

The Costs of Limited Availability of Technologies

Living in a Second Best World

Side Event on The True Costs of Climate Policy
Poznań Climate Change Conference, COP 14

Monday, 8 December 2008



Research Domain Sustainable Solutions



Co-Chair of WG III



Chair: Economics of Climate Change

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Overview

- The IPCC has basically calculated costs within a first best world.
- A first best world implies that all relevant mitigation options are available and all countries will participate in a global carbon market.
- However, it is timely to derive costs in a second best world in which
 - there is a delay in technological breakthroughs
 - there is an institutional delay in international participation

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Model intercomparisons

- Intercomparisons of energy-economy-environment models
- Currently two model intercomparisons coordinated at PIK:
 - Focus on low stabilisation and the feasibility of the EU target
- Report on Energy and Climate Policies in Europe (RECIPE)
 - Top-down policy analysis: delayed participation, fragmented regimes
 - Bottom-up: Sectoral studies and policy instrument
- Regional Modelling Comparison Project (RMCP) within the EU project ADAM

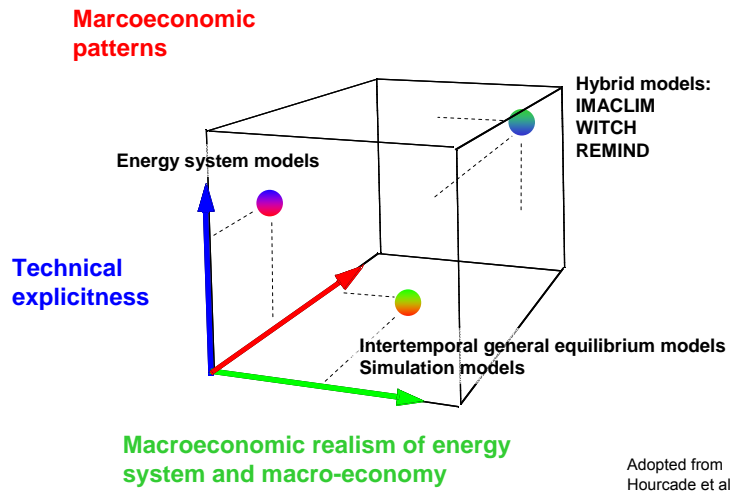
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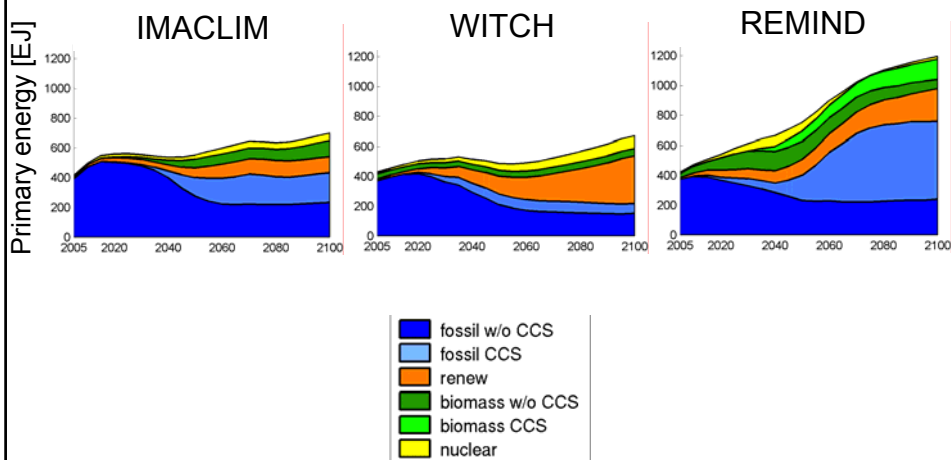
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Comparing three hybrid models



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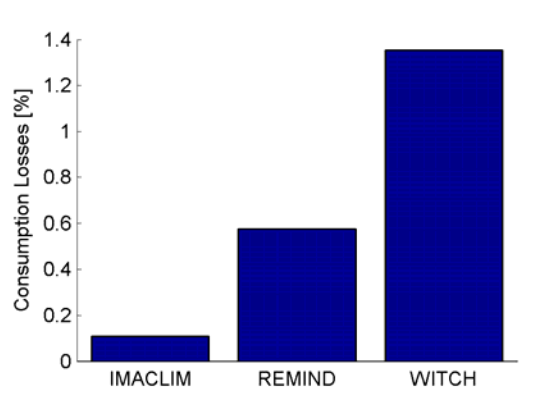
How can the 450 ppm stabilization target be achieved?



