POTSDAM-INSTITUT FÜR KLIMAFOLGENFORSCHUNG

PIK

Results From Two Integrated Assessment Model Comparison Studies: ADAM project (funded by EU FP6) RECIPE project (funded by Allianz and WWF)

Elmar Kriegler

Potsdam Institute for Climate Impact Research

Research Domain Sustainable Solution

IAMC Annual Meeting, Tsukuba, Japan

September 15, 2009

Leibniz Gemeinschaft

Report on Energy and Climate Policy in Europe (RECIPE)

Model intercomparison on economic costs, technical feasibility, delayed participation and the role of sectors on 450 ppm and 410 ppm CO_2 only stabilization scenarios. Policy and sectoral analysis.

Coordination and Compilation of Results:
G. Luderer, O. Edenhofer, J. Strohschein

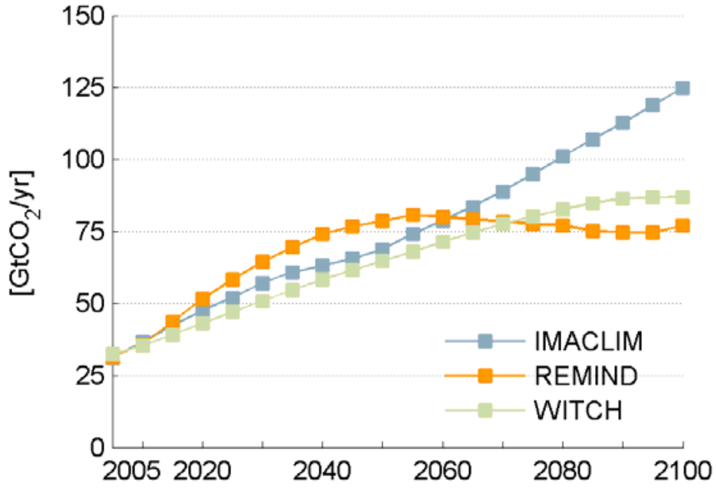
RECIPE modelling teams:

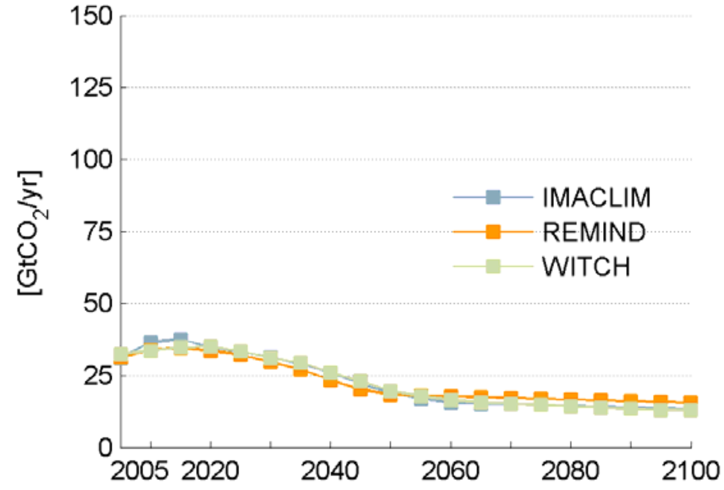
PIK (REMIND model):	O. Edenhofer, G. Luderer, M. Jakob, J. Steckel, M. Leimbach., N. Bauer, L. Baumstark et al.
CMCC (WITCH model):	C. Carraro, V. Bosetti, E. Decian, M. Tavoni
CIRED (IMACLIM model):	J.-C. Hourcarde, H. Waisman

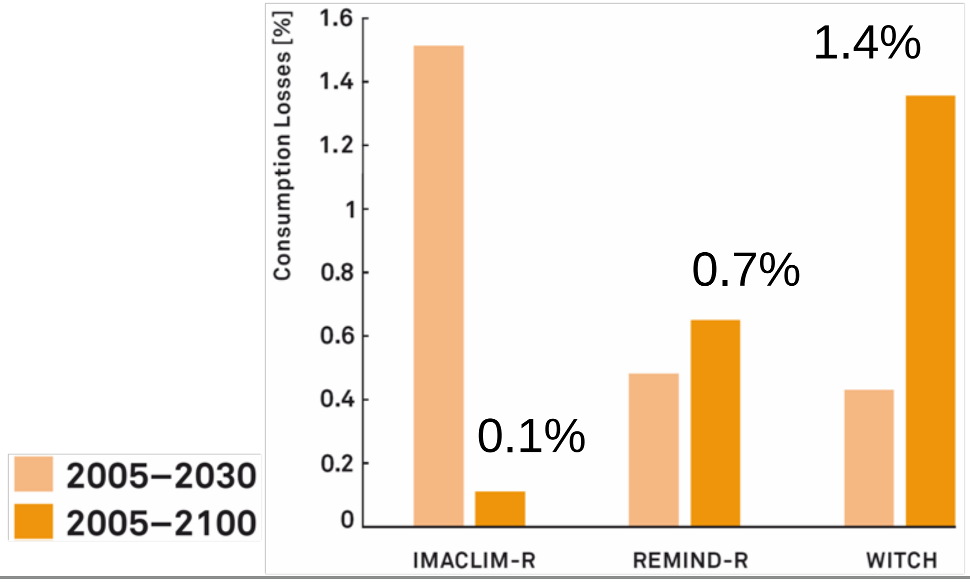
RECIPE policy analysis and sectoral studies:

U Cambridge:	K. Neuhoff
CE Delft:	H. van Essen
IPP:	P. del Rio
SWP:	S. Dröge
CIRED:	R. Crassous-Doerfler, S. Monjon, O. Sassi
Joanneum Research:	A. Tuerk
PIK:	C. Flachsland, H. Lotze-Campen, A. Popp

