POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

Combating Climate Change and Global Poverty

Entdeken Stakeholder Workshop

Potsdam, April 19, 2012

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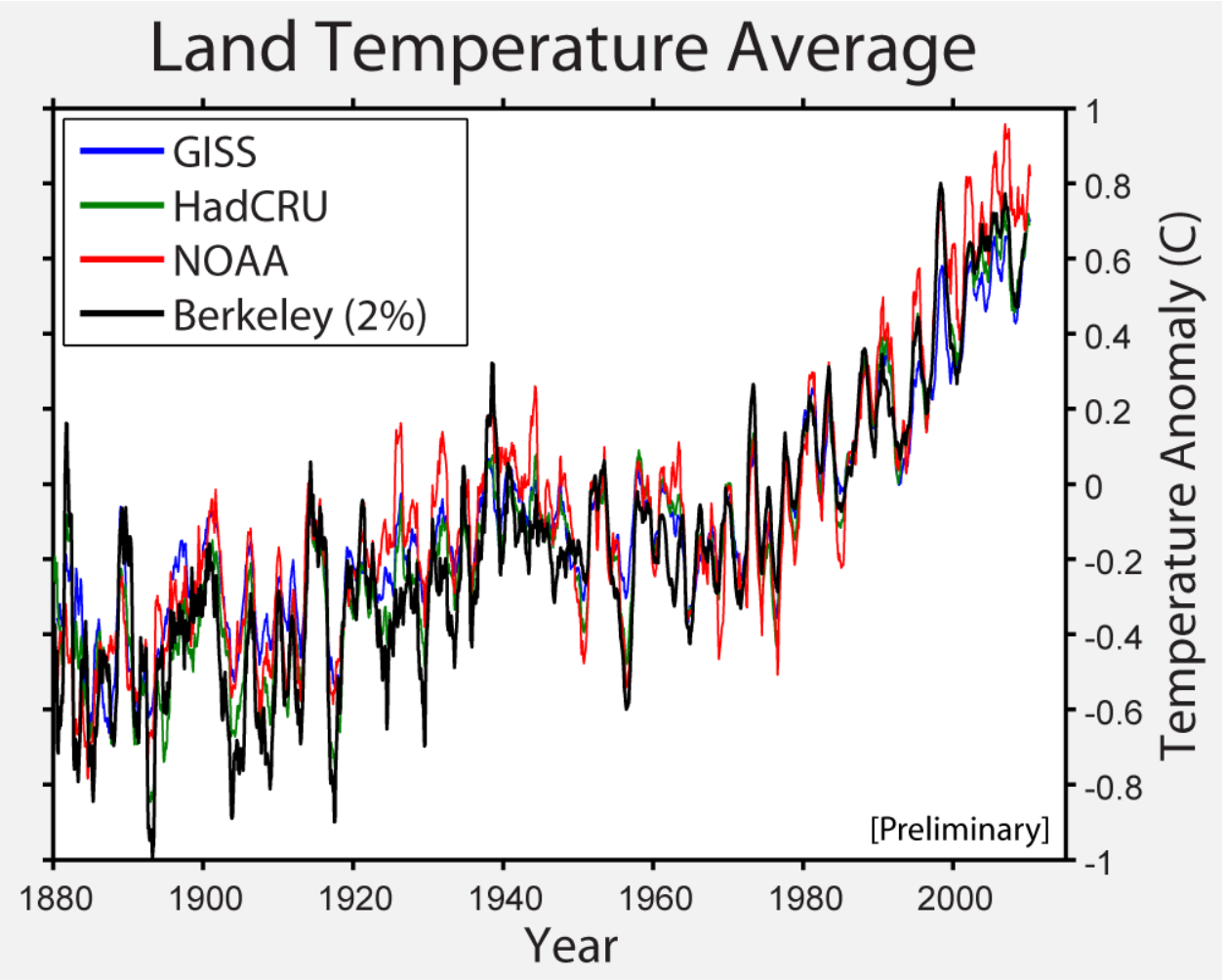
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

Working Group III
Mitigation of Climate Change

Technische Universität Berlin

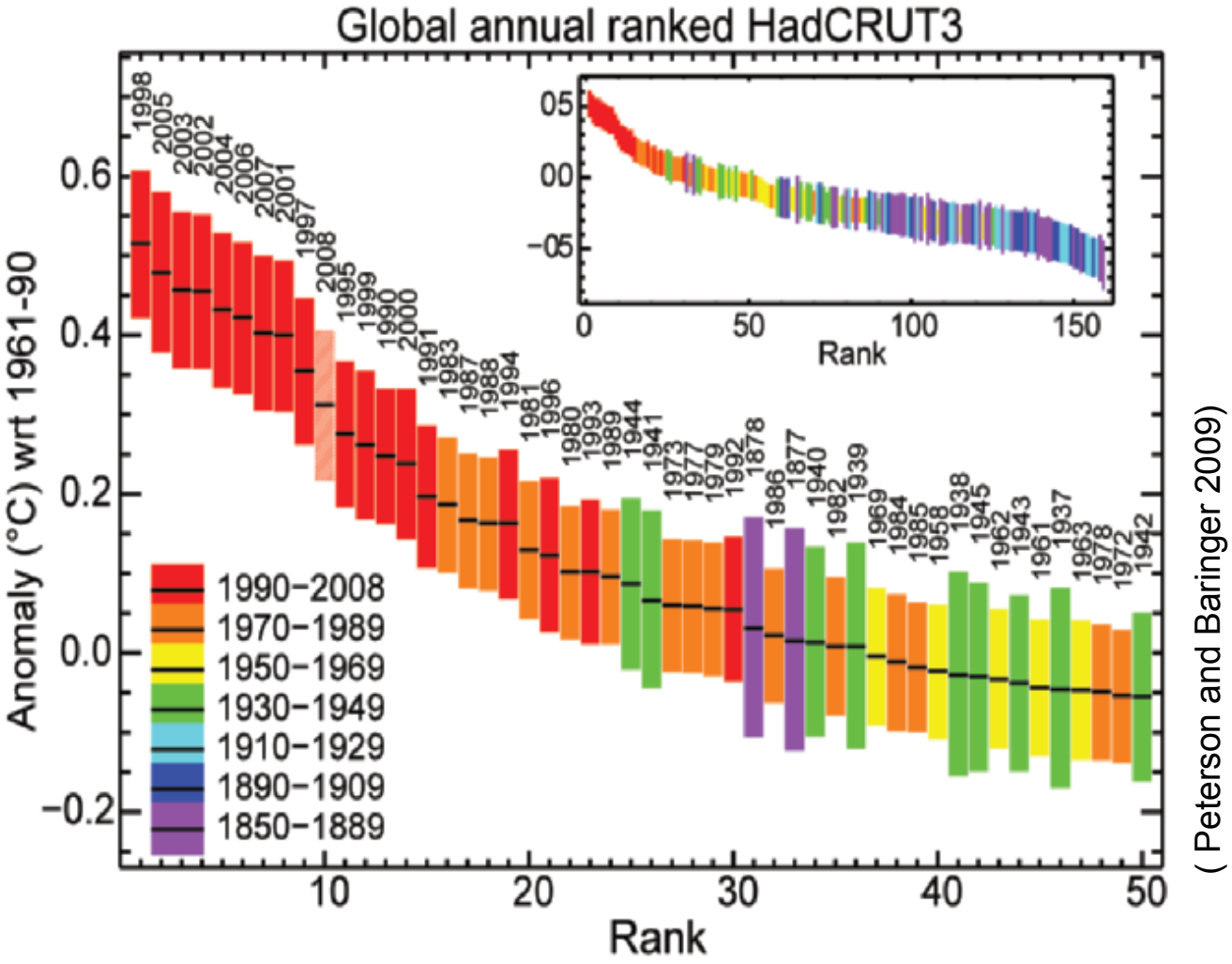
Climate Change, Development, and Equity

Long term trends show clear evidence



- Temporal slow downs of global warming have occurred already in the past
- Recent independent examination of IPCC results (Berkeley Earth Surface Temperature Project) has confirmed results

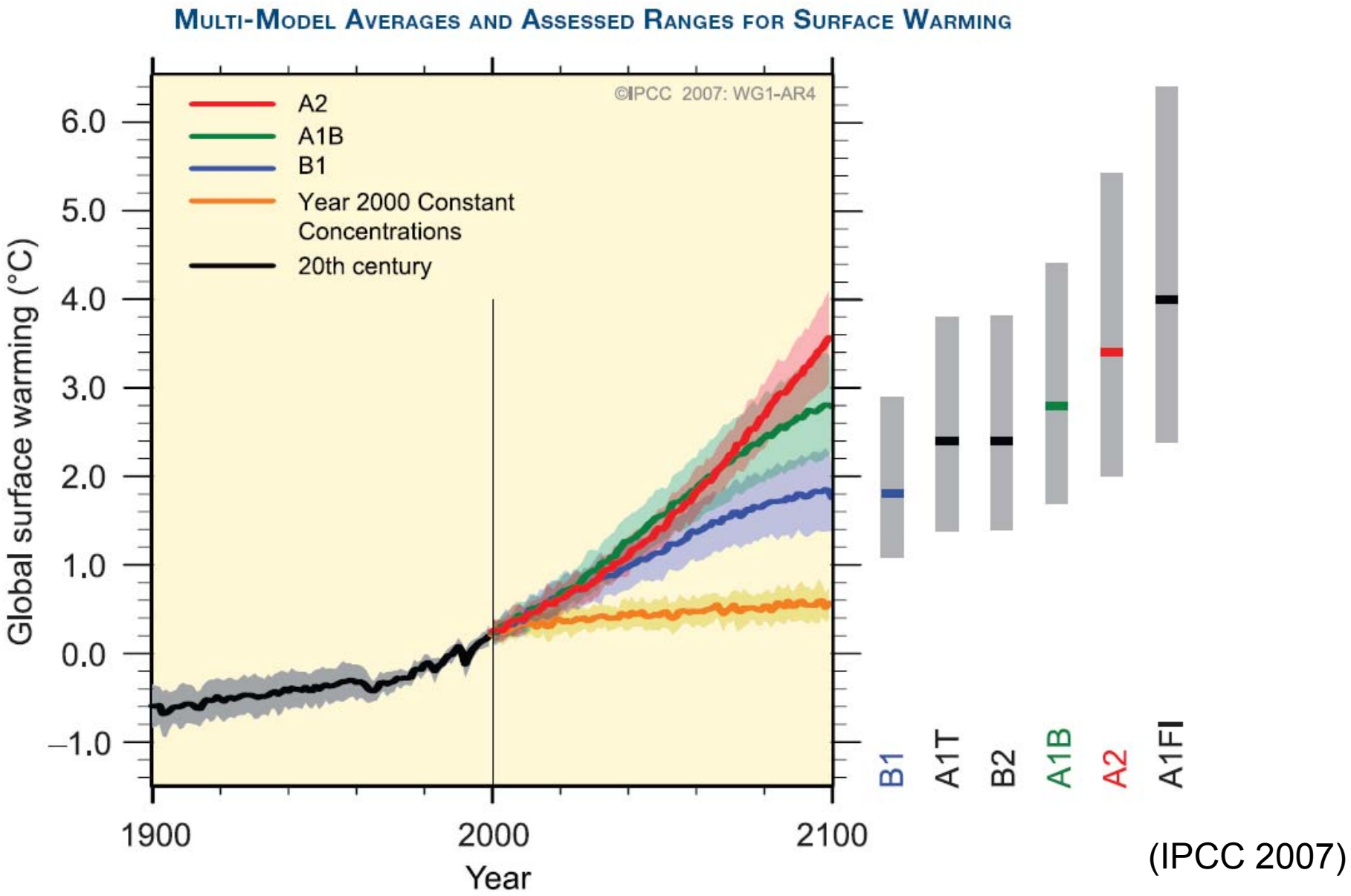
Average temperature anomaly per year



(Peterson and Baringer 2009)