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Costs of mitigation

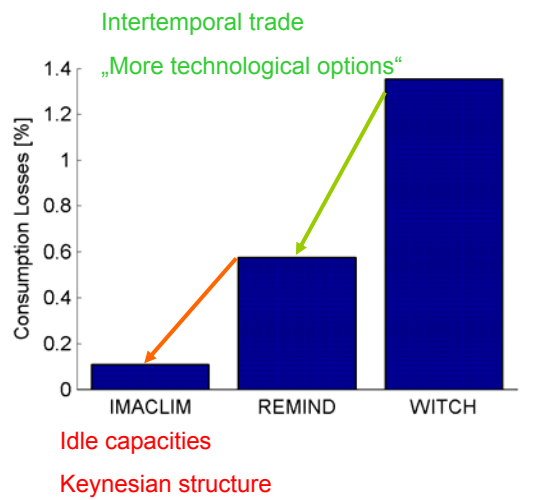
Discounted aggregated consumption losses from 2010 - 2100



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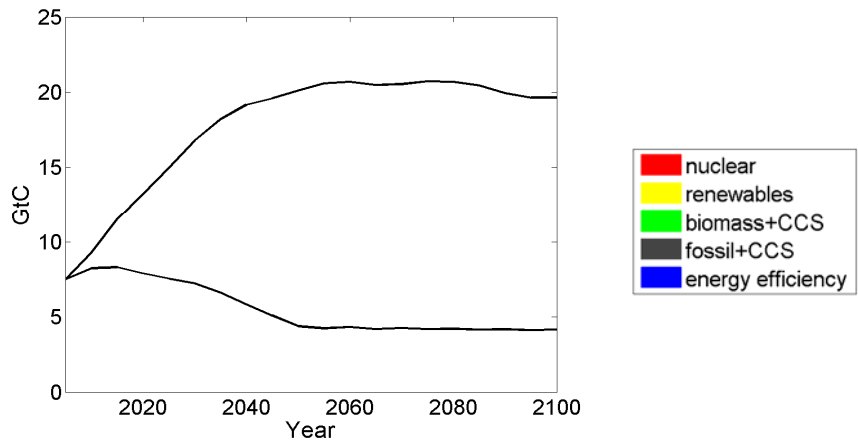
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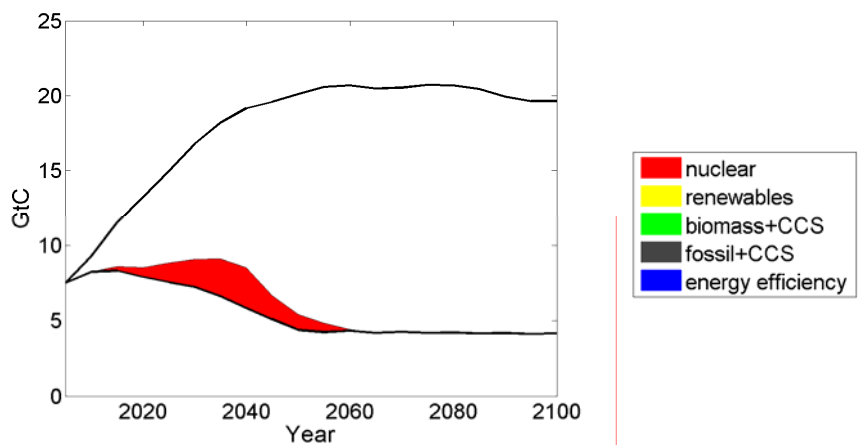
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A first best portfolio of mitigation options in REMIND