The RECIPE scenarios







Discounted at 3%

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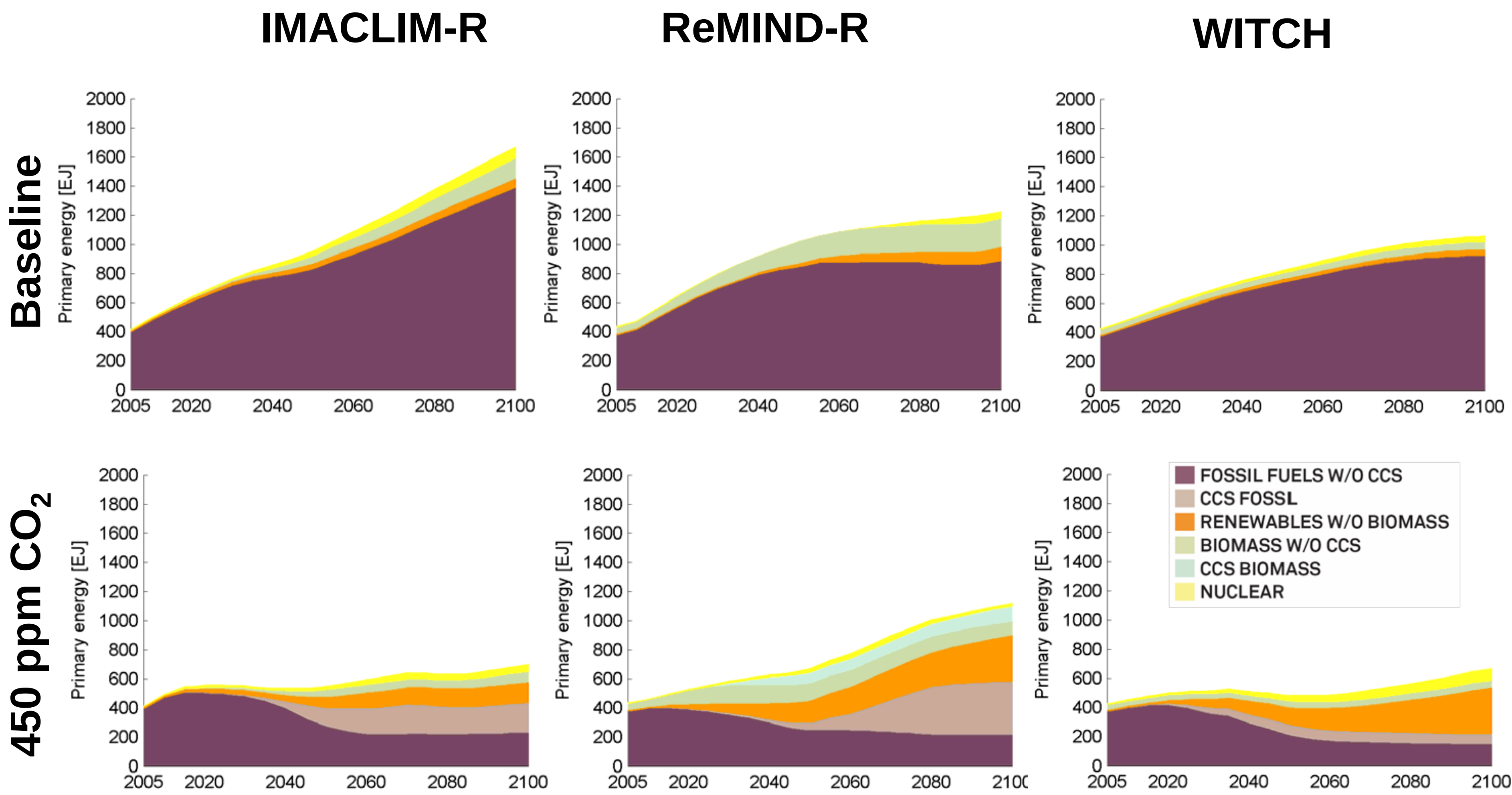
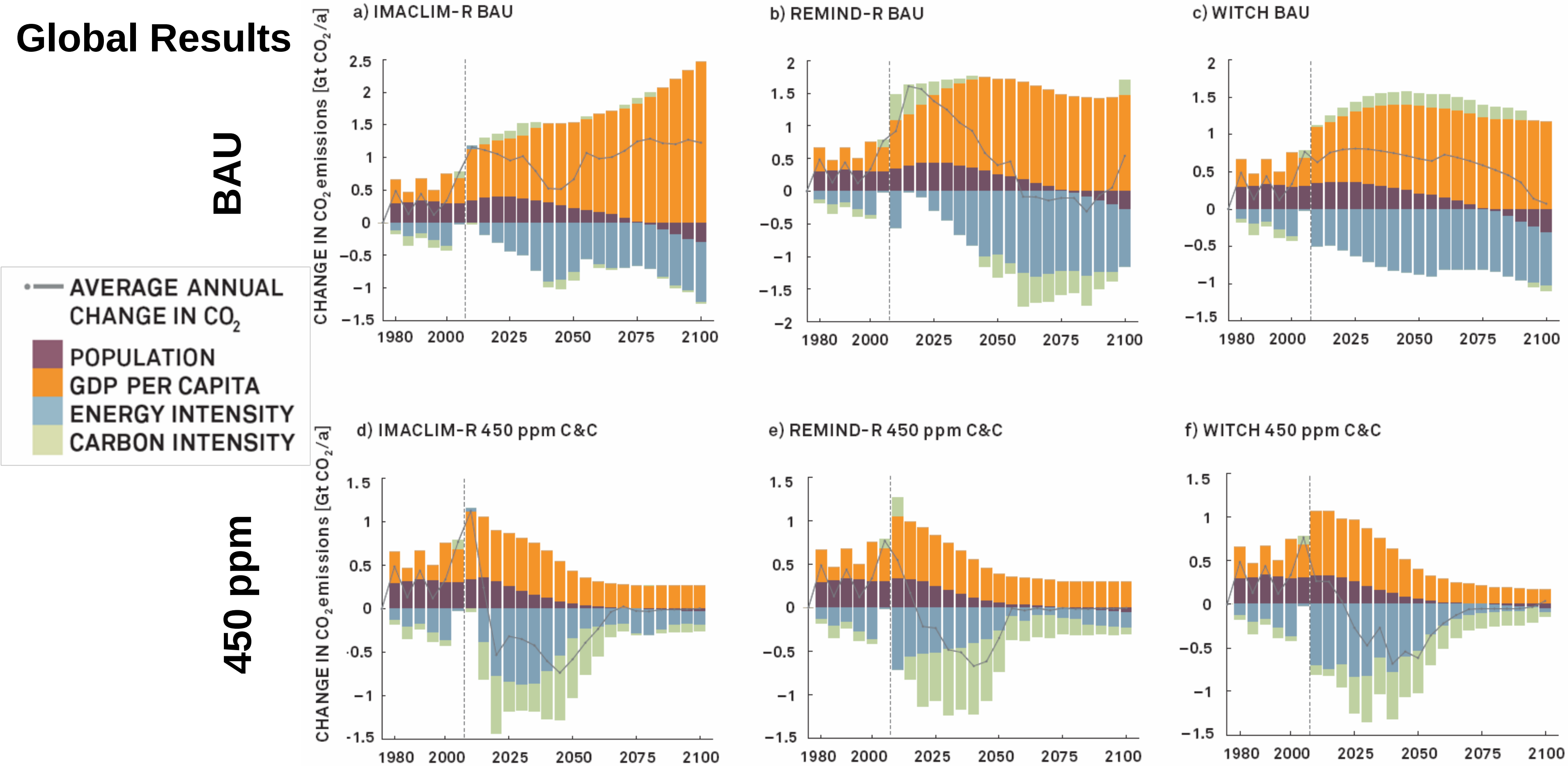
The energy system transformation



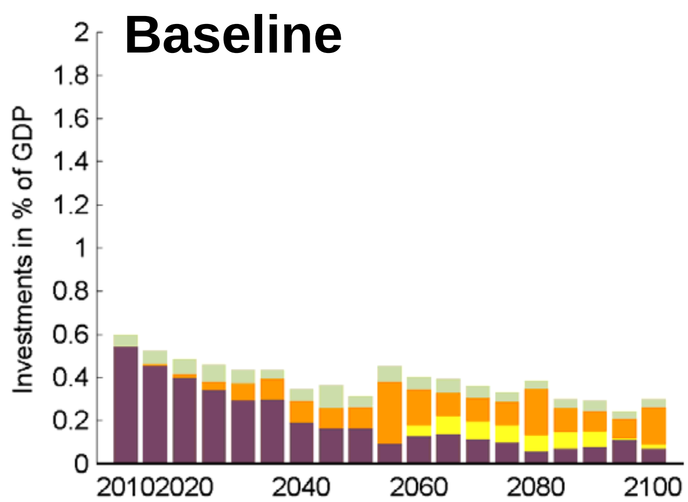
Macro-Economic Effects of Climate Policy

