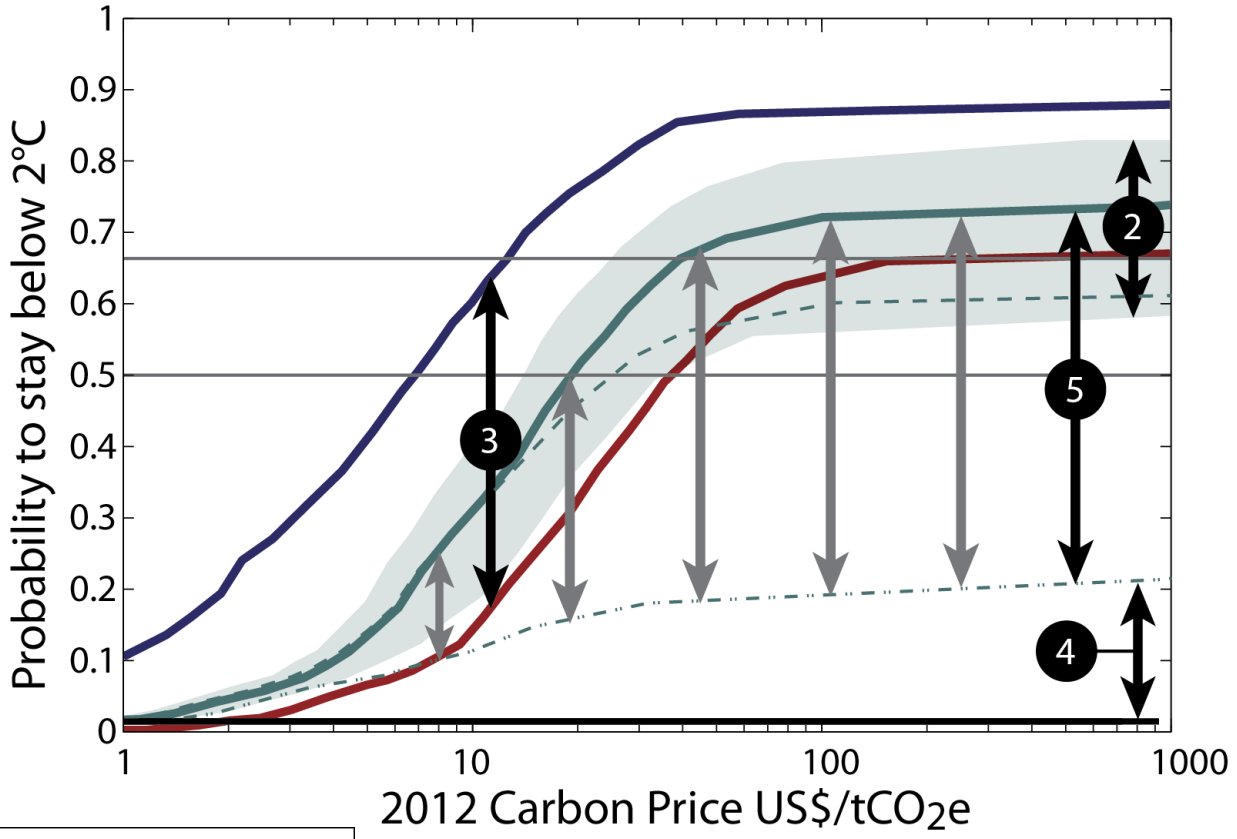

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