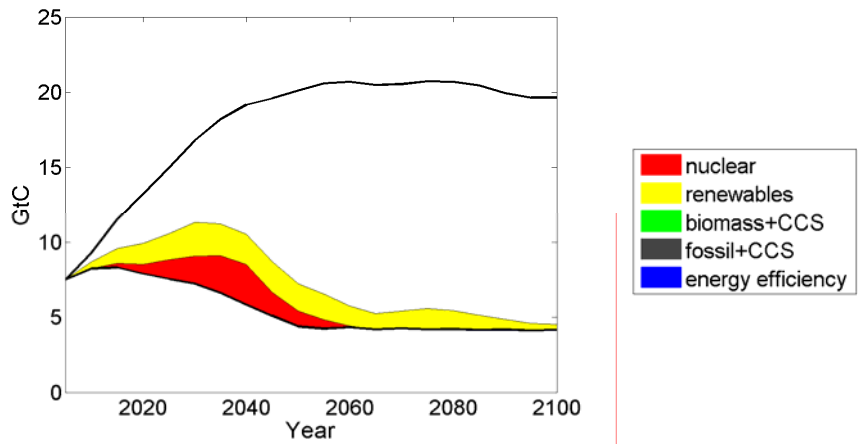
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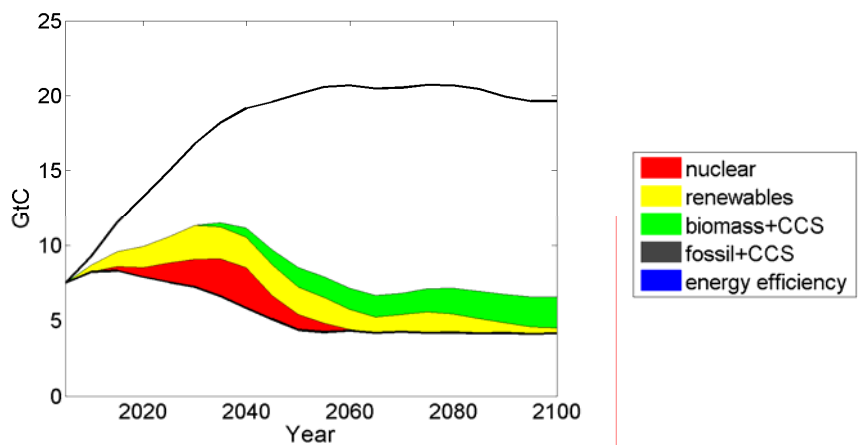
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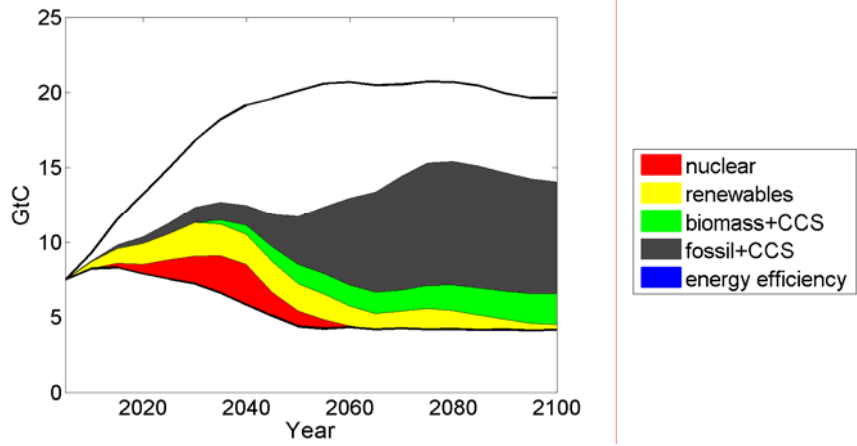
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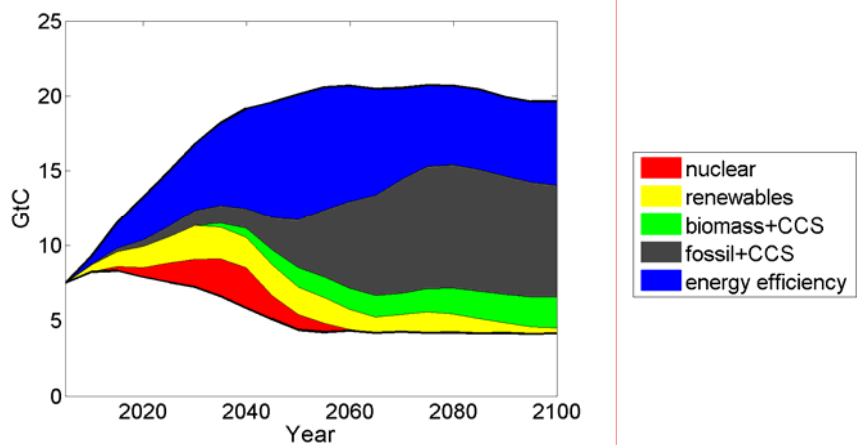
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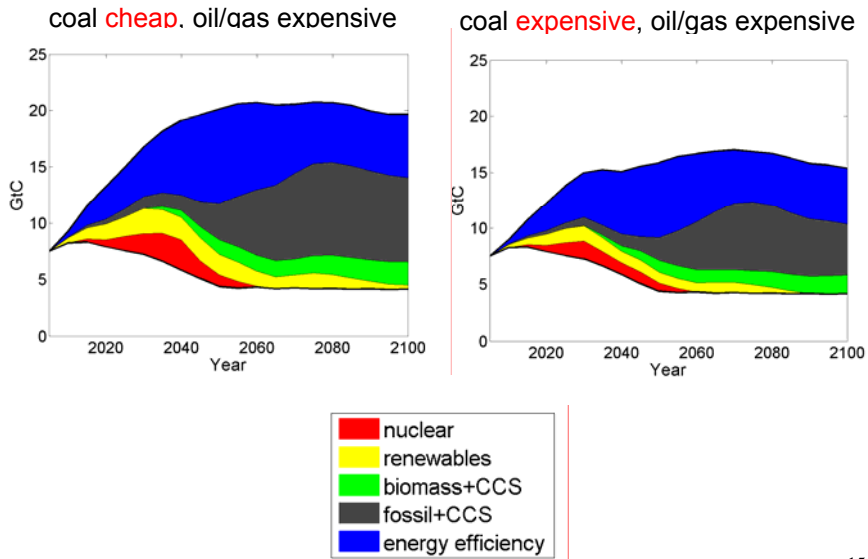
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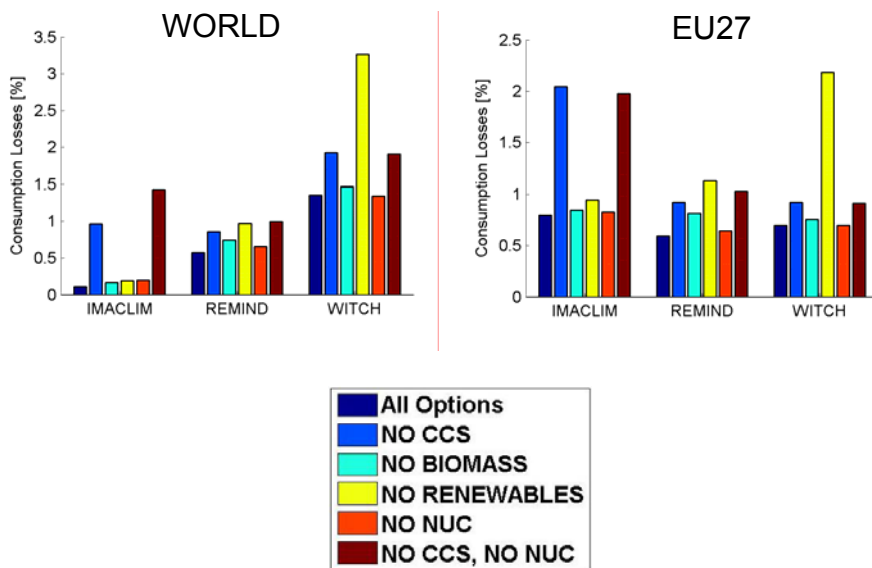
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Options for CO₂ abatement: Influence of fossil prices