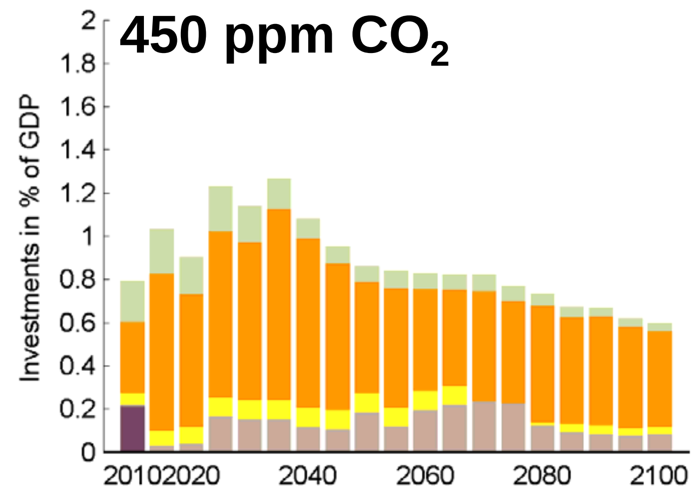
Global Results

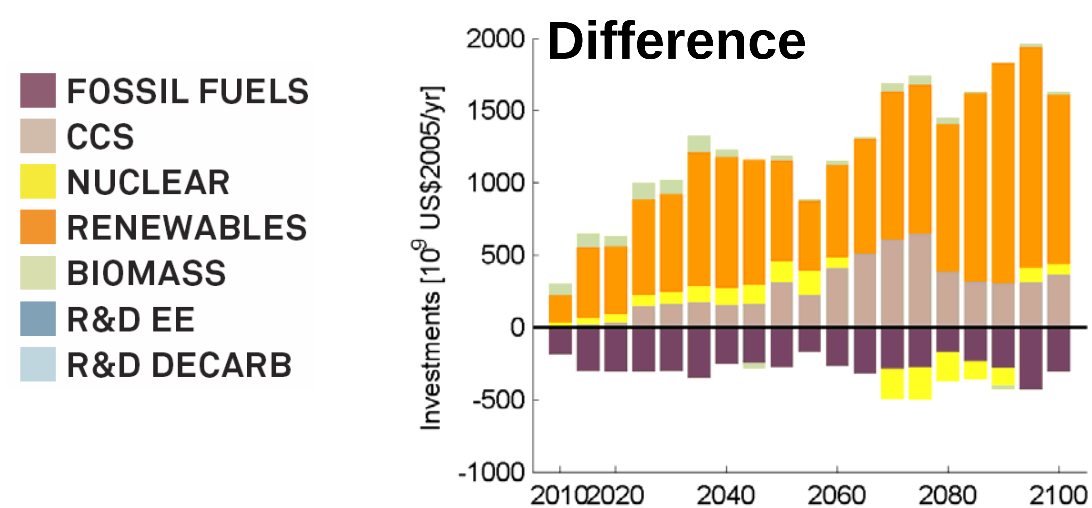


➔A reduction of carbon intensity is essential for a low carbon economy

Energy System Investments (World total, REMIND)







Investments into fossil fuels must be redirected until the year 2015.

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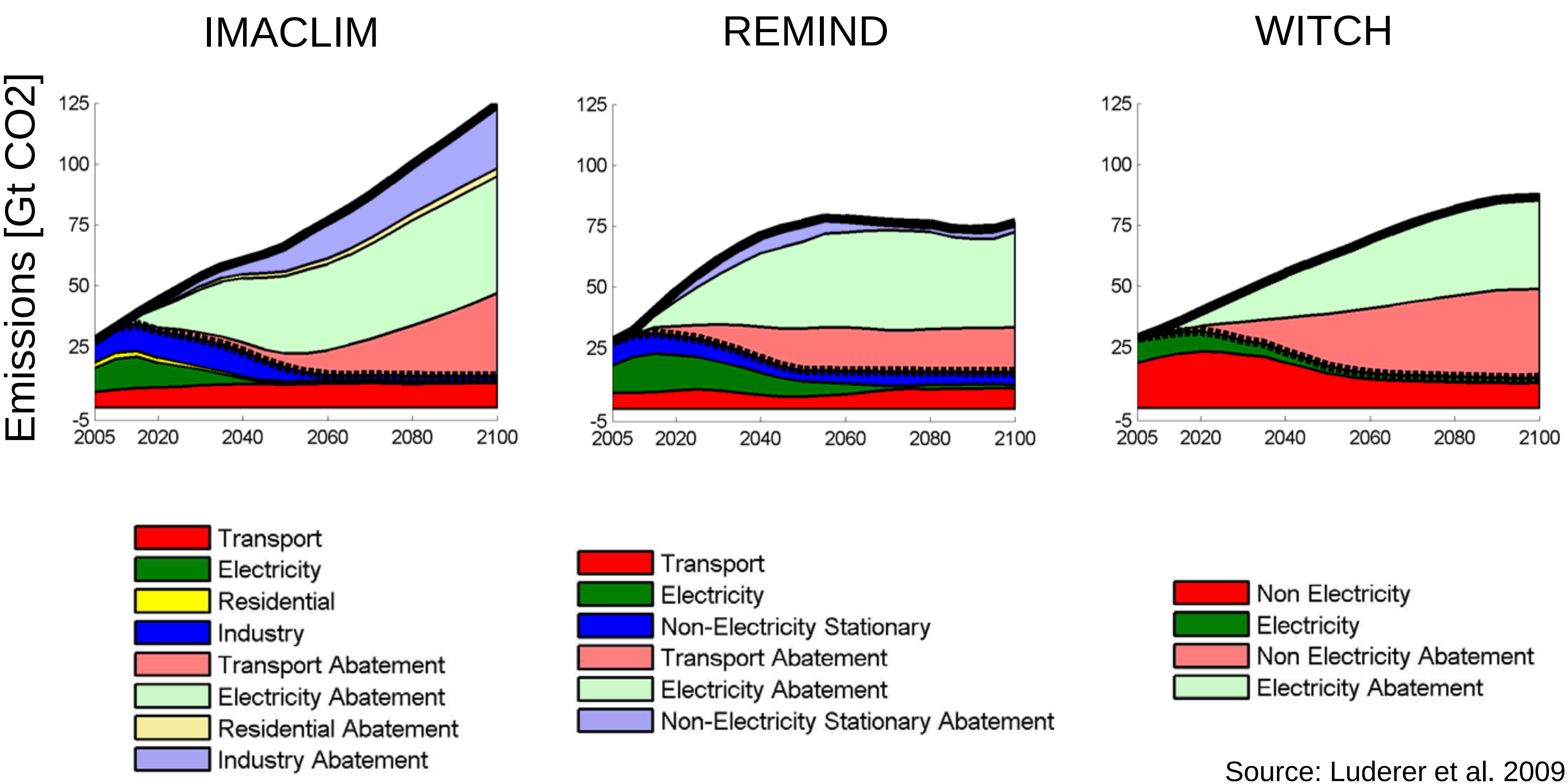
Mitigation Per Sector: "Dynamic Sectoral Wedges"

