



POTSDAM INSTITUTE FOR
CLIMATE IMPACT RESEARCH

Key challenges for integrated assessment of the energy-land nexus

Elmar Kriegler, Nico Bauer, Gunnar Luderer, Alexander Popp (PIK)

Snowmass Workshop on Energy, Land and Water in the Context of a Changing Climate

27 July 2011, Snowmass, Colorado

Challenges for Integrated Assessment

- Bioenergy is the most versatile renewable energy (electricity, heat, gas, fuel). IAMs will use it extensively if they can.
- BioCCS makes bioenergy even more attractive due to negative emissions

Need to model constraints on bioenergy properly:

- land scarcity (competition with forest, cropland, pasture)
- co-emissions and indirect LUC emissions
- water and other environmental constraints
- regional governance factors

Assumptions about technology progress in the agricultural sector is key!

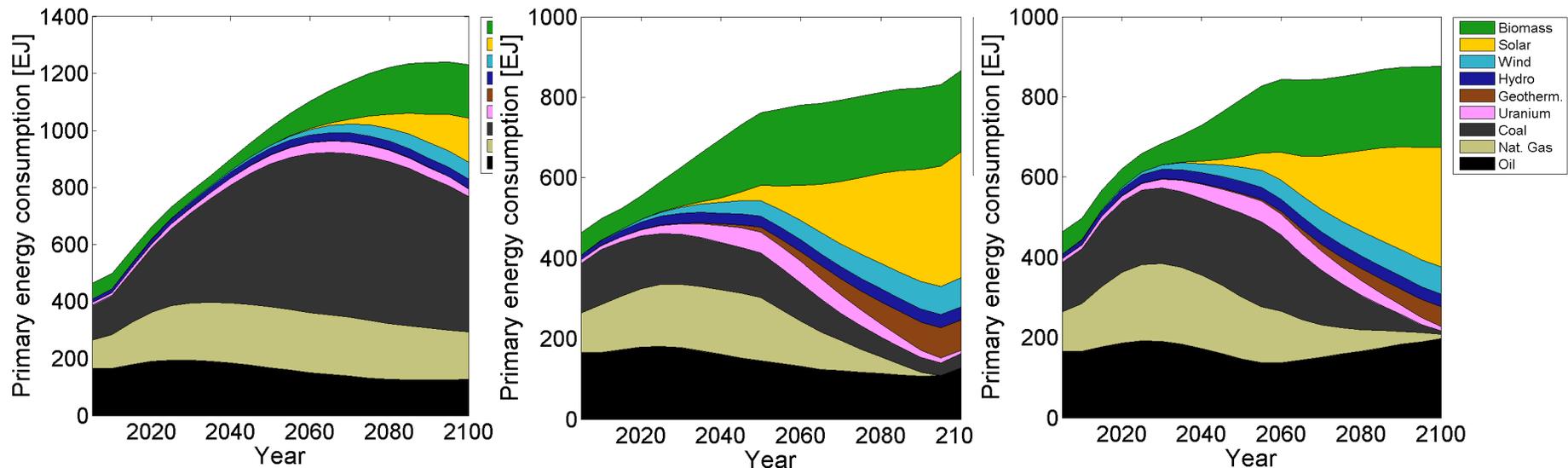
How will agricultural productivity increase in the future?