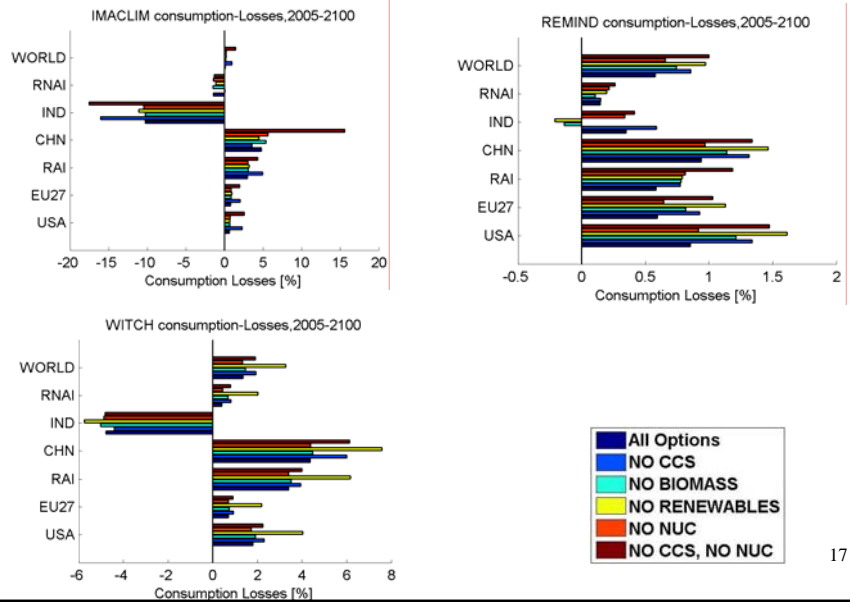
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Escalation of costs of mitigation due to a lack of technology options