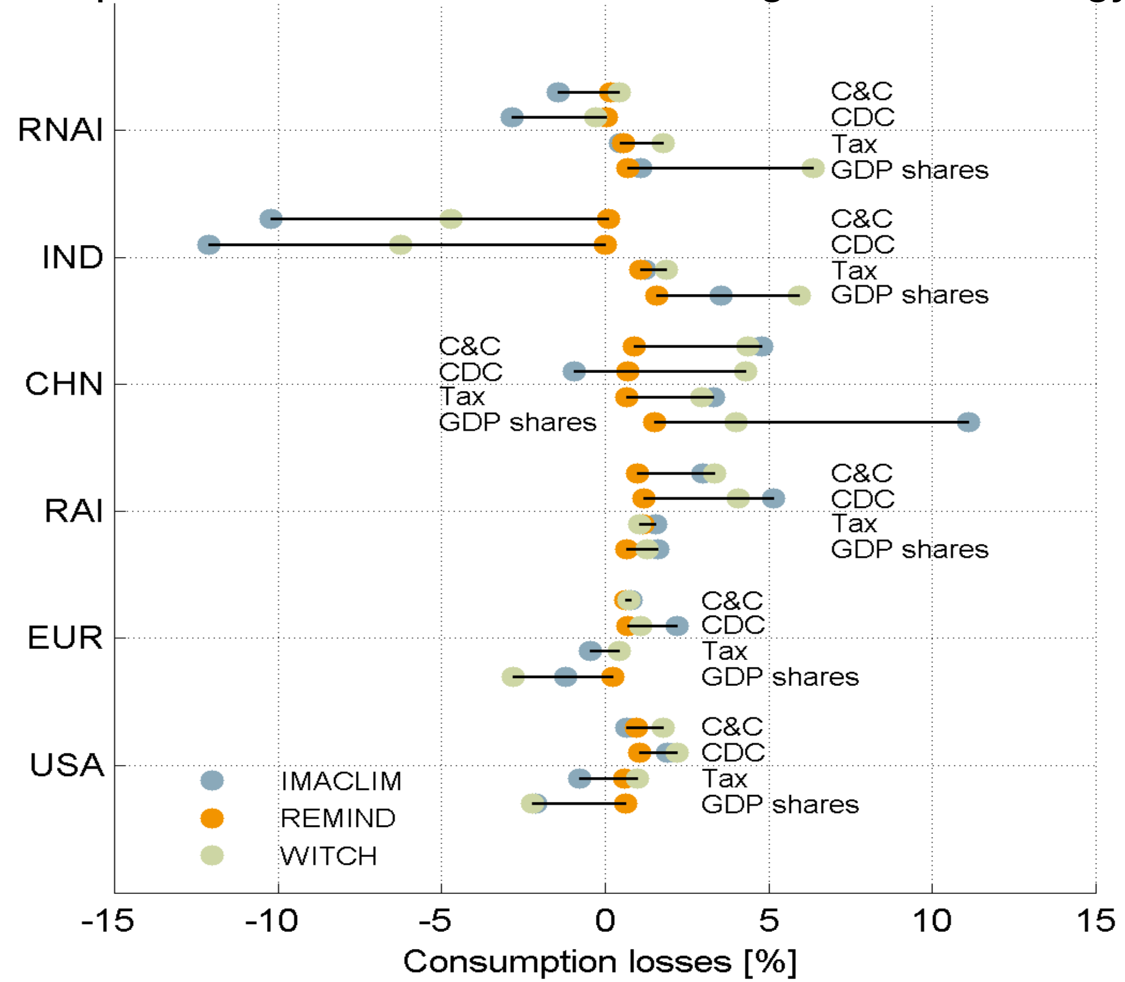
➔ Electricity sector is first to be decarbonized



Source: Luderer et al. 2009

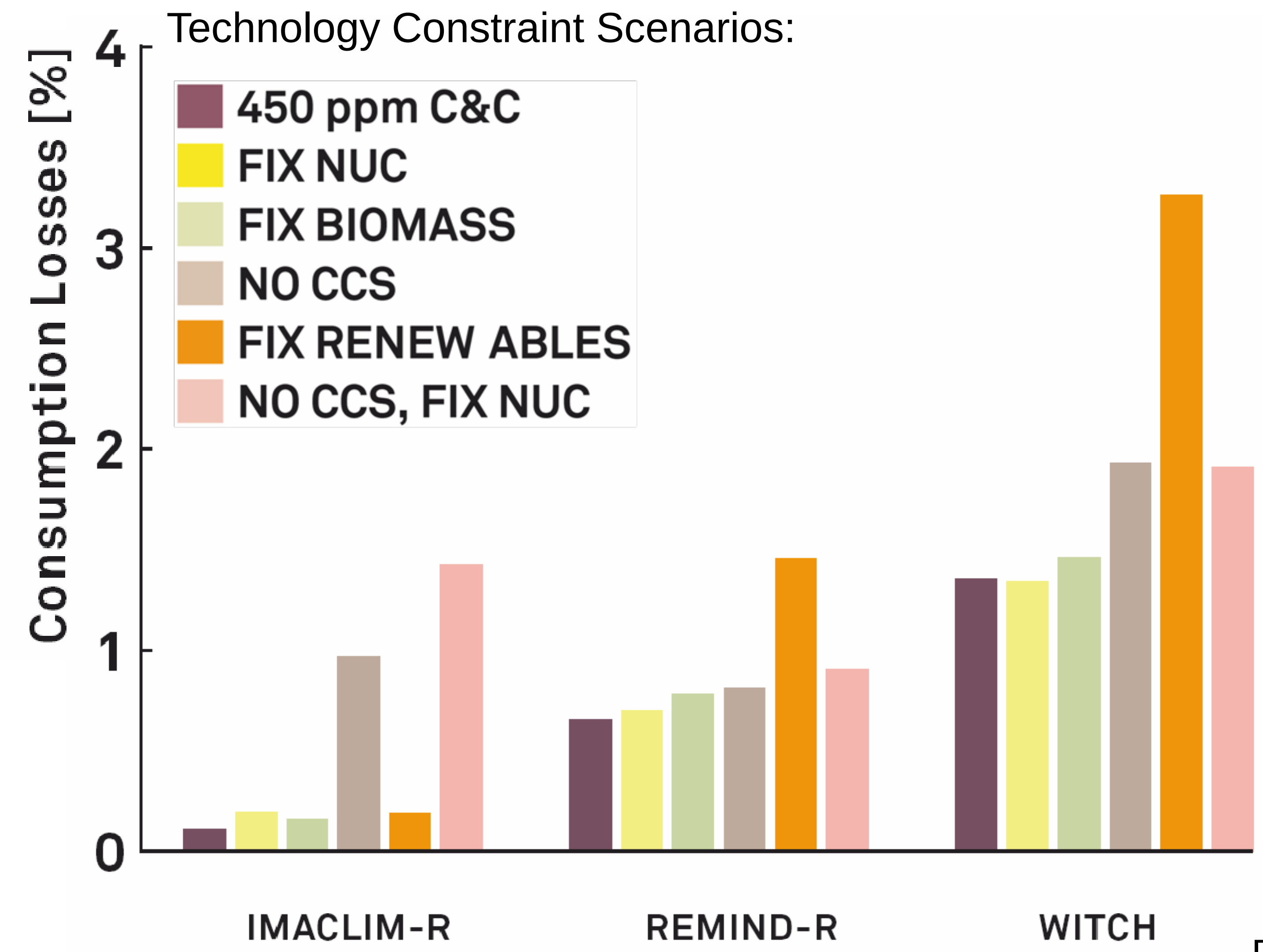
Distributional Effects

➔The size of income redistribution from permit allocation schemes increases with the carbon price, which is a function of mitigation technology availability