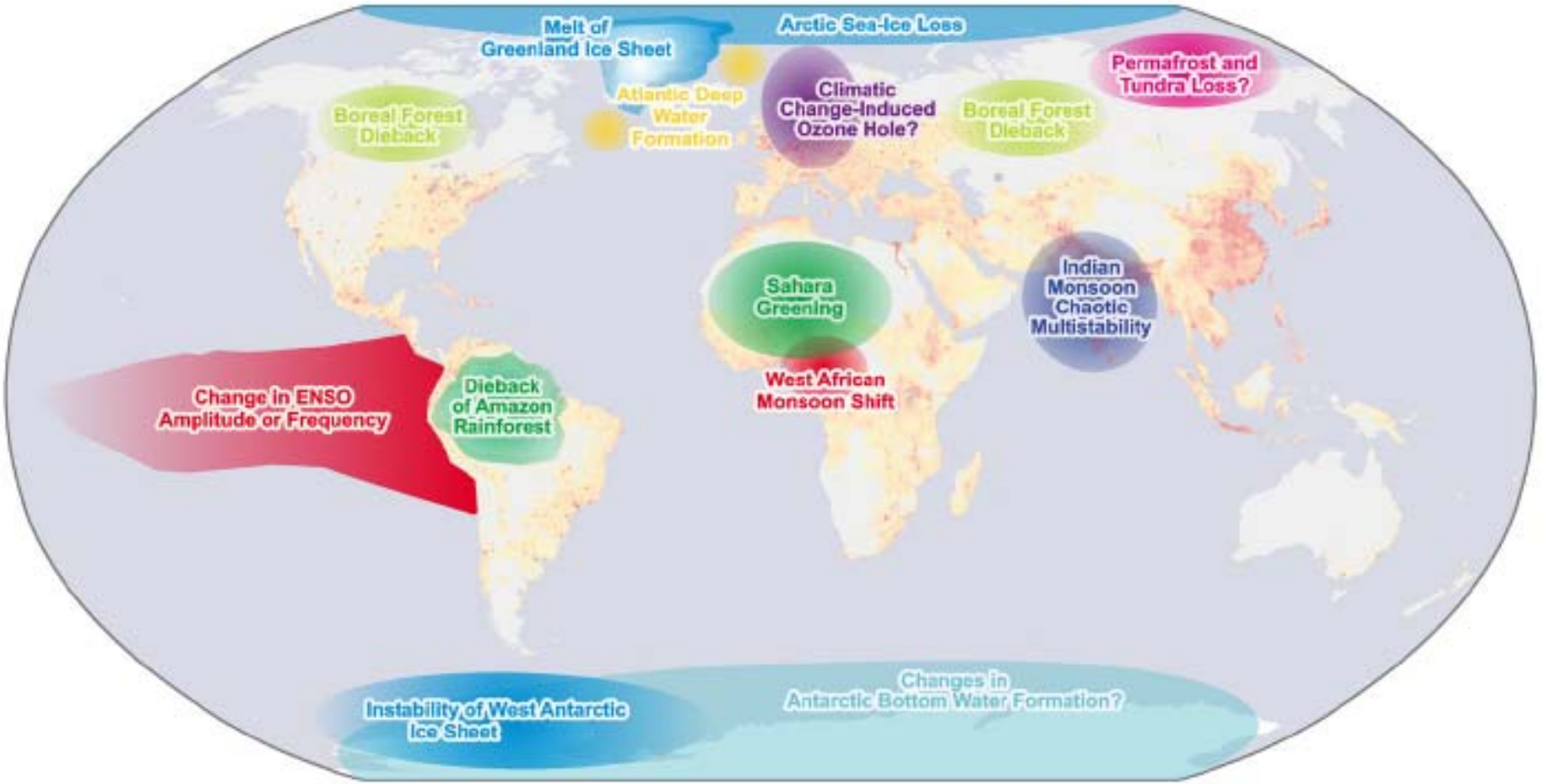
Last decade was the warmest since the beginning of industrialization !

Projections of Global Warming



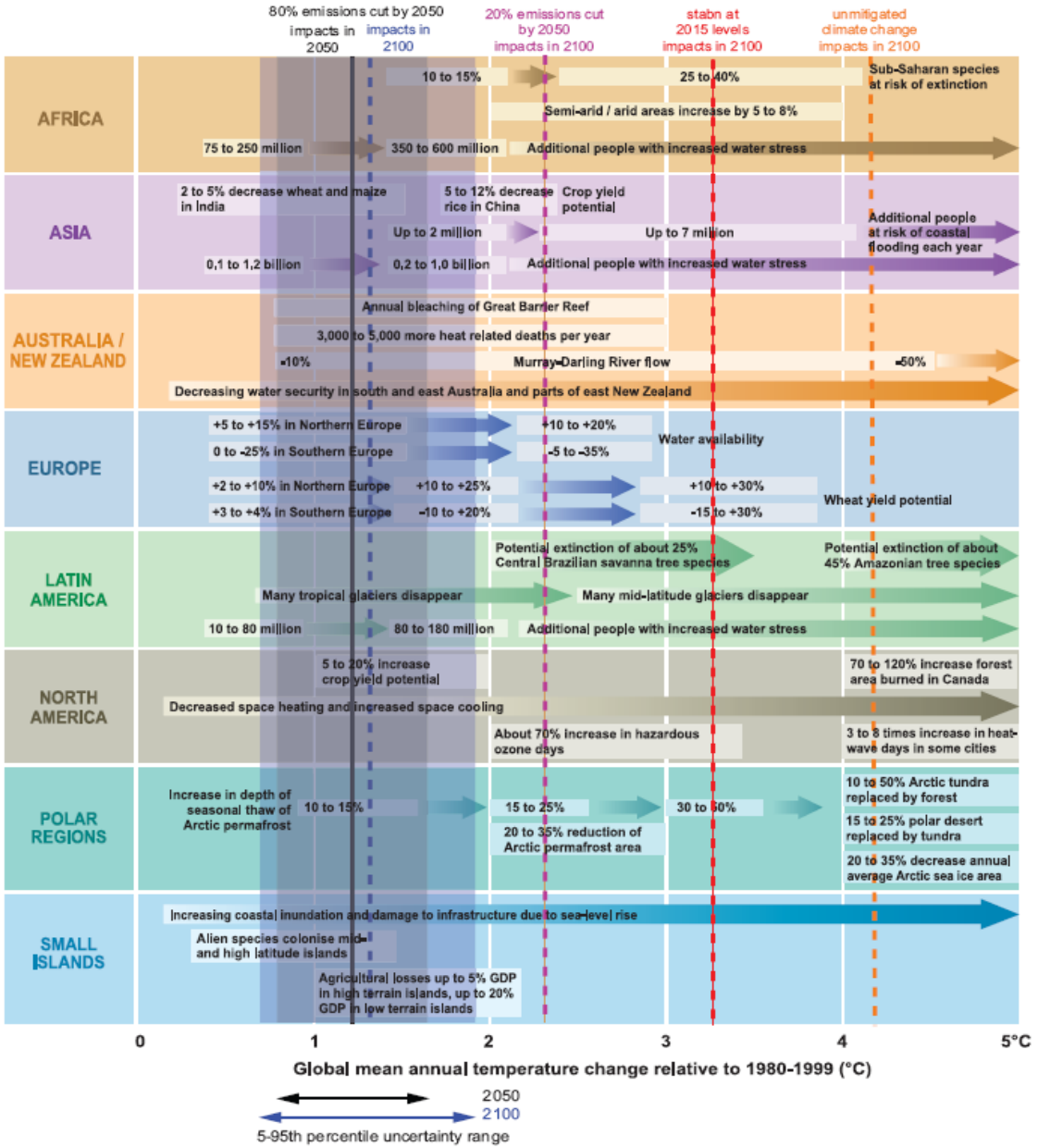
(IPCC 2007)

Tipping Points



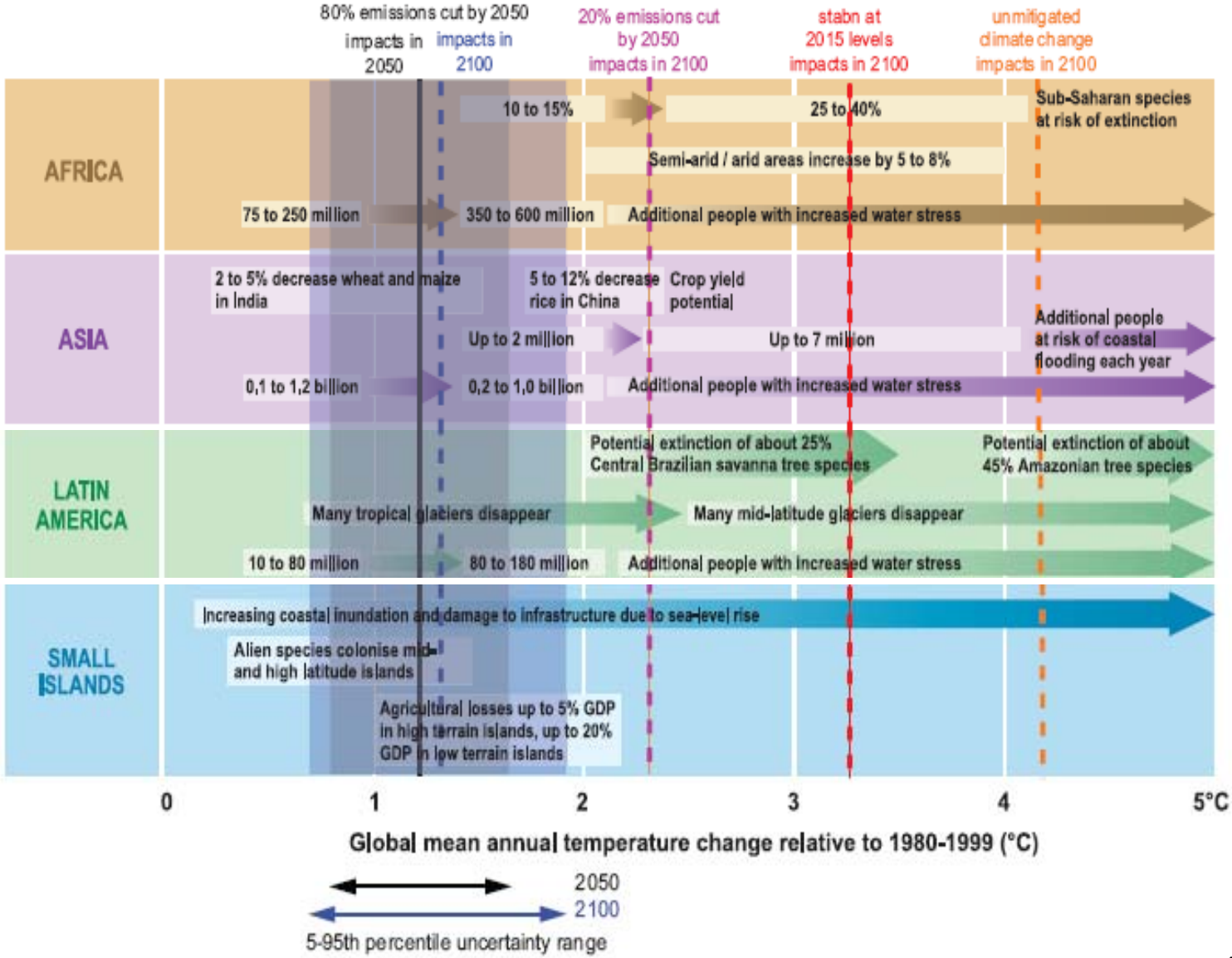
(Lenton et al. 2008)