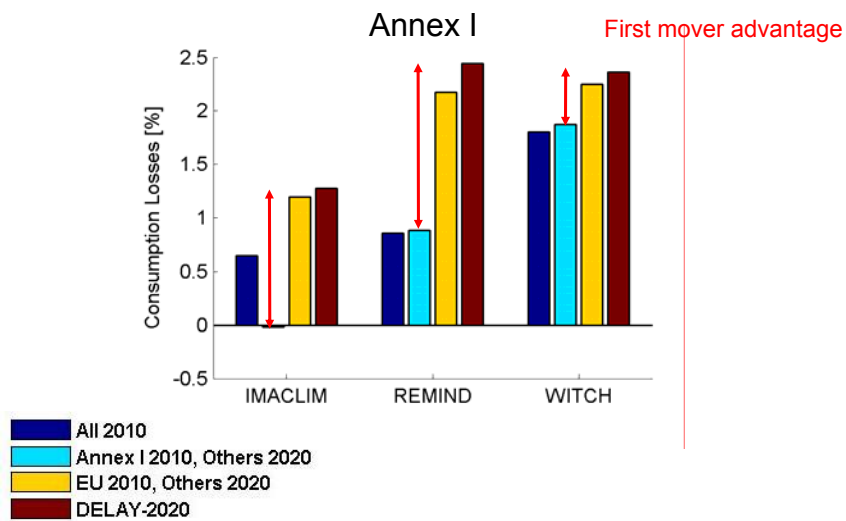
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Regional Costs and Technology Delay



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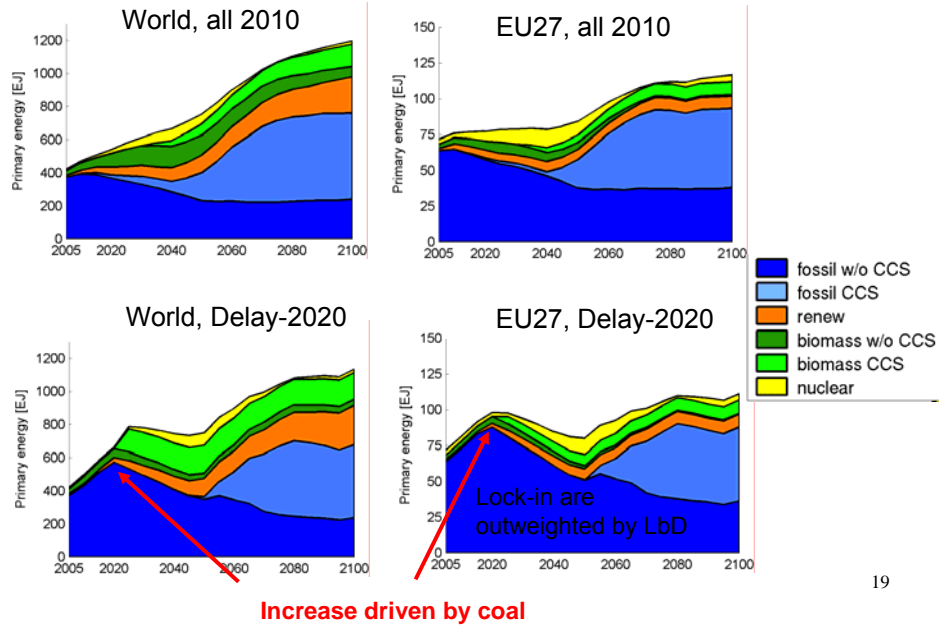
Mitigation costs for Annex I



→ First mover advantage for other Annex I

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Institutional delay and the energy mix (REMIND)