Source:
Luderer et al. 2009

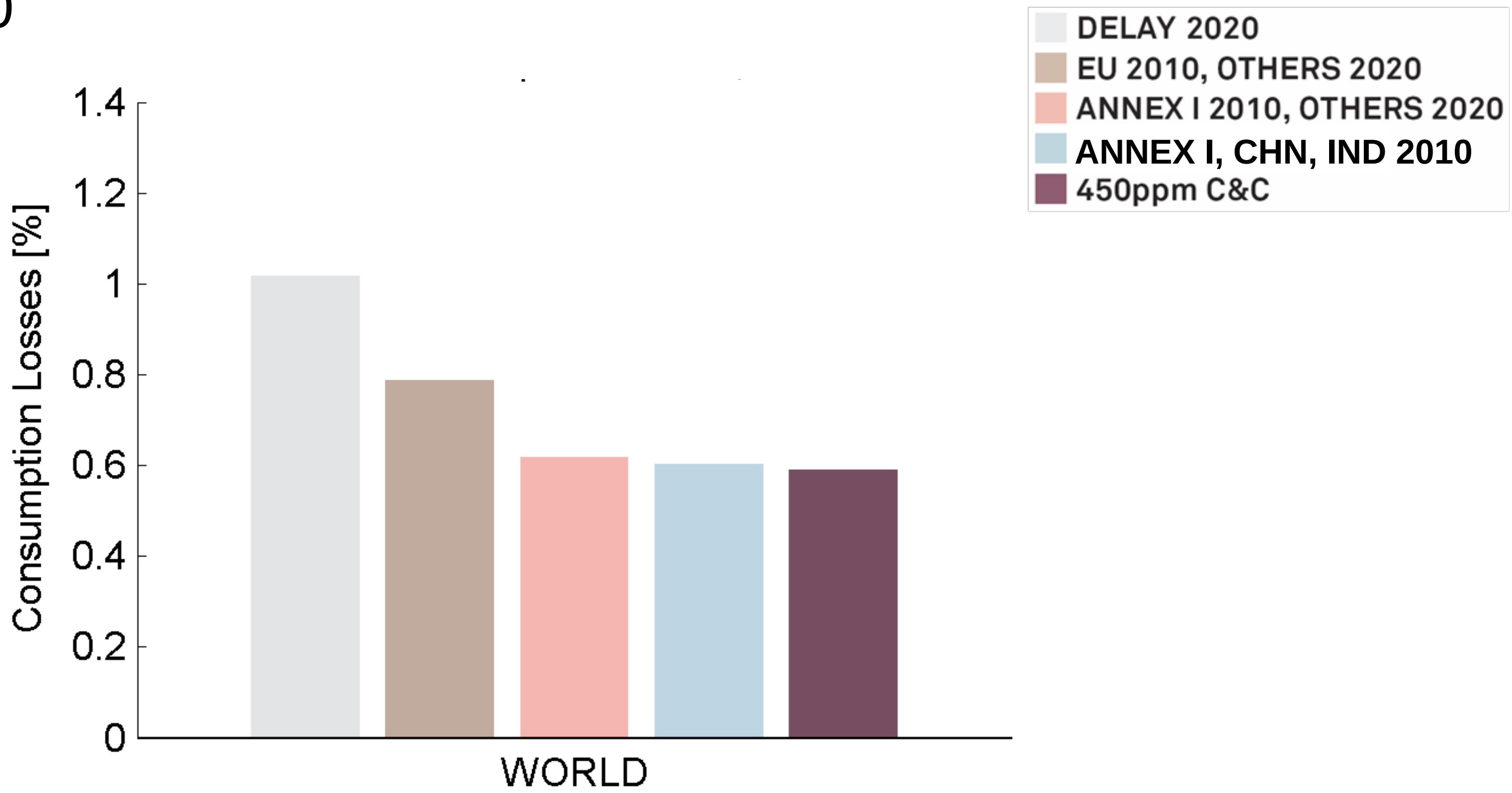
The role of technologies



Discounted at 3%

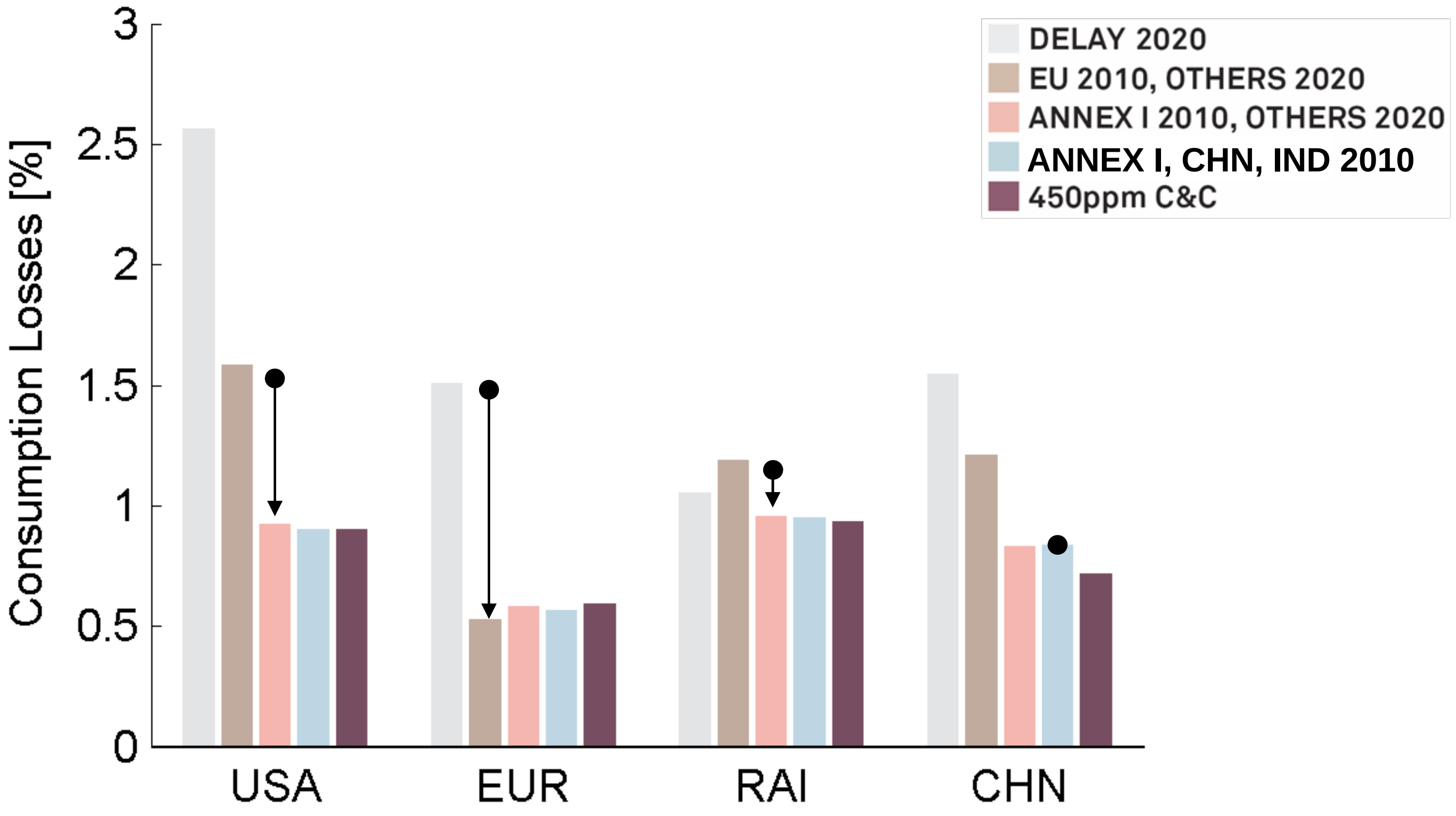
The value of early action (REMIND)