Impacts



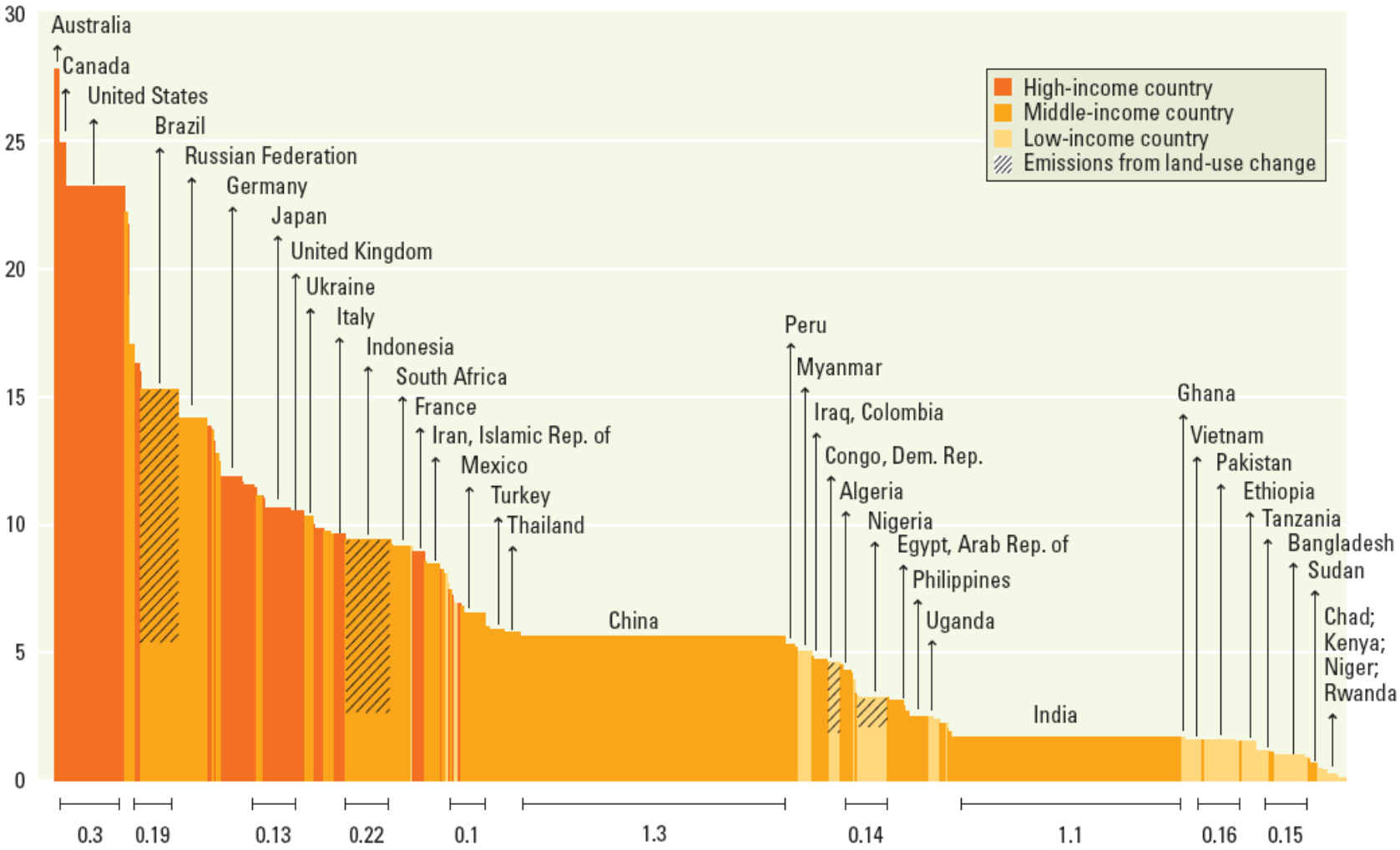
(IPCC 2007)

Impacts for Developing Countries



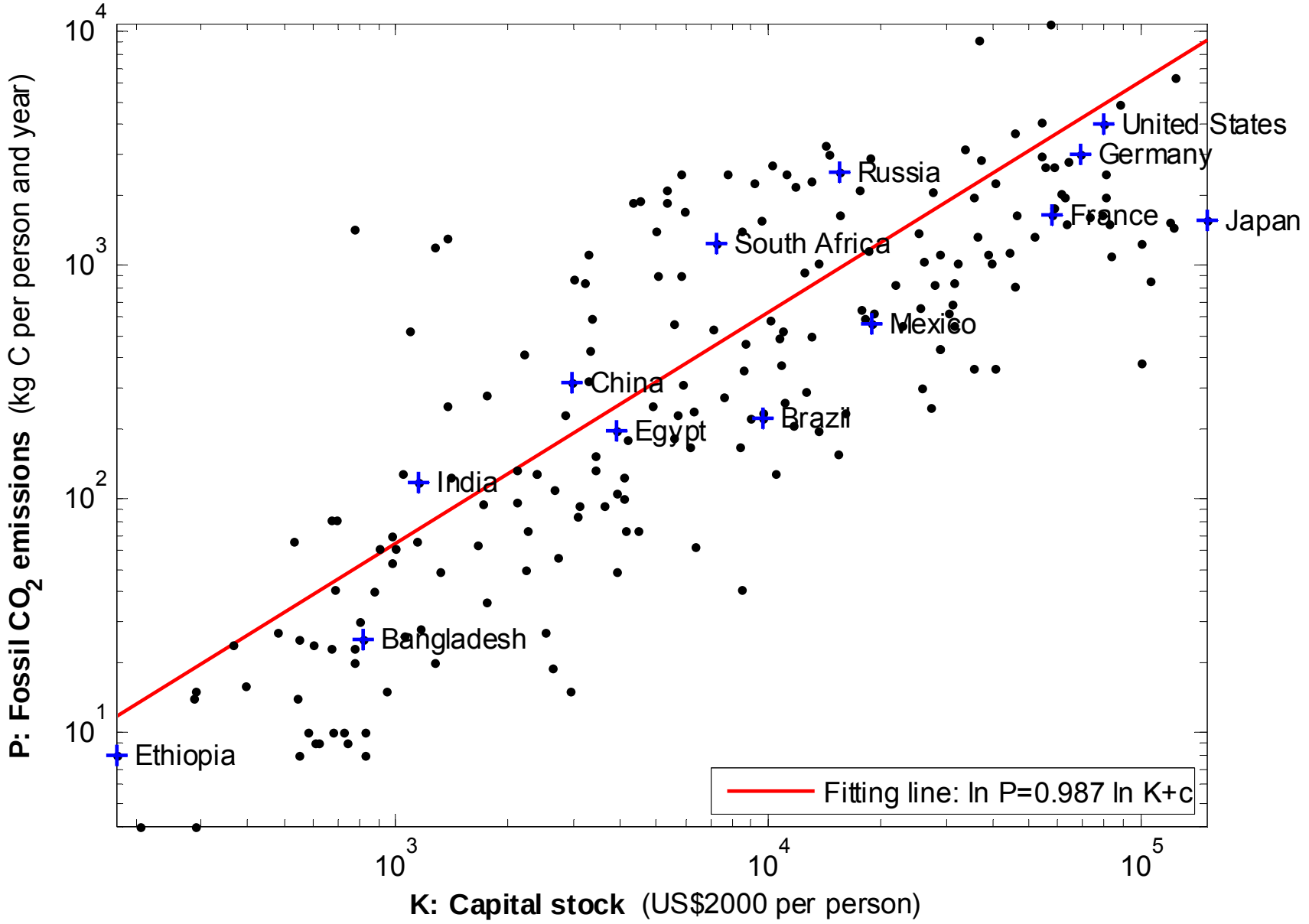
(IPCC 2007)

Where do we stand? – GHG emissions by country today



(WDR 2010)

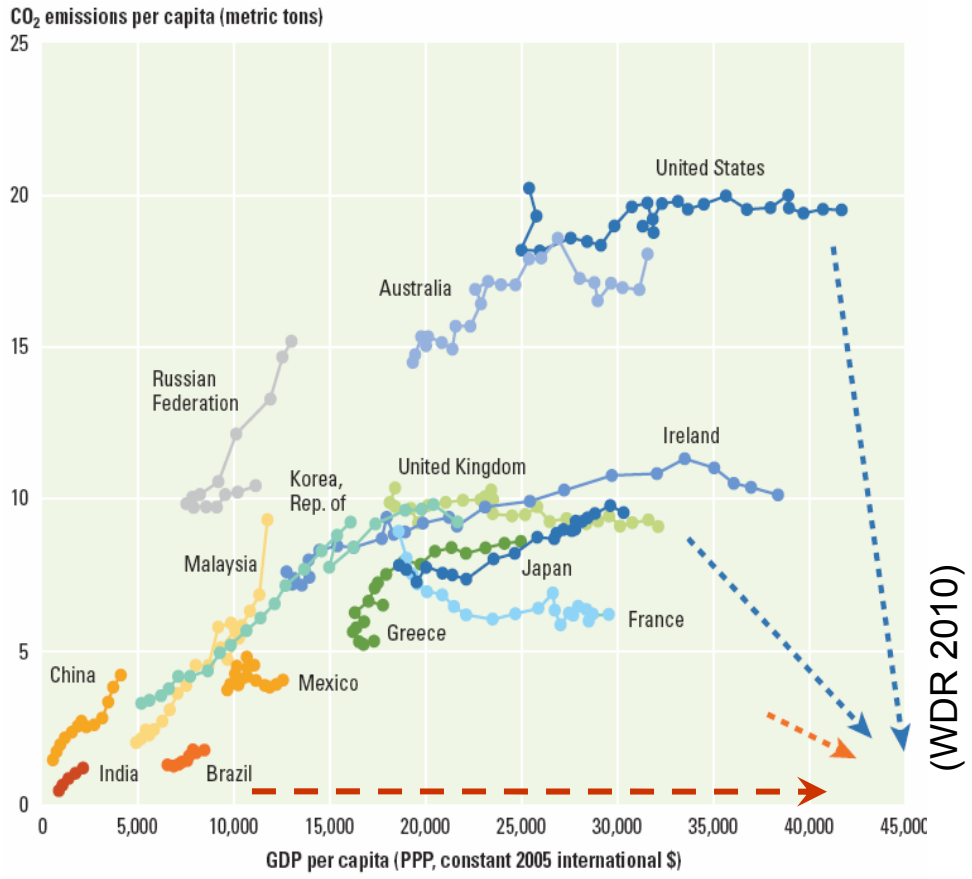
Wealth and carbon emissions



(Füssel 2007)