Global Primary Energy Consumption: Hogwijk supply curves

EMF24
Baseline

EMF24
450ppm

EMF24
550ppm



ReMIND stand alone results. Includes 200 EJ/yr limit

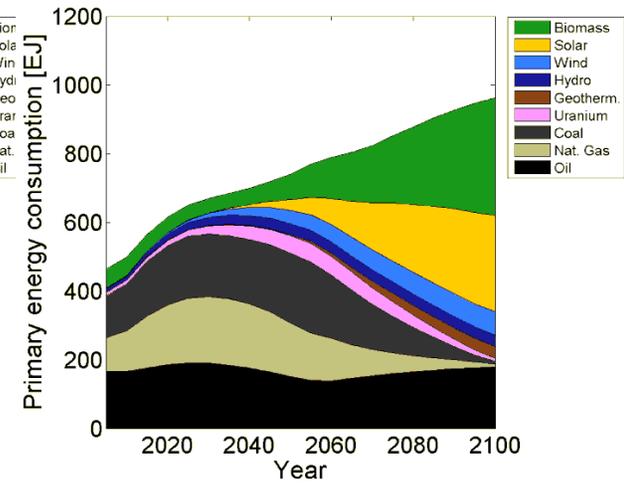
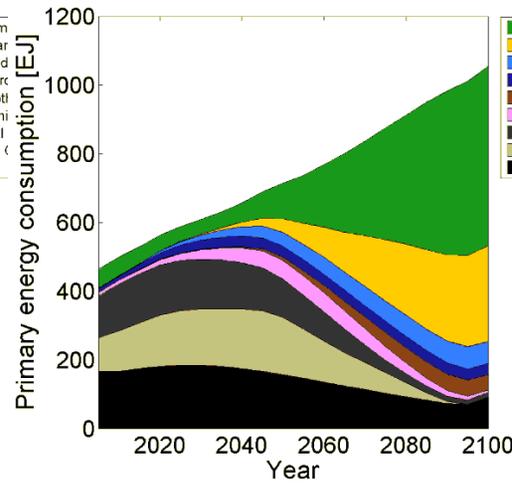
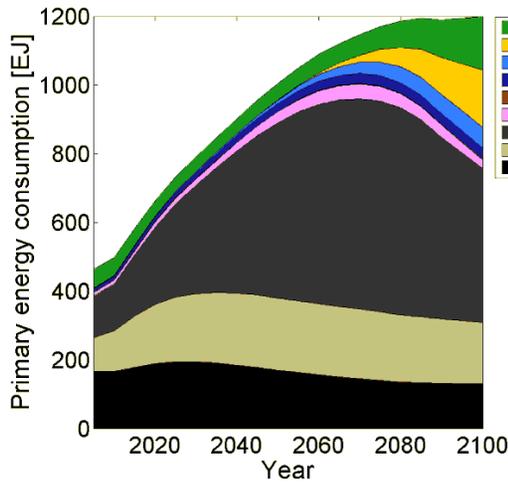
Preliminary results

Global Primary Energy Consumption: ReMIND-MAgPIE

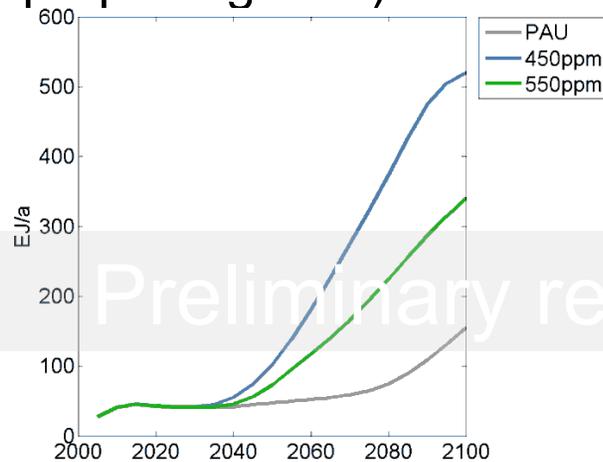
EMF24
Baseline

EMF24
450ppm

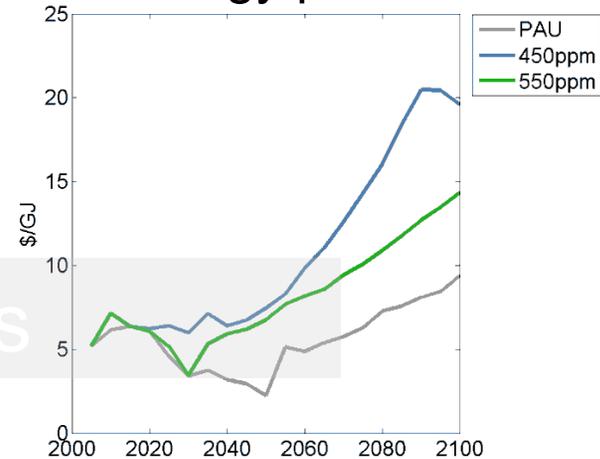
EMF24
550ppm



2nd generation bioenergy demand
(Residues + purpose grown)