- Delay of mitigation action until 2020 will increase global costs by 70%.
- Stabilization at 450 ppm CO2 is not feasible when delaying action until 2030



The value of early action (REMIND)

- In a world serious about achieving 2°C, early action is beneficial for some regions:



Model Comparison Within ADAM

Model intercomparison on economic costs and technical feasibility of low stabilization pathways

Coordination and Compilation of Results: B. Knopf, O. Edenhofer

Members:

PIK (REMIND model):	O. Edenhofer, M. Leimbach. L. Baumstark, B. Knopf
PSI (MERGE model):	T. Hal, S. Kypreos, B. Magné
U Cambridge (E3MG model):	T. Barker, S. Scrieciu
ENERDATA (POLES model):	A. Kitous, E. Bellevrat, B. Chateau, P. Criqui
PBL (TIMER):	D. van Vuuren, M. Isaac

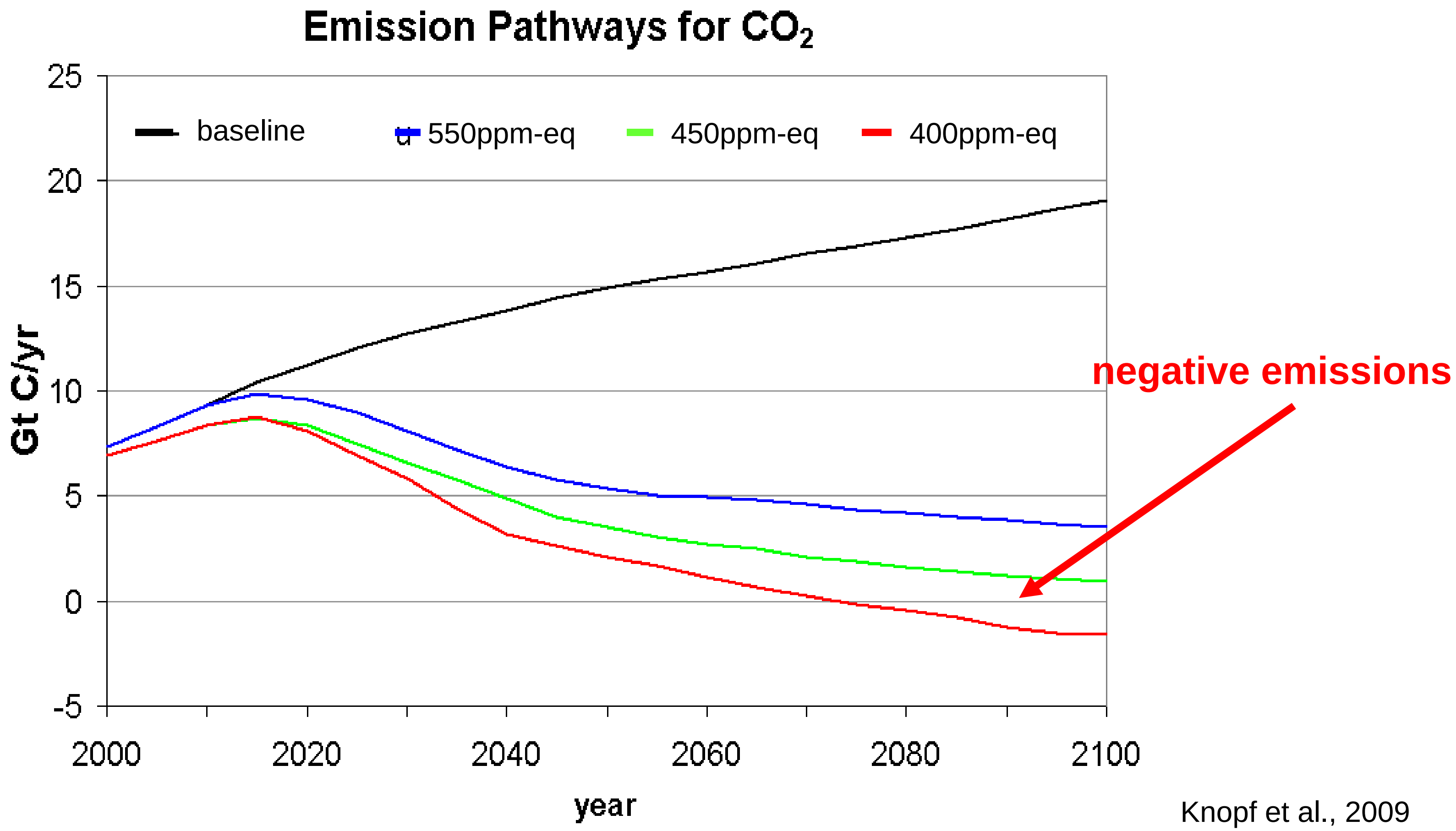
References:

• Edenhofer, Knopf, Leimbach, Bauer (Editors): A Special Issue in the Energy Journal on *The economics of low stabilisation* (2009)

• B. Knopf, O. Edenhofer, T. Barker, N. Bauer, L. Baumstark, B. Chateau, P. Criqui, A. Held, M. Isaac, M. Jakob, E. Jochem, A. Kitous, S. Kypreos, M. Leimbach, B. Magné, S. Mima, W. Schade, S. Scrieciu, H. Turton, D. van Vuuren (2009) The economics of low stabilisation: implications for technological change and policy. In M.Hulme, H. Neufeldt (Eds) Making climate change work for us – ADAM synthesis book, Cambridge University Press.

Model Comparison Within ADAM

3 stabilisation targets with different probabilities to reach the 2° target:
550ppm-eq, 450ppm-eq, 400ppm-eq



Knopf et al., 2009

Model Comparison within ADAM

Model comparison with five energy-economy models

Model	Model classification	Calculus	Constraint
MERGE REMIND-R	Intertemporal general equilibrium model	Welfare maximisation	Radiative forcing En&In CO_2 emissions
POLES TIMER	Energy system model	Cost minimisation	En&In CO_2 emissions
E3MG	Econometric simulation model	Initial value problem	Cumulative CO_2 emissions