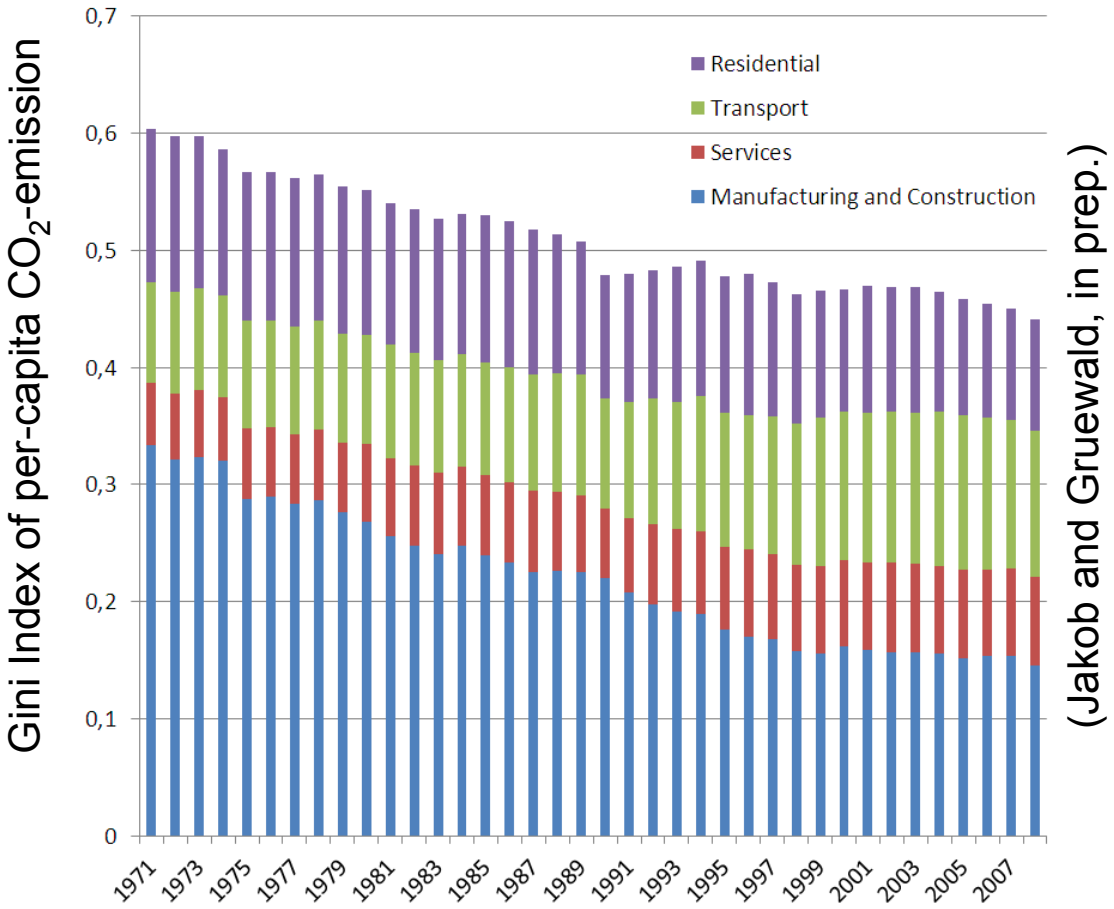
Economic Development, Energy Use, and CO_2 Emissions

The scope of the challenge



Key question for developing countries:
Is leapfrogging possible?

Inequality in per-capita emissions across countries



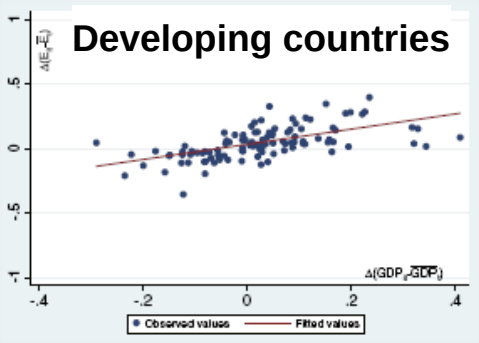
-Inequality in per capita emissions has decreased in last decades

-Decrease particularly driven by manufacturing sector

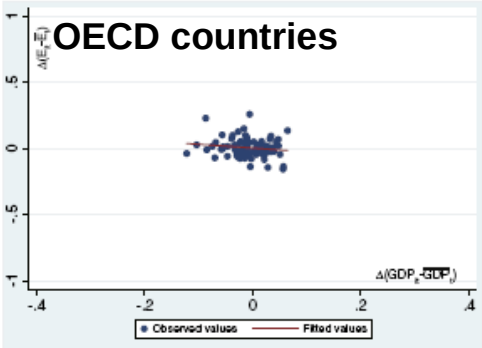
-Increasing inequality in transportation hinges mainly at increasing share of transportation sector

Empirical relationship between economic and emissions growth and energy consumption in developing countries

Energy 1971 - 2005

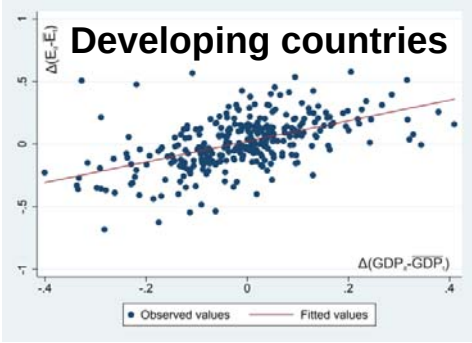


Stronger coupling of growth and energy

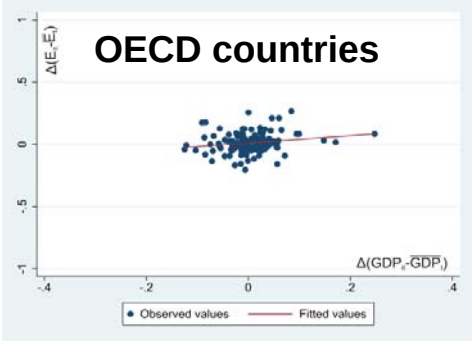


Weaker coupling of growth and energy

Emissions 1971 - 2005



Stronger coupling of growth and emissions



Weaker coupling of growth and emissions

➡ ‚Decoupling' should not be expected for developing countries in the near to midterm

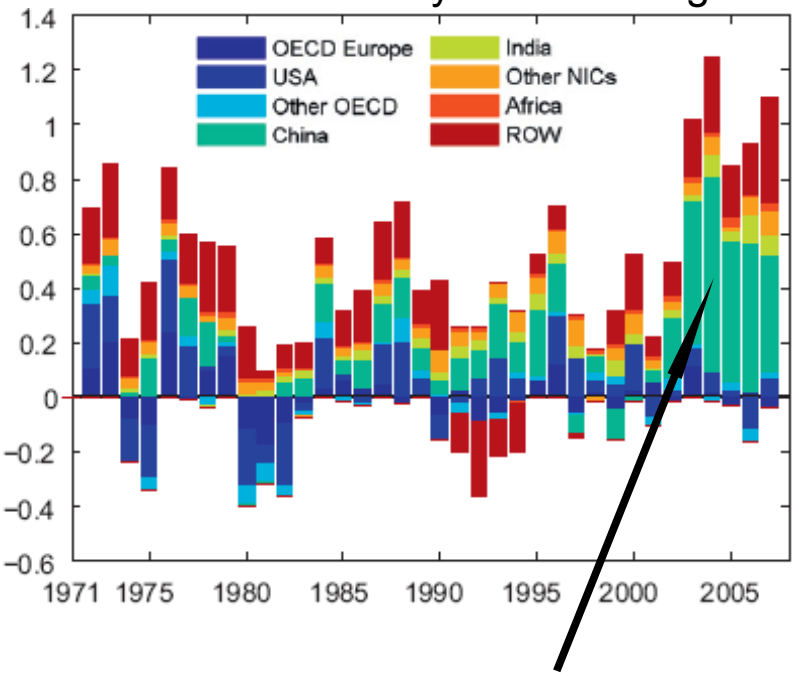
(Jakob et al. 2012)

Development of global emissions

	World	OECD	NIC	China	China 2000–2007
Population	1.59	0.71	1.93	1.29	0.67
GDP per capita	1.96	2.07	2.84	7.51	9.27
Energy intensity	−1.36	−1.55	−0.66	−4.13	−2.34
Carbon intensity	−0.16	−0.47	0.59	1.2	1.37
CI attributed to					
Coal	0.36	0.1	0.86	1.61	1.9
Gas	−0.04	−0.06	0.04	−0.02	−0.07
Oil	0.02	−0.01	0.52	0.004	−0.19
Nuclear	−0.24	−0.37	−0.15	−0.04	−0.11
Biomass and Waste	−0.18	−0.09	−0.49	−0.24	0.08
Renewables (incl. Hydro)	−0.08	−0.05	−0.18	−0.11	−0.24
Net annual CO_2 growth	2.02	0.76	4.71	5.88	8.97

Contributions to net annual emissions growth coming from different characteristic factors [all in %]

Global emissions by countries/regions

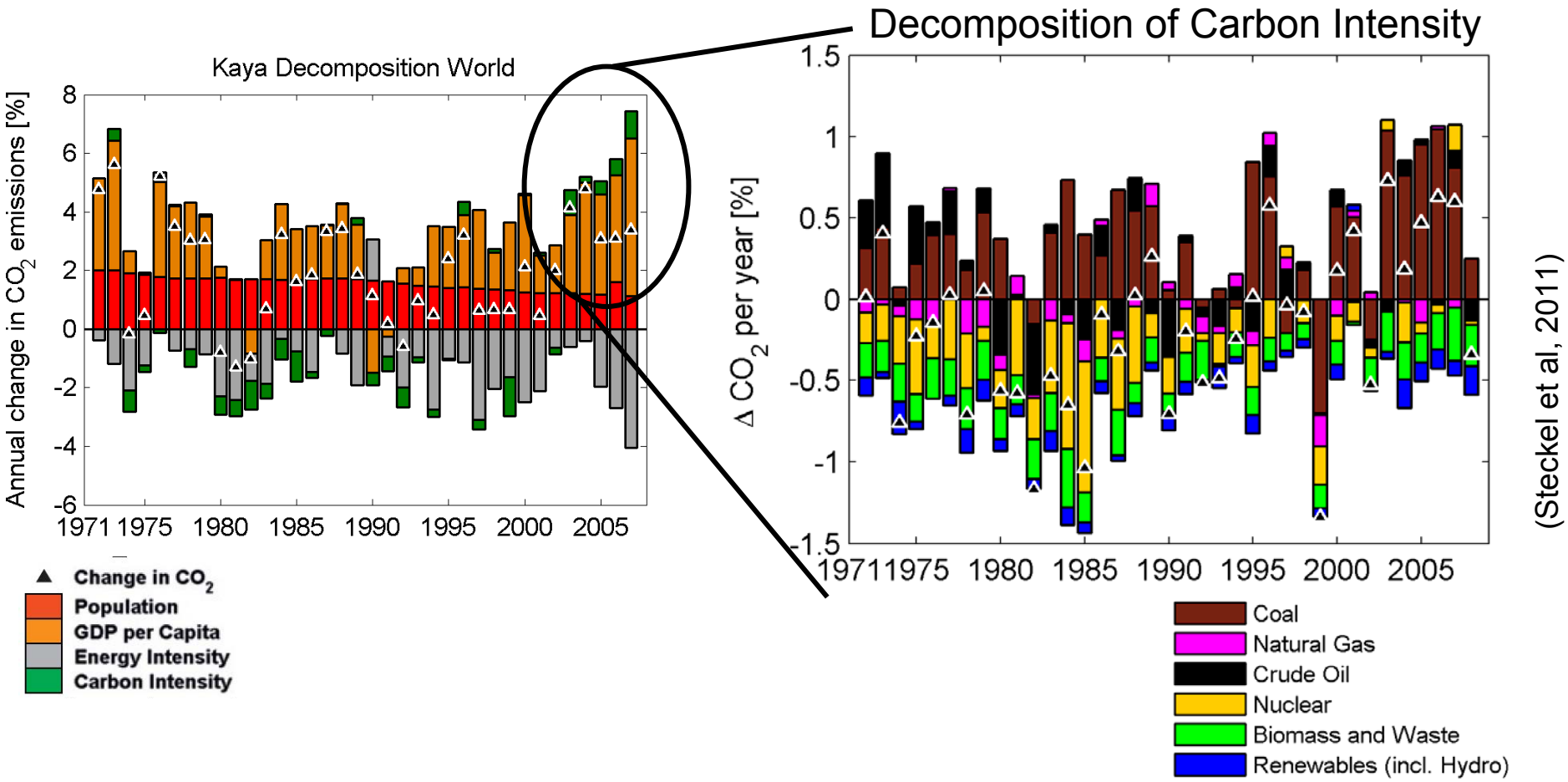


➡ Slower energy efficiency improvements and a growth surge, *not necessarily carbonisation*, explain China's explosion of emissions