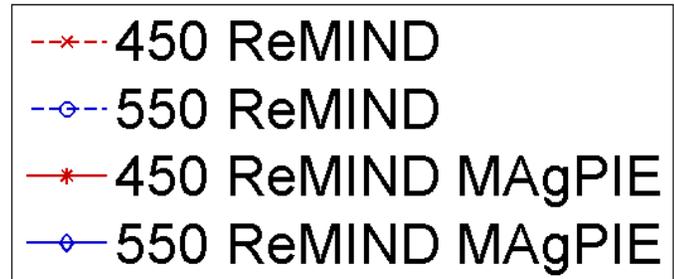
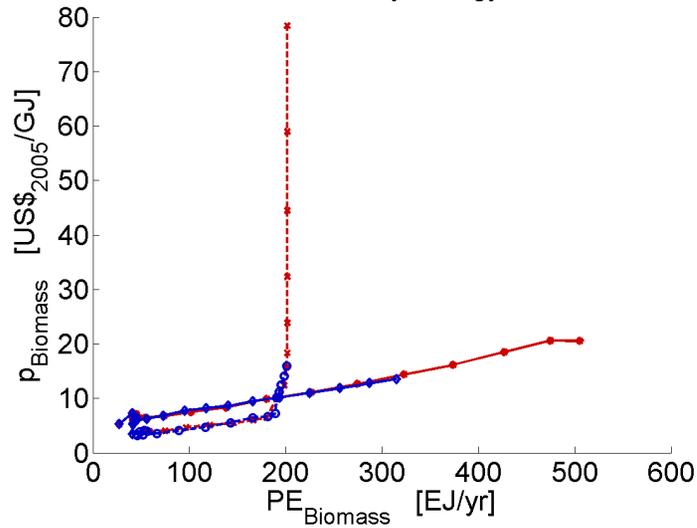
Bioenergy prices