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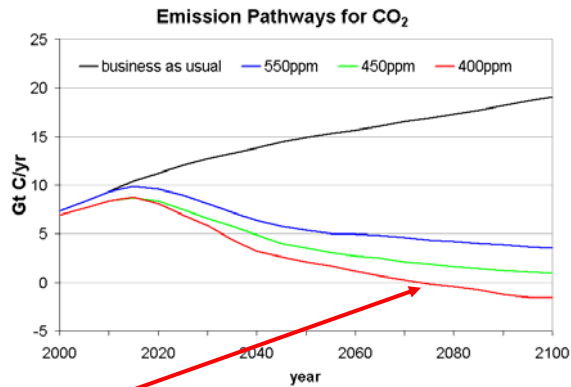
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Regional modelling comparison project (RMCP)

- 5 Models
- 7 Regions: China, India, Russia, EU27, USA, Japan, Rest of the World
- 3 stabilisation targets with different probabilities to reach the 2° goal: 550ppm-eq, 450ppm-eq, 400ppm-eq
- constraint on energy related CO₂ emissions



negative emissions

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Regional Modelling Comparison Project (RMCP)

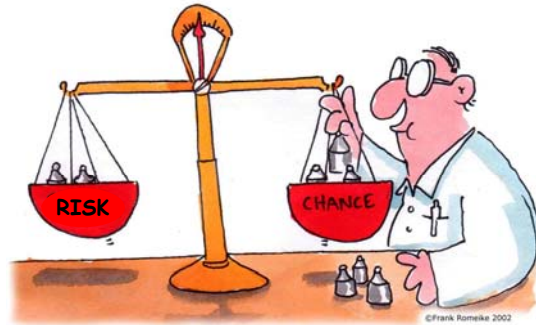
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| Model | Model classification | Calculus |
|-------------------|---|-----------------------|
| REMIND-R MERGE | Intertemporal general equilibrium model | Welfare maximisation |
| POLES TIMER | Energy system model | Cost minimisation |
| E3MG | Econometric simulation model | Initial value problem |

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Risks of mitigation - Very low stabilisation scenarios

Keeping the balance



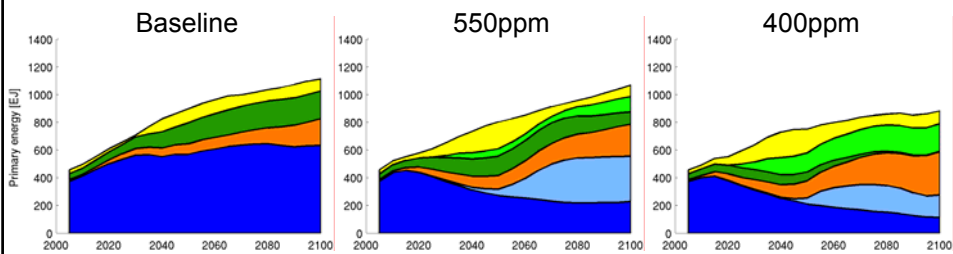
Source: RiskNET GmbH, www.risknet.de

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Energy mix of a decarbonised future