China's large contribution to recent global emissions growth

(Steckel et al. 2011)

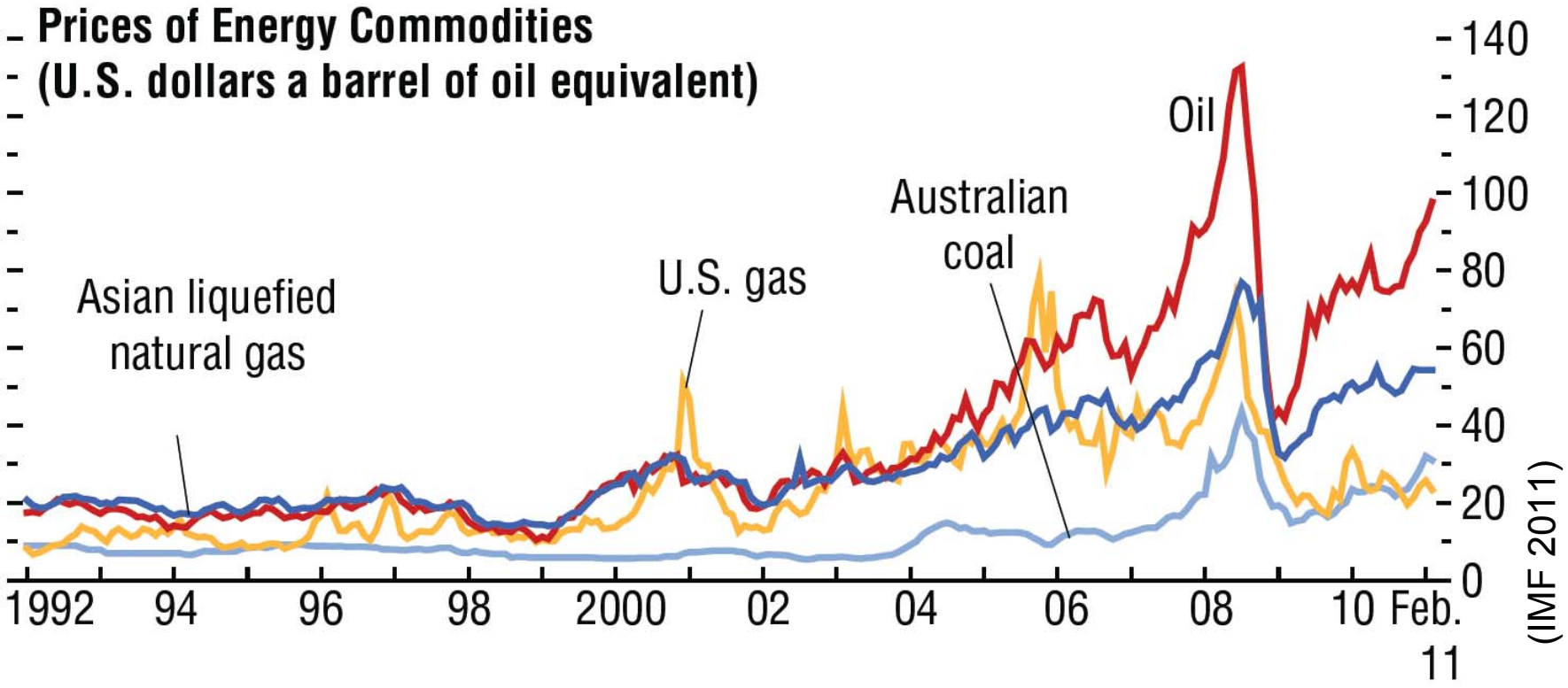
Economic Growth as Driver of CO_2 Emissions



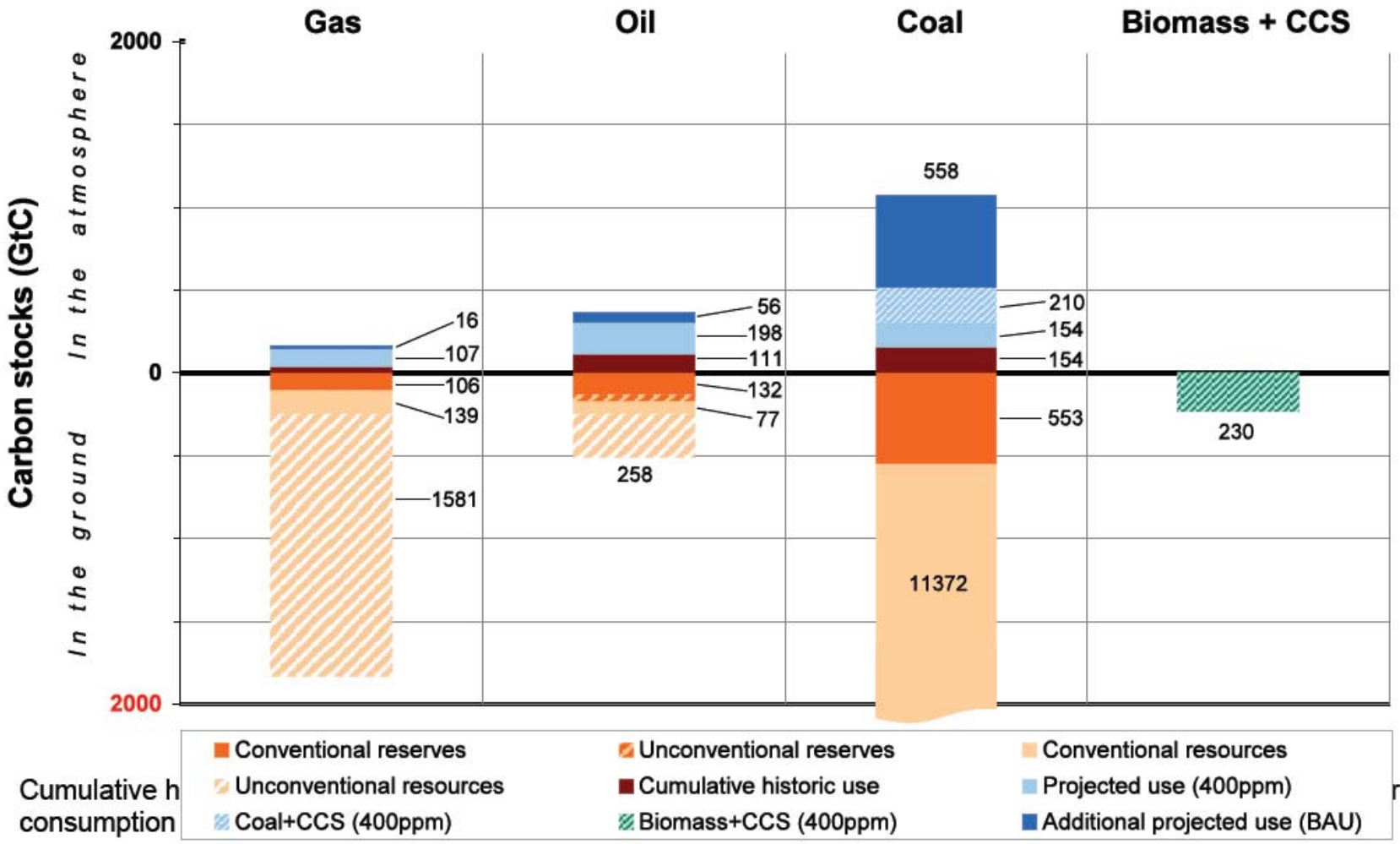
(Steckel et al, 2011)

Renaissance of Coal?

Renaissance of Coal?



Fossil Fuel Scarcity vs. Limited Atmospheric Space



Cumulative h re
consumption

Source: Kalkuhl. Edenhofer and Lessmann. 2009

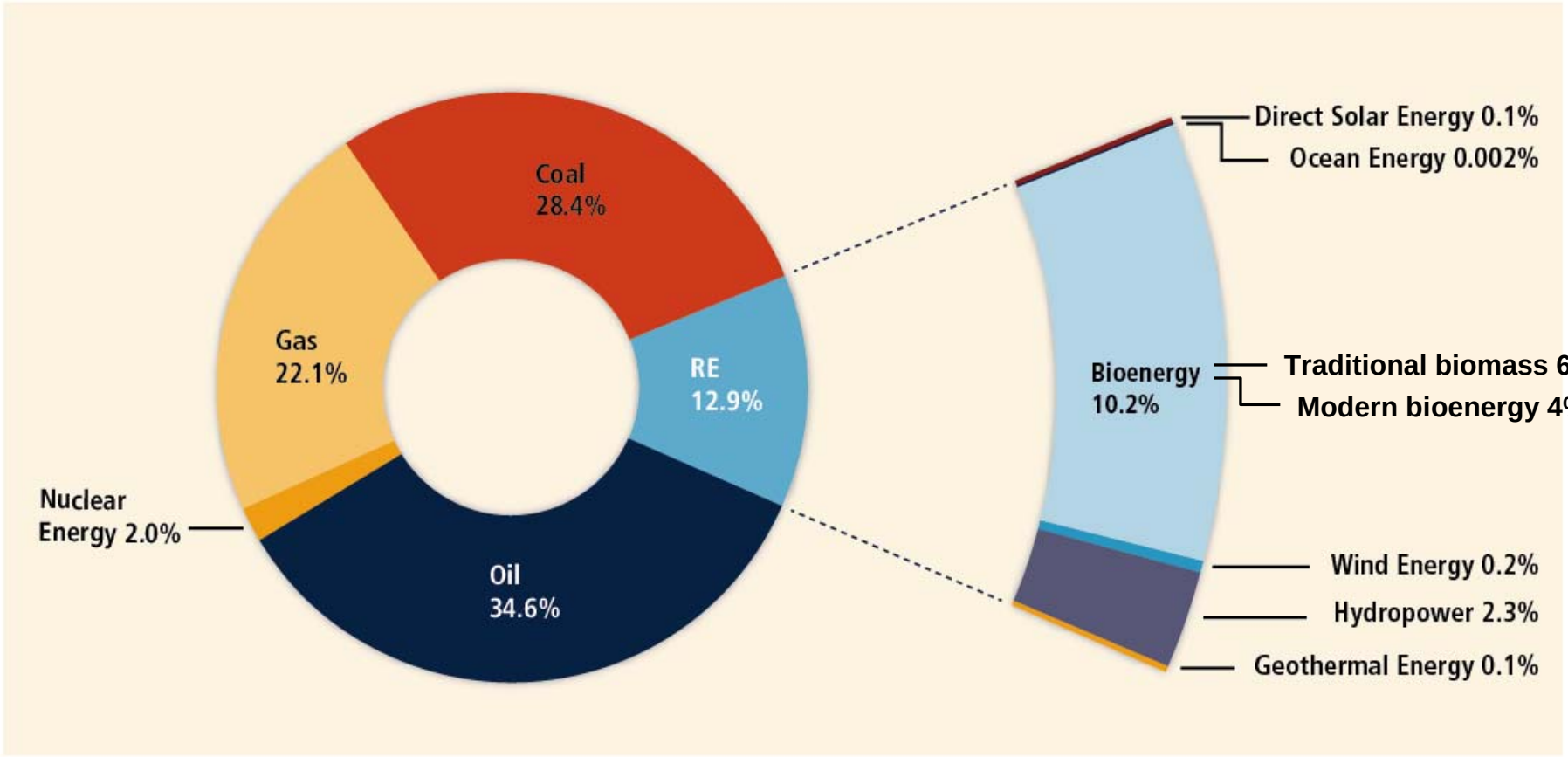
Conclusions 1st part

- Leapfrogging is not taking place

- Economic growth particularly in newly industrializing countries drives CO_2 emissions