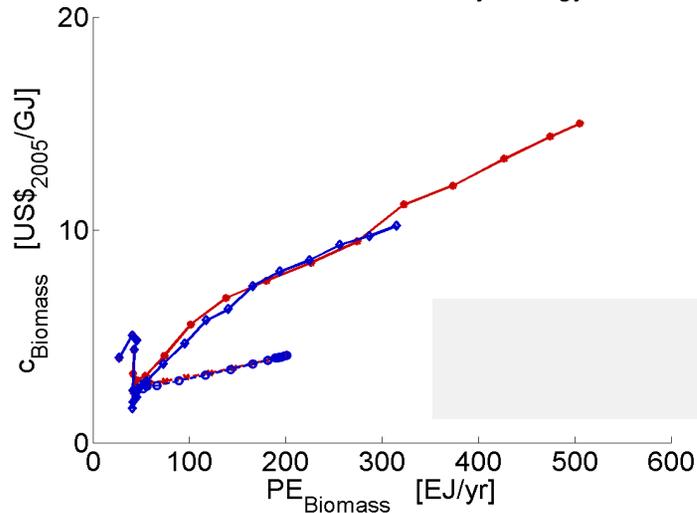
Preliminary results

Bioenergy price vs. bioenergy demand

Biomass Price vs Primary Energy from Biomass



Cost of Biomass Production vs Primary Energy from Bioma



average cost
of production

Preliminary results

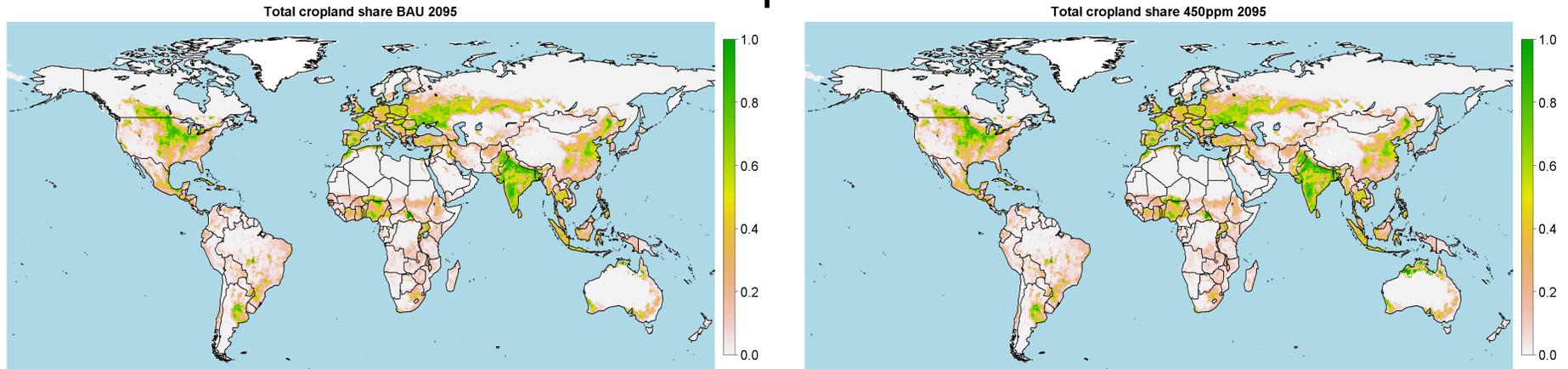


Crop land expansion

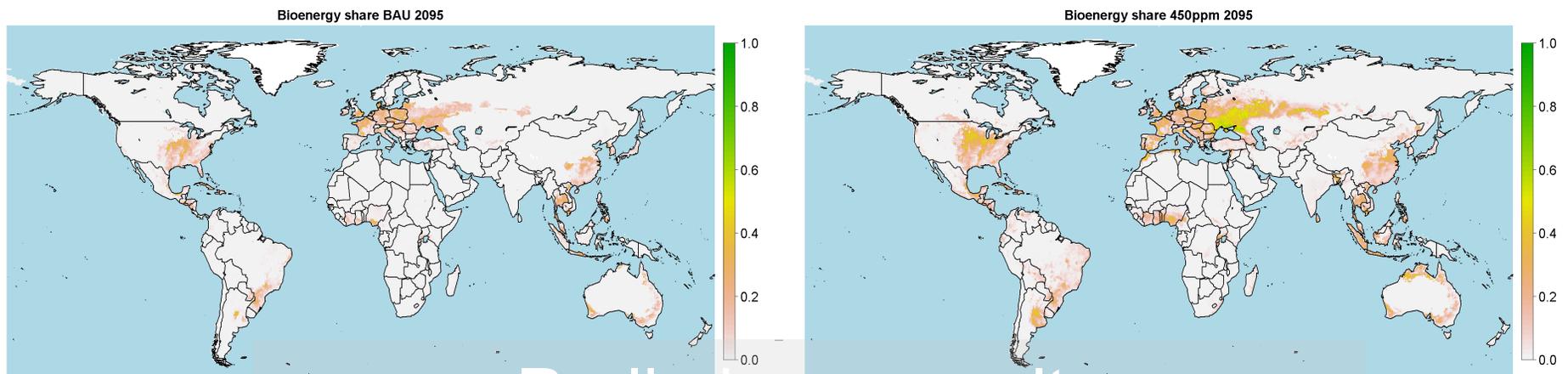
Baseline

450ppm

Total cropland share



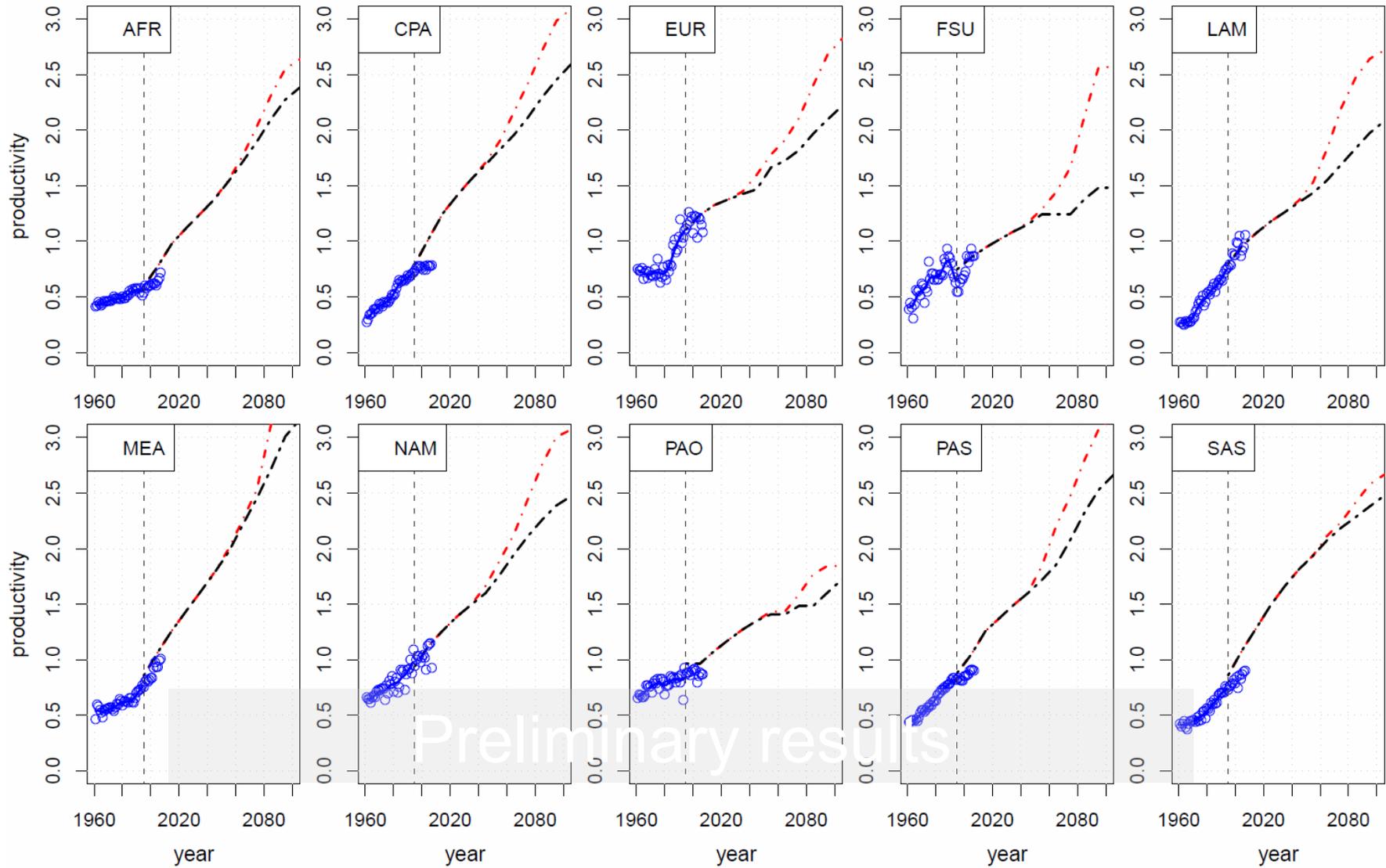
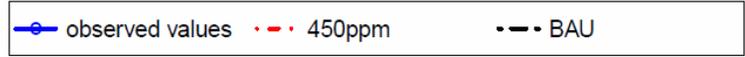
Bioenergy cropland share