- 7 regions: CHN, RUS, EU27, IND, JPN, USA, ROW
- Time horizon: 2000-2100

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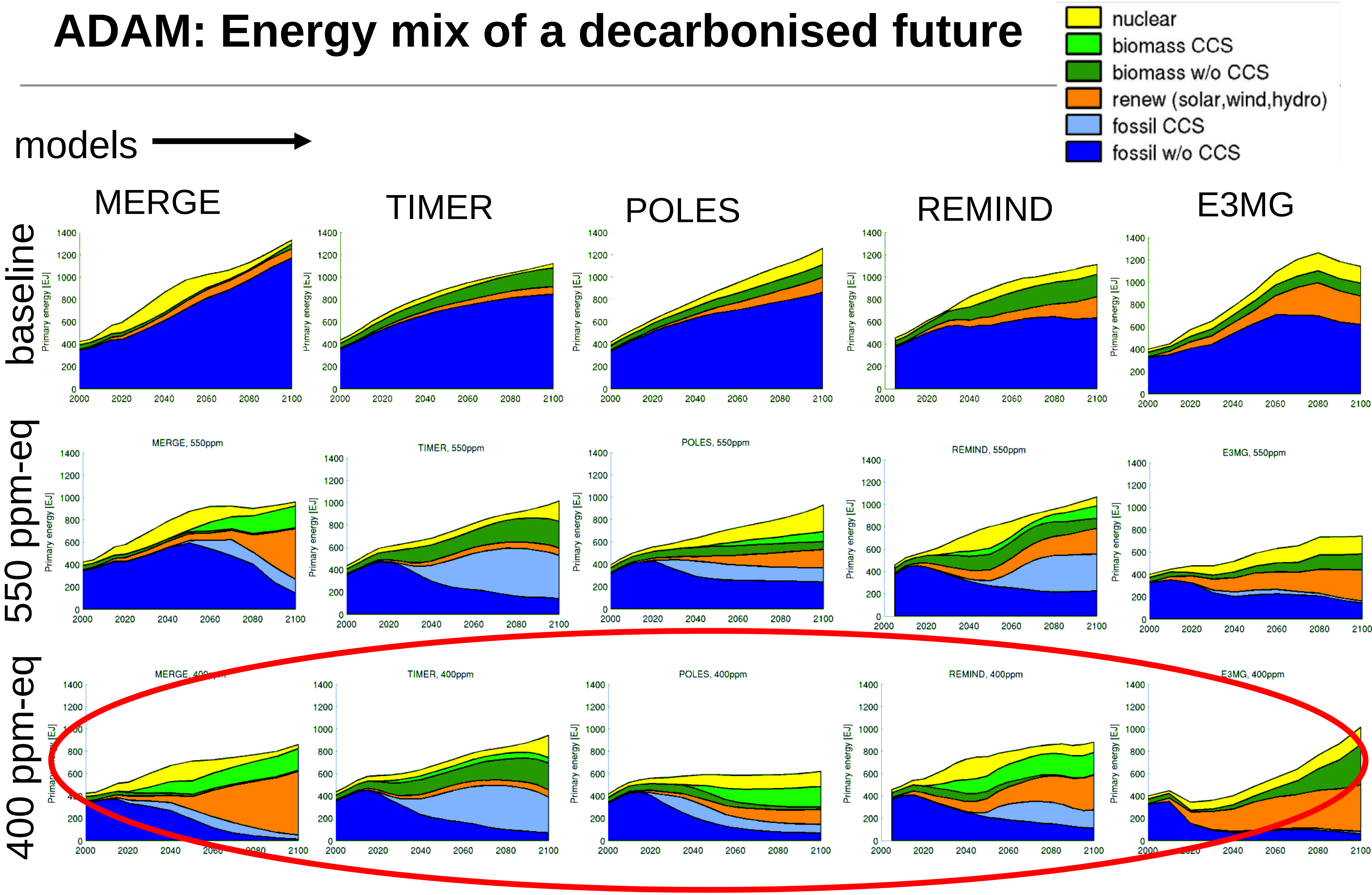
Potsdam Institute for Climate Impact Research

ADAM: Energy mix of a decarbonised future

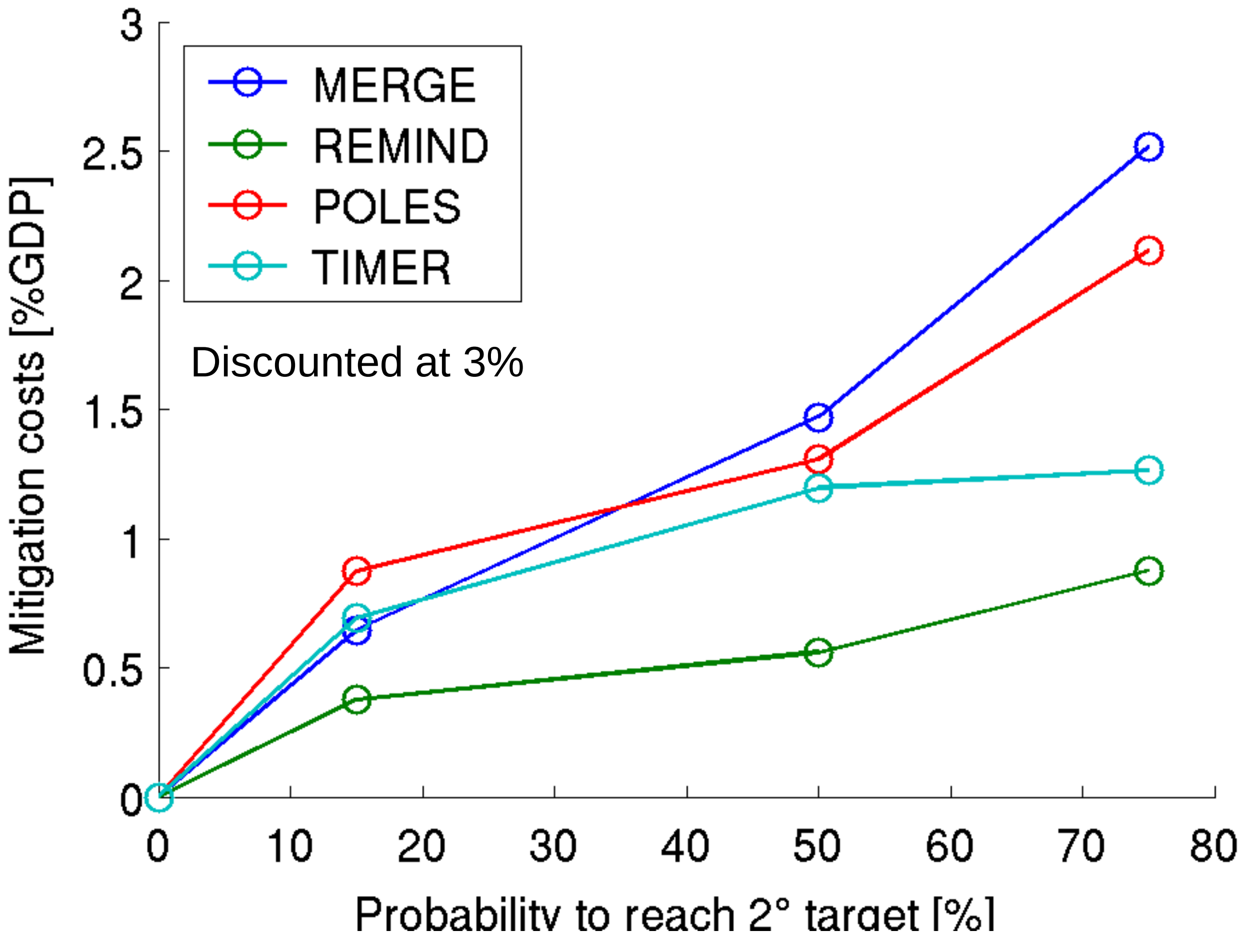


➔ different possibilities to reach low stabilisation

➔ 400ppm can be achieved by all models

Knopf, Edenhofer et al. (2009)

Mitigation costs of low stabilization (full flexibility)



Mitigation costs for 400, 450, 550 ppm-eq plotted against probability of reaching 2°C target at these levels (median estimate from Hare & Meinshausen, 2004; idea after Schaeffer et al. 2009)