The Energy System Transformation in the Context of Global Justice

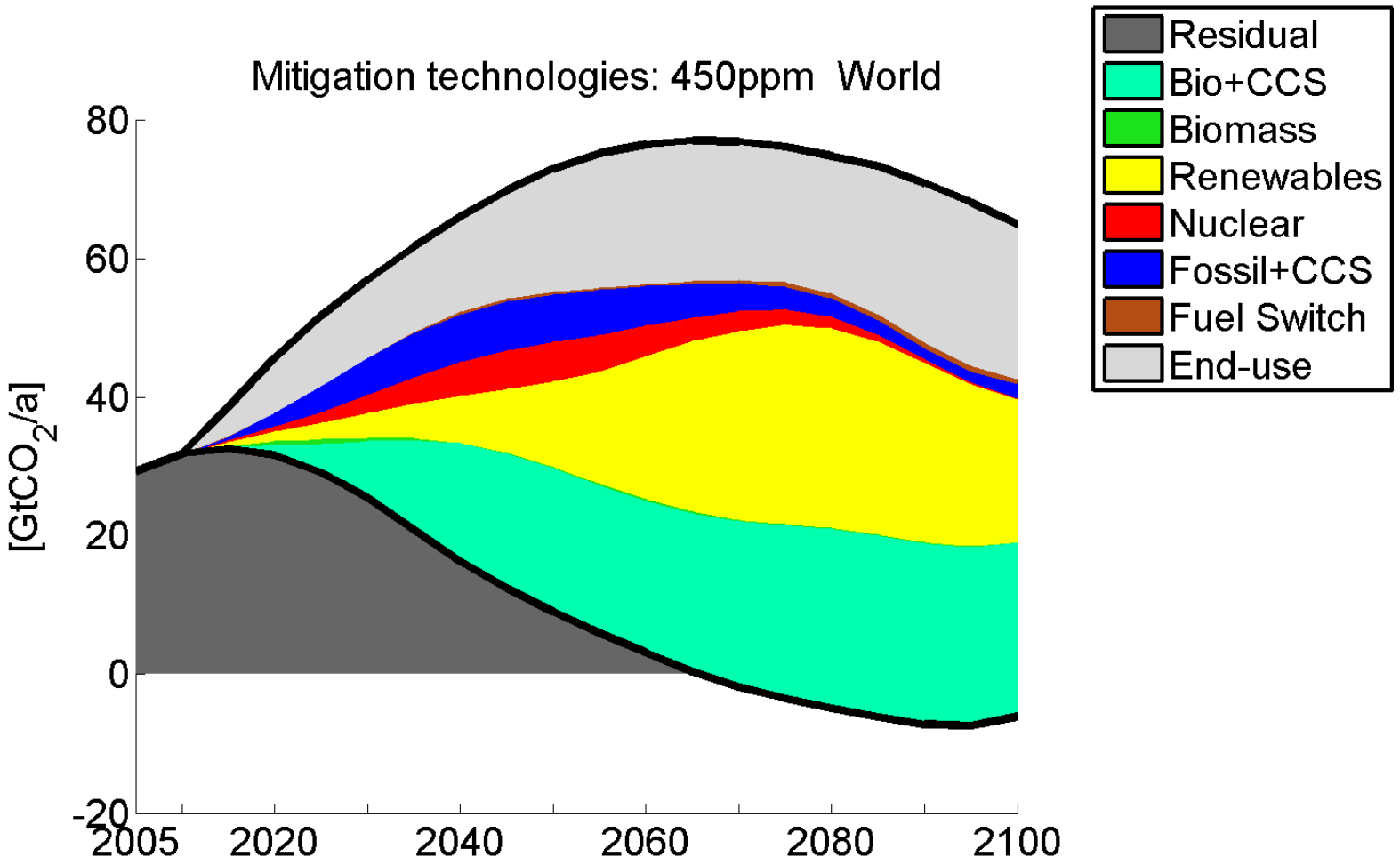
Fossil Fuels Dominate the World Energy System



Shares of Primary Energy Supply 2008

SRREN, Edenhofer et al. (2011)

Transformation of the Energy System



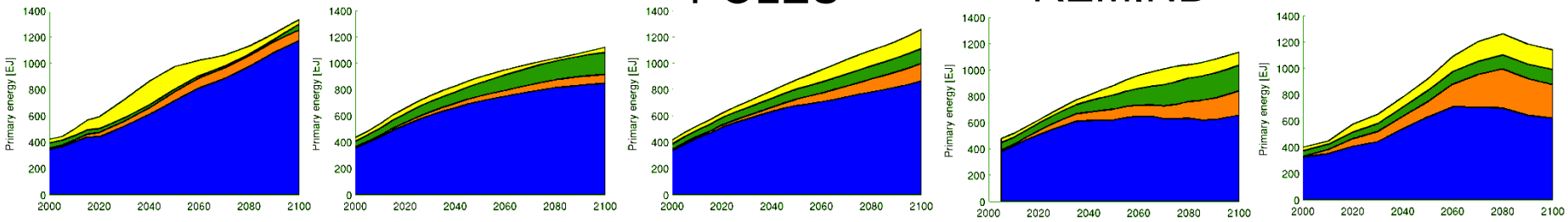
(Luderer et al., 2011)