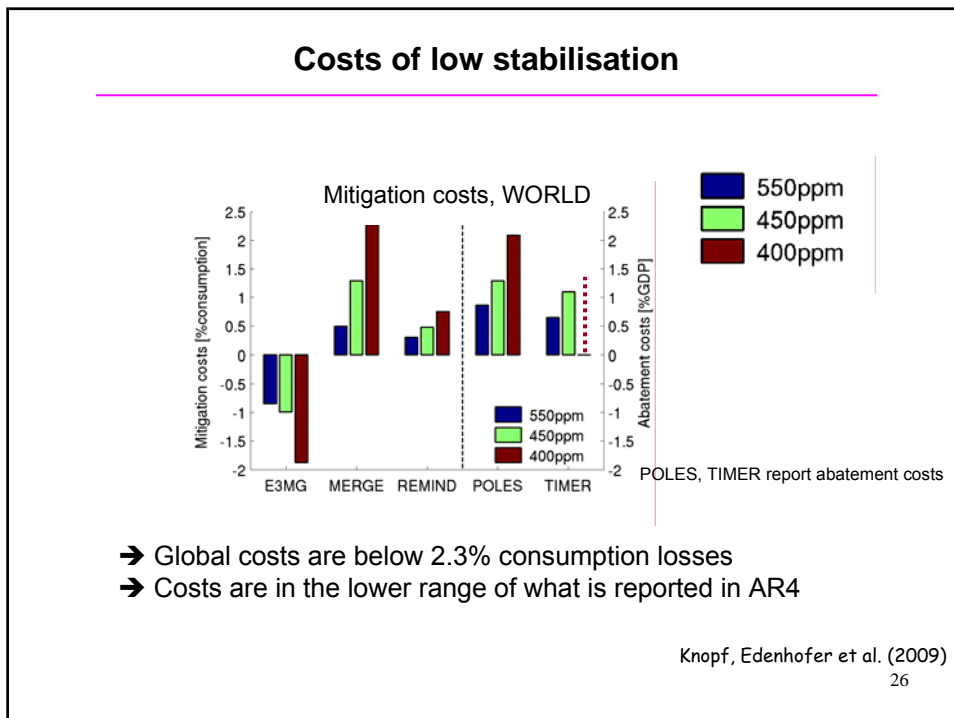
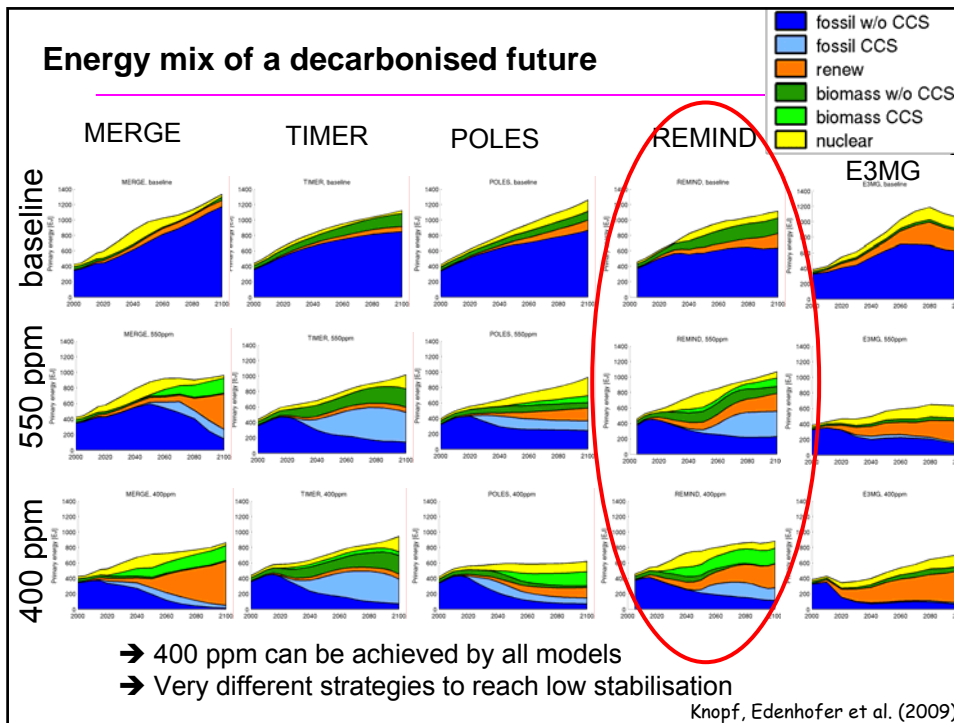
Example: REMIND

- fossil w/o CCS
- fossil CCS
- renew
- biomass w/o CCS
- biomass CCS
- nuclear

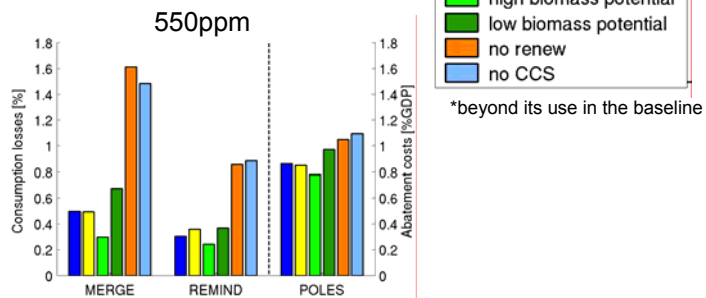


Knopf, Edenhofer et al. (2009)

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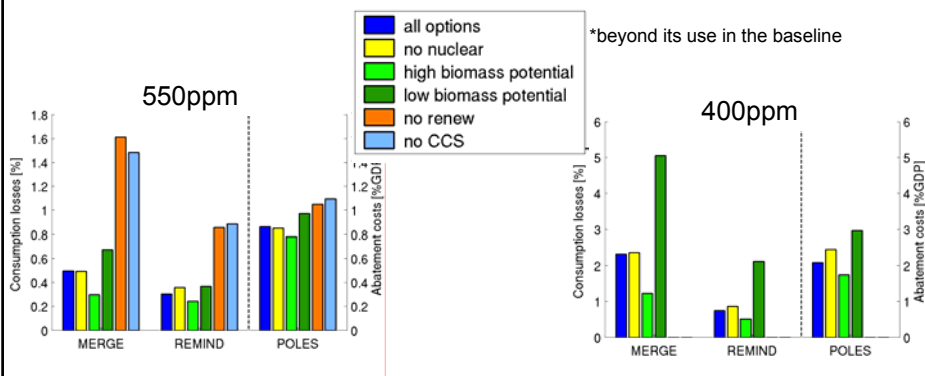
Mitigation costs: Technology options