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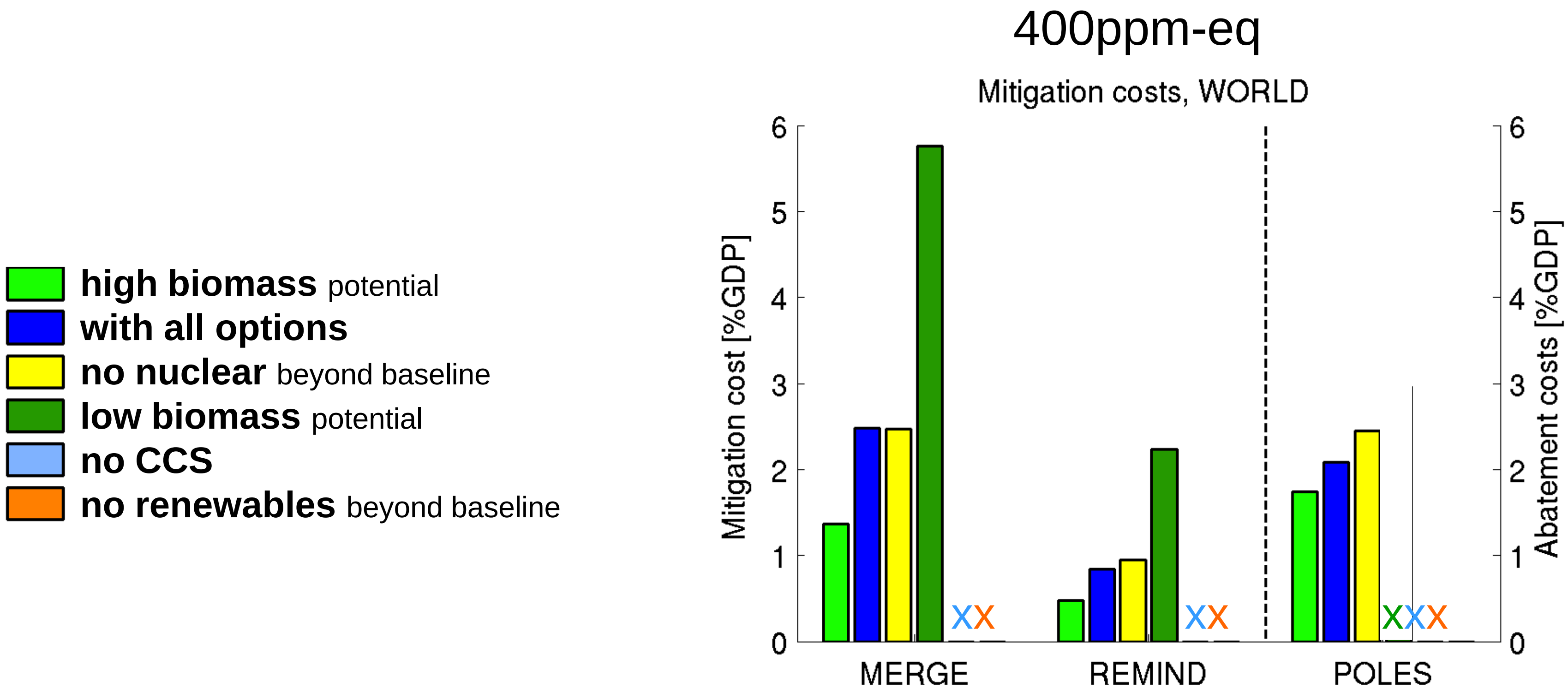
Costs & Feasibility As Function of Technology Availability

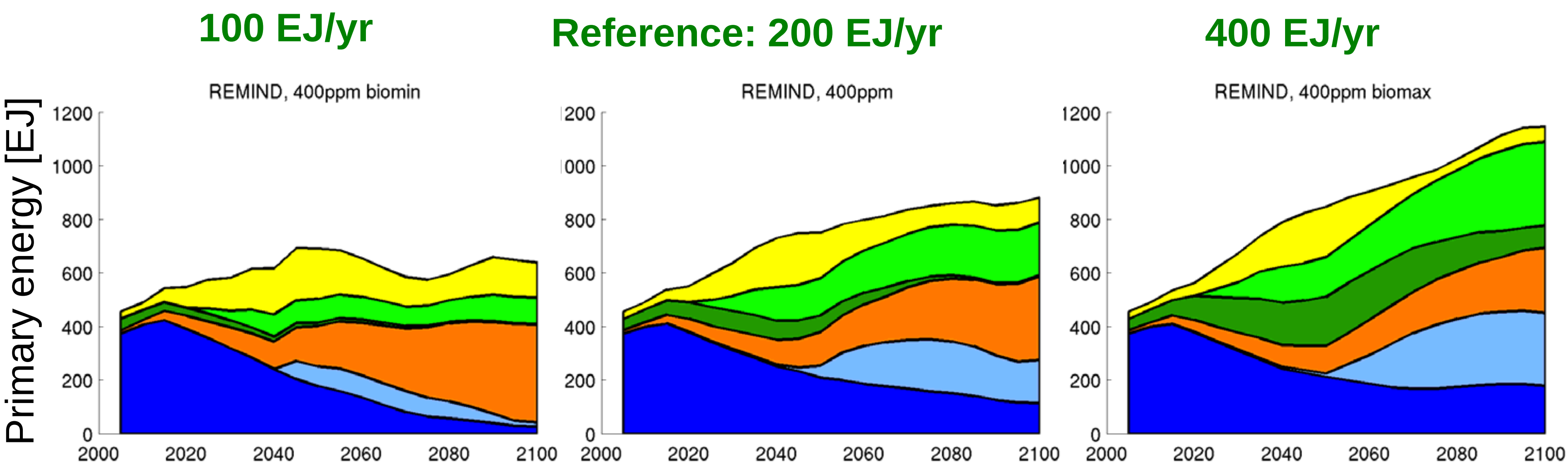


Knopf et al., 2009

- ➔ 400 ppm not achievable without CCS or extension of renewables
- ➔ Biomass potential dominates the mitigation costs of low stabilisation
- ➔ nuclear is not important beyond its (high) use in the baseline

Influence of Biomass Potential

REMIND, 400 ppm-eq policy



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

Knopf et al., 2009

ADAM Model Intercomparison: Summary and Caveats

Keeping 2 ºC target with a high probability is technically feasible and economically viable (in the models!), but

- depends on optimistic assumption of biomass use
- relies on CCS
- assumes a full international agreement from 2010 on

Elmar Kriegler
Potsdam Institute for Climate Impact Research

Integrated assessment for AR5: Key challenges

- **Integrating mitigation and adaptation**
  ➔ Interaction with IAV community, Identification tools to propagate aggregate IAV and climate information
- **Climate policy in 2nd best worlds**
  ➔ Fragmented (carbon) markets, Constrained investment, …
- **Climate policy and development**
  ➔ Endogenous technological change, Path dependency, Leap-frogging, Cross-sectoral and international trade effects
- **Including relevant micro-scale dynamics**
  ➔ Infrastructure, Variability of energy supply, Geographical economics
- **Sustainability context: Co-benefits and negative side effects**
  ➔ Land use, Resource and waste streams, supply bottlenecks
- **Identifying robust results and structuring scenario space**
  ➔ Model intercomparison, Exploratory analysis, Offline bottom-up analysis