Transformation of the Energy System

models →

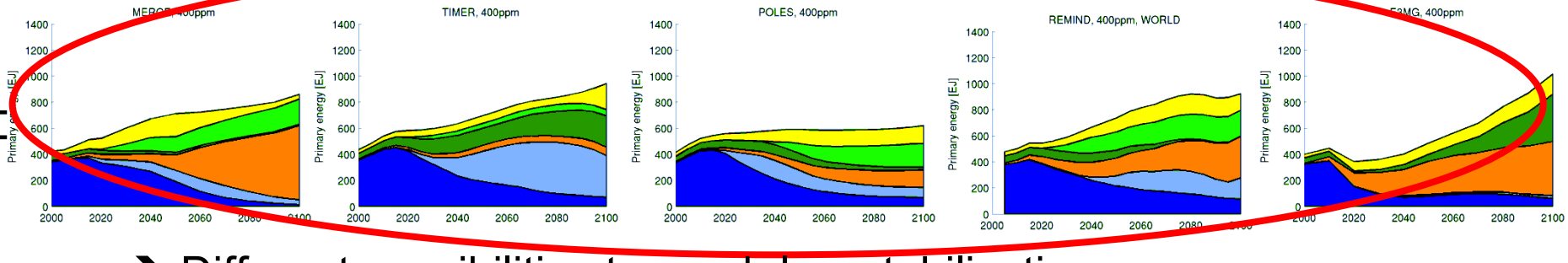
Baseline

MERGE | TIMER | POLES | REMIND | E3MG



Many different pathways to transform the energy system

400 ppm-eq

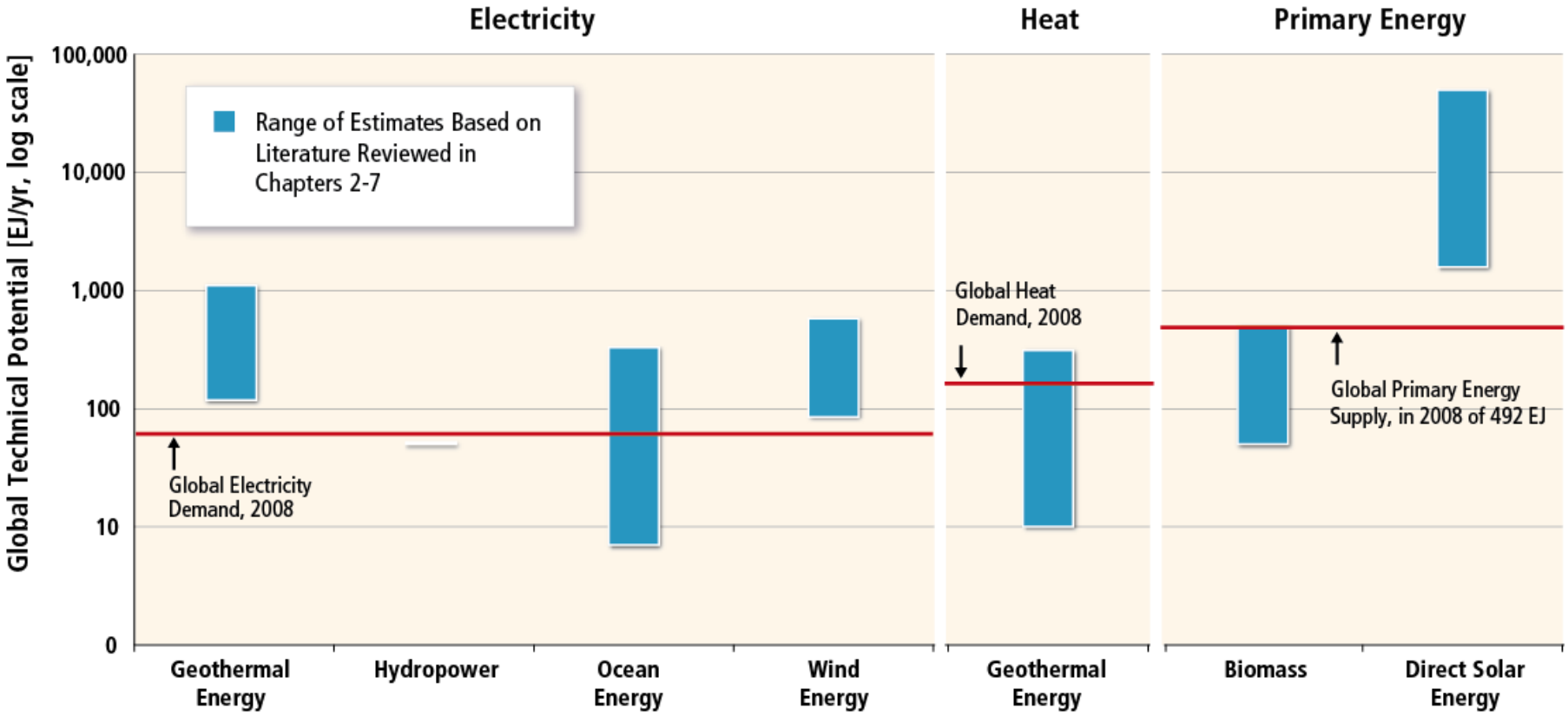


➔ Different possibilities to reach low stabilisation

➔ 400ppm can be achieved by all models

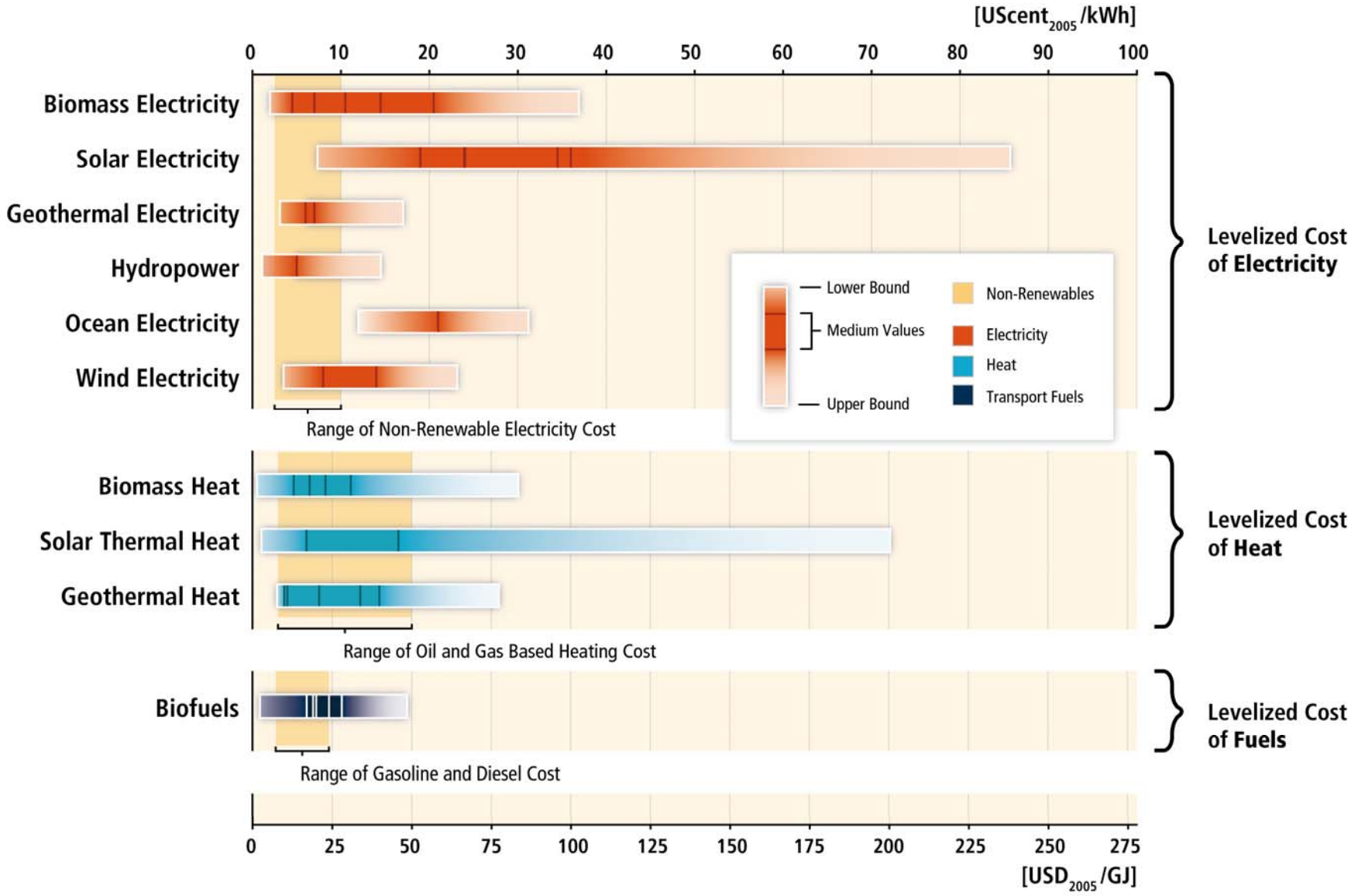
(Knopf et al. 2009)

Renewable Energy Potentials



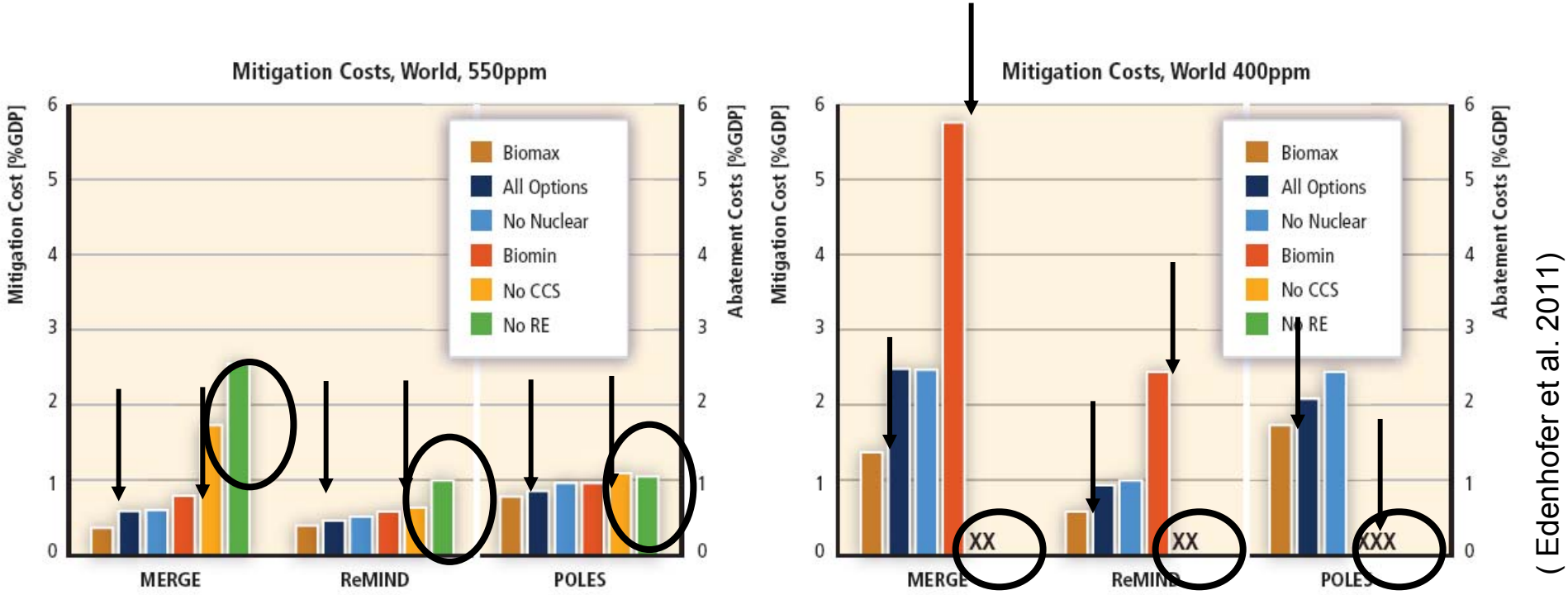
(Edenhofer et al. 2011)

Costs of Renewable Energy



(Edenhofer et al. 2011)

Costs of mitigation

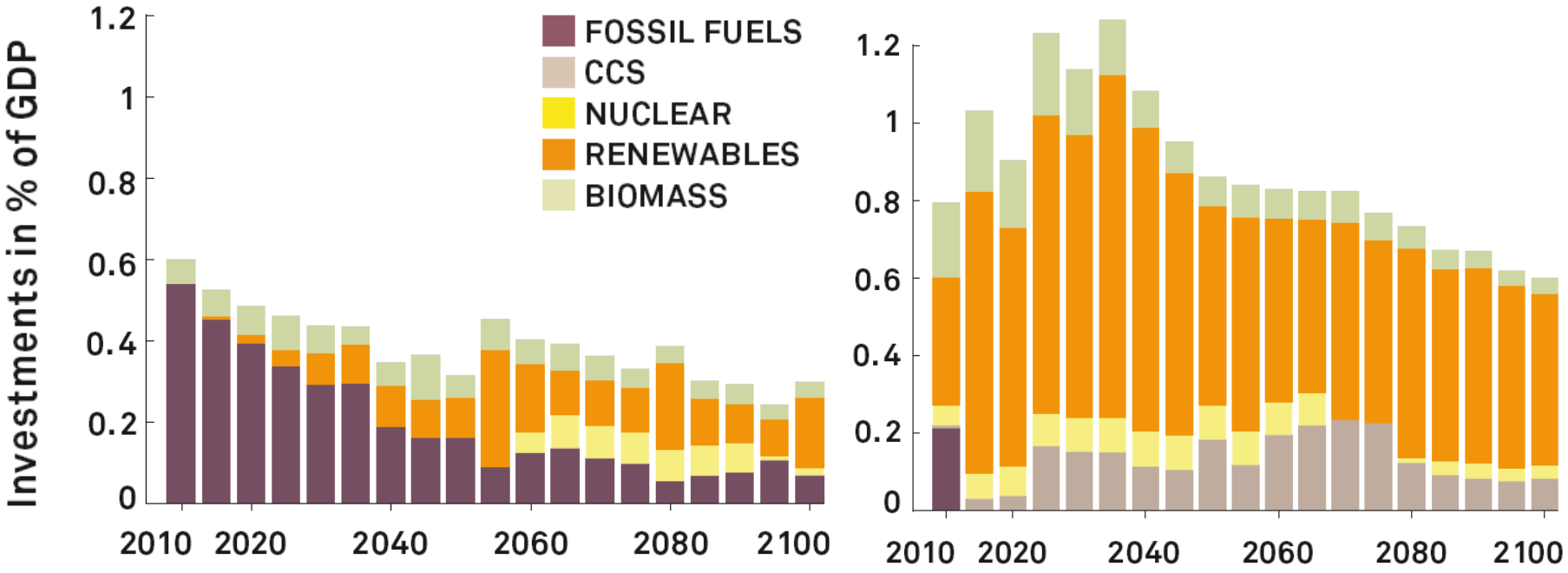


(Edenhofer et al. 2011)

Costs hinge critically on:

- The stabilization target
- The biomass potential
- The availability of technologies, RE and CCS in particular

Investment Requirements



business-as-usual

450ppm-CO_2

(Luderer et al. 2011)

How to finance mitigation in developing countries?

Non-market based mechanisms to disburse climate finance:

Coverage of incremental investment costs

Coverage of total mitigation costs

Market-based mechanisms (International Emissions Trading):

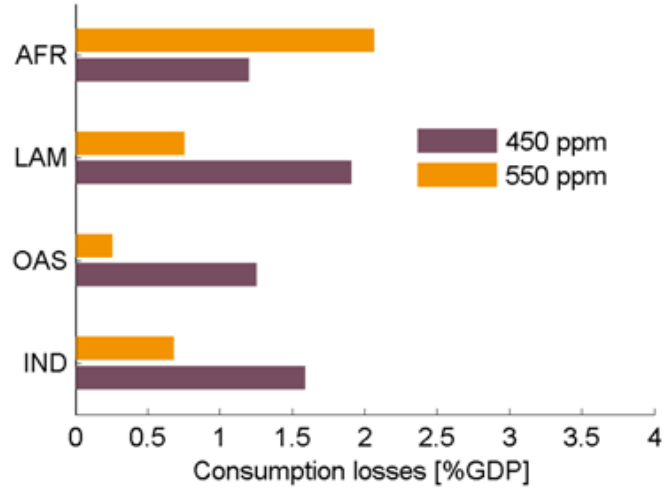
Grandfathering, or allocation proportional to GDP