- Renewables and CCS are the most important options
- Ranking of options: robust picture among all models

Knopf, Edenhofer et al. (2009)
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Mitigation costs: Technology options

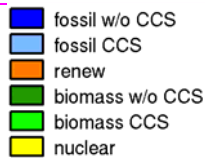


- 400 ppm target neither achievable without CCS nor without use of renew beyond baseline
- Biomass potential determines the mitigation costs of low stabilisation
- Nuclear is not important beyond its (high) use in the baseline

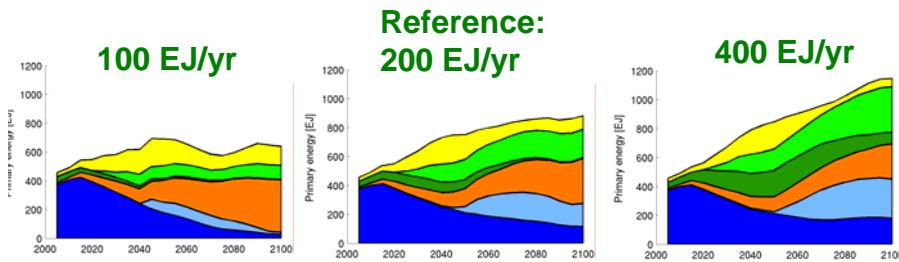
Knopf, Edenhofer et al. (2009)
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Influence of the biomass potential

Example: REMIND



Primary energy [EJ]

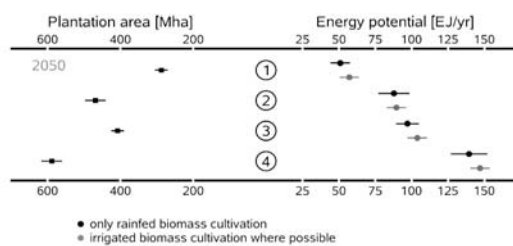


- ➔ Competition between biomass+CCS with other renewables
- ➔ Longer use of fossil energy with higher biomass potential

Knopf, Edenhofer et al. (2009)
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Global bioenergy potential

New results for WBGU:



expanded agriculture
strong conservation

expanded agriculture
moderate conservation

conservation
intensified agriculture
strong conservation

intensified agriculture
moderate conservation

Energy potential

50 – 150 EJ/yr

Plantation area

300 – 600 Mha

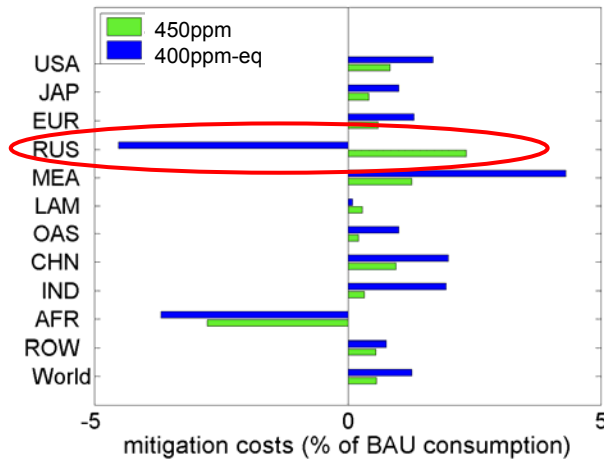
Beringer and Lucht, in prep 2008

Limited blue water resources for irrigation

At the lower end of what is implemented in the models

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Geopolitical impact of biomass + CCS



→ Russia benefits from targets with negative emissions due to the use of biomass

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Conclusions

- 550 ppm scenario: flexibility in technologies
- CCS, renewables are an important option, biomass is important but not essential
- 400 ppm scenario: achievable by all models
- BUT: not achievable without CCS nor without the extension of renewables
- Mitigation costs moderate if full suite of technologies is available
- Biomass and CCS potential dominate the costs for low stab
- Nuclear power is not important beyond its use in the baseline

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