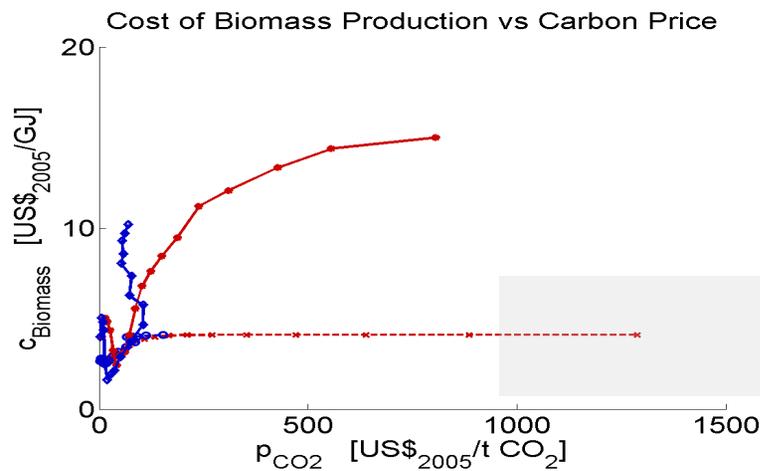
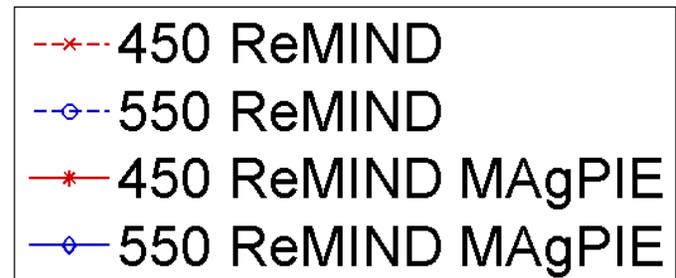
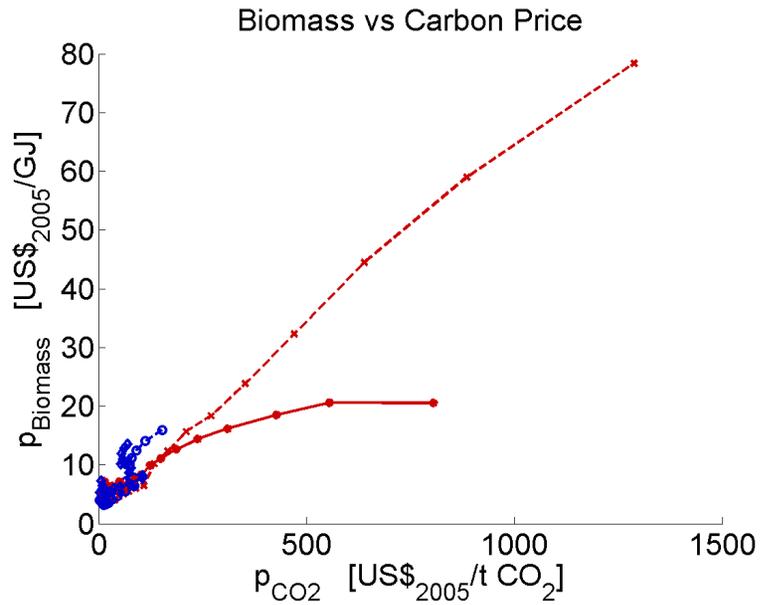
Preliminary results

Technological change

agr. productivity total



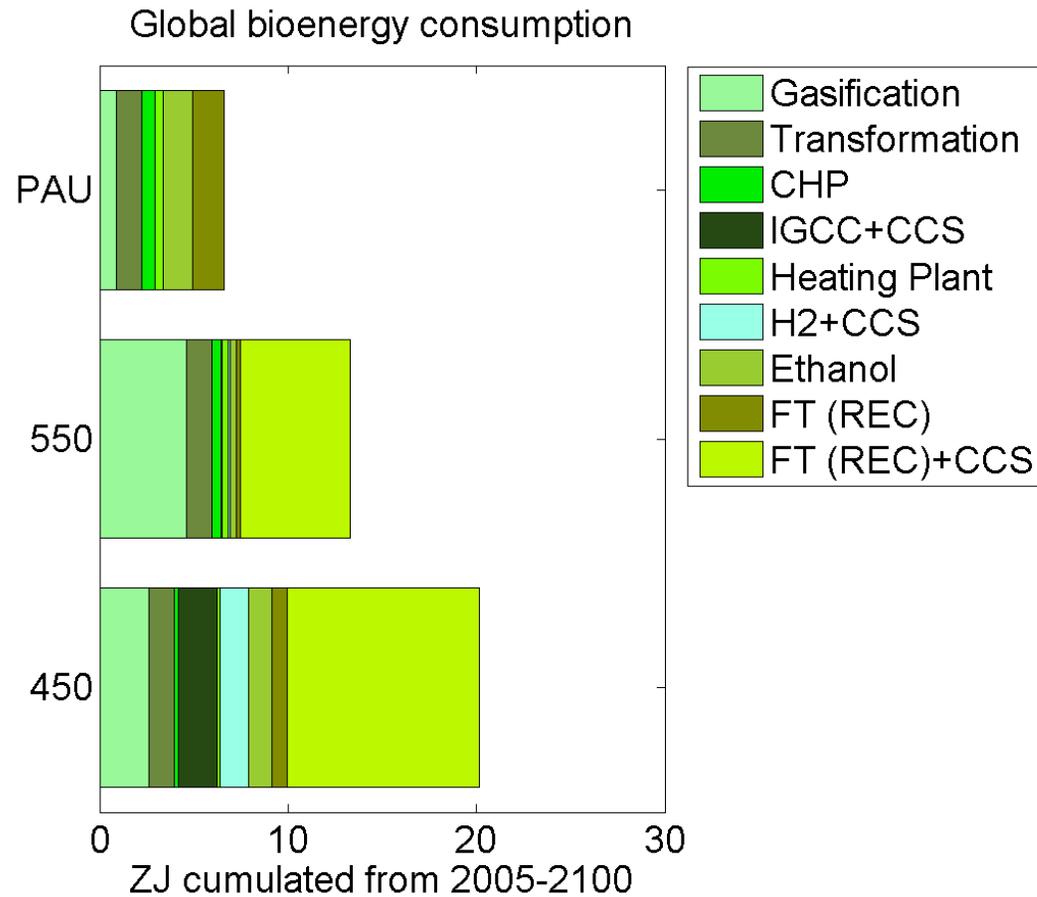
Bioenergy price vs. carbon price



average cost
of production

Preliminary results

Bioenergy technologies



Preliminary results

Thank you!



Elmar Kriegler
Potsdam Institute for Climate Impact Research