Equal per capita allocation of permits

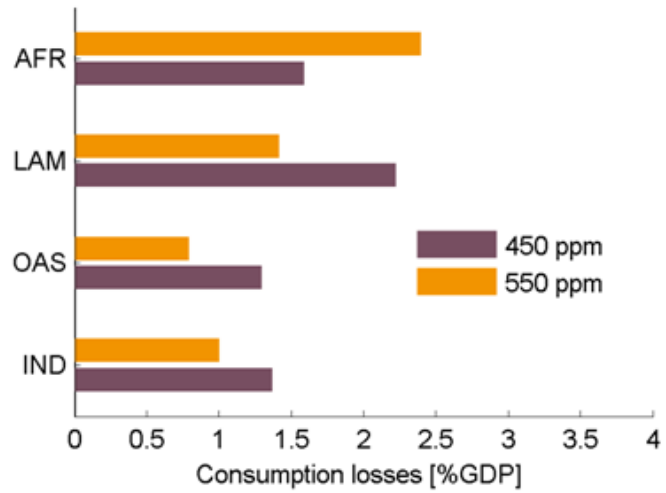
Contraction and Convergence

Non-Market Transfers

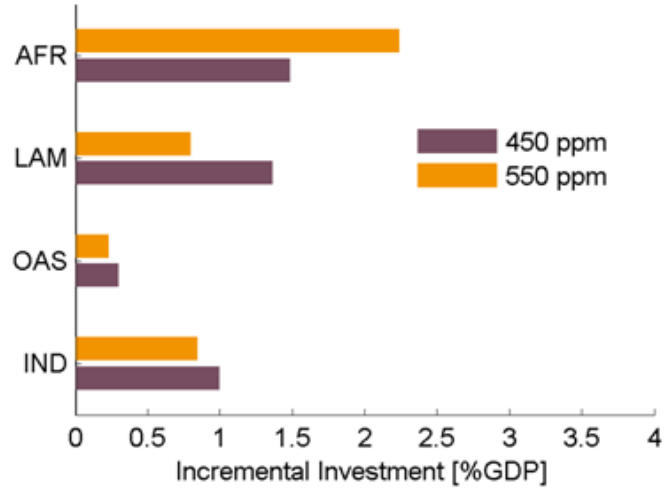
a) Mitigation costs 2020



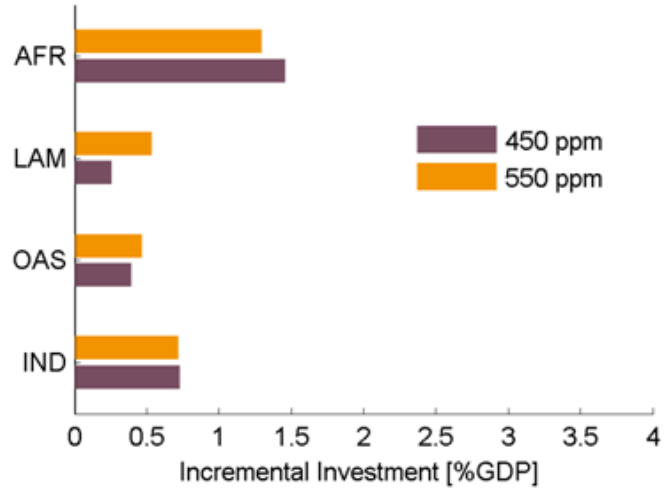
b) Mitigation costs 2050



c) Incremental investments 2020

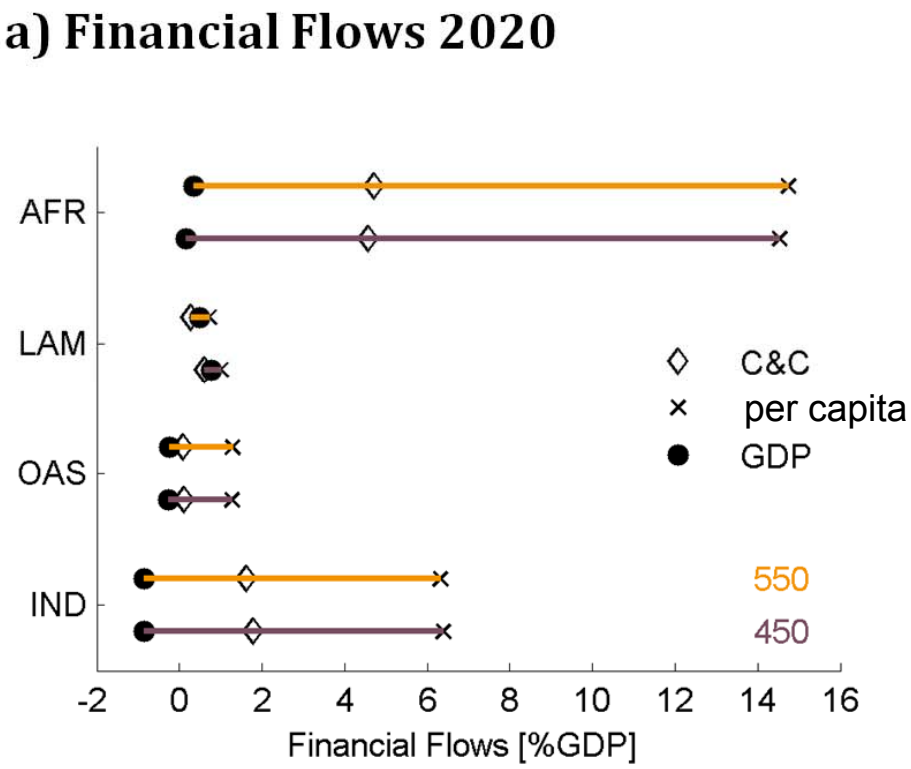


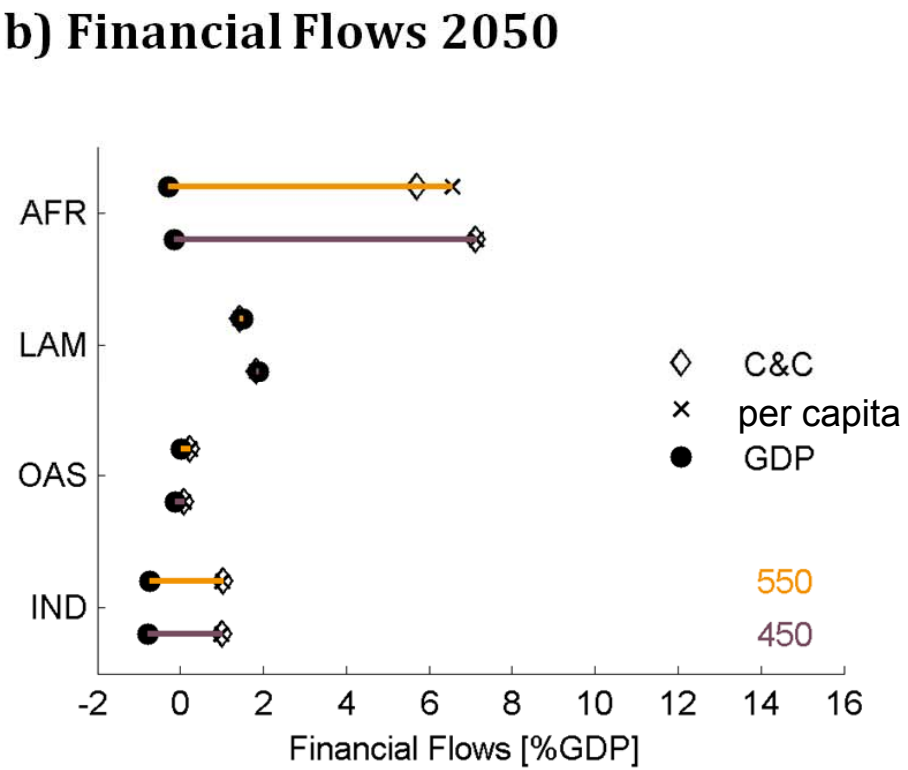
d) Incremental investments 2050



(Jakob et al, submitted.)

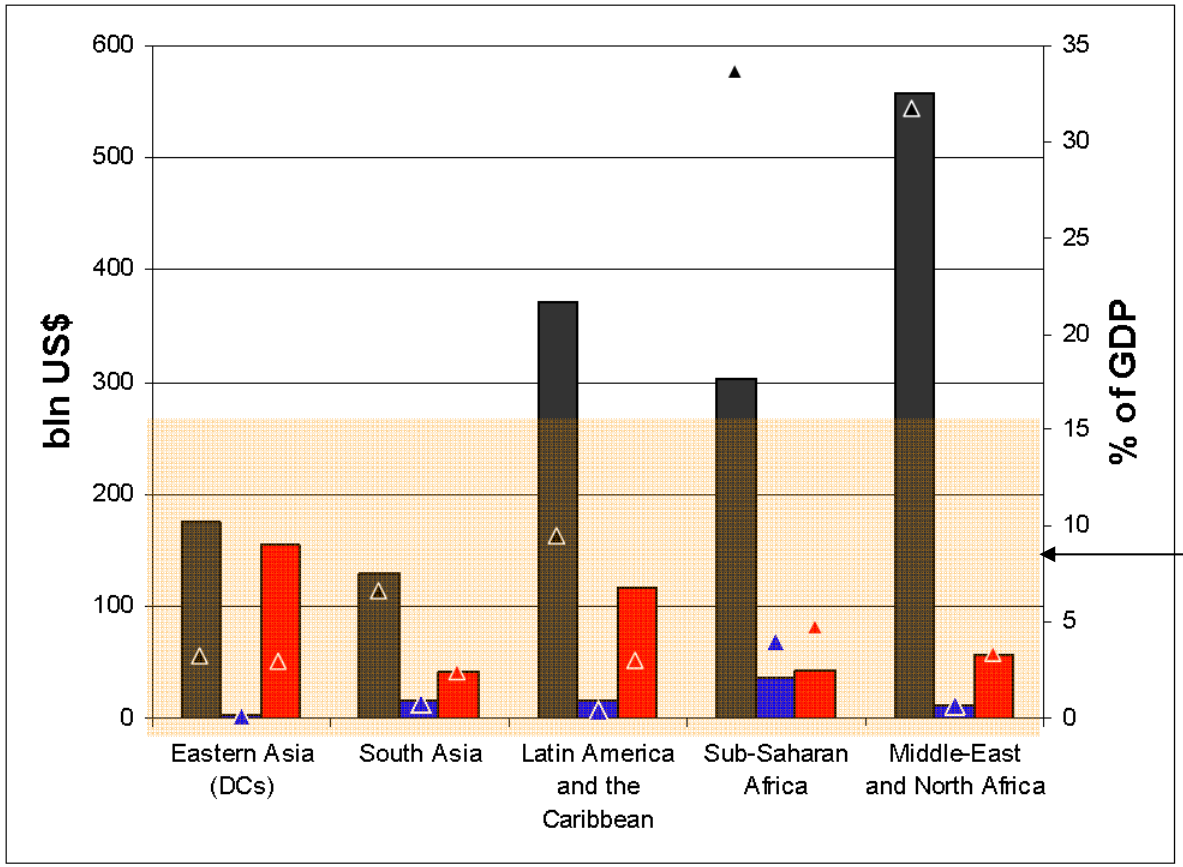
Emission Trading





(Jakob et al, submitted.)

Risk of Adverse Effects



Climate Finance Range [% of GDP]

- Resource Exports
- Foreign Aid
- FDI

Data
Resource Exports, FDI: Year 2009
Aid: Year 2008
ETS: ReMIND scenario Year 2020

How to Avoid a Climate Finance Curse?

- Possible problems with financial inflows: volatility, Dutch disease, rent-seeking
- Higher risk of climate finance curse with emissions trading; but problem to efficiently deliver non-market transfers
- Transfer of rents can be limited by appropriate choice of allocation; but might conflict with notions of equity
- Properly designed institutions can reduce risk of climate finance curse (e.g. price corridors, sovereign wealth funds, civil society involvment)

Conclusions 2nd part

- Leapfrogging is not taking place
- Economic growth particularly in newly industrializing countries drives CO_2 emissions
- A structural transformation of the energy system is possible at modest costs (according to state-of-the art models); but without historical precedent
- How to design climate policy in developing countries is a key issue

Climate Policy, Poverty, and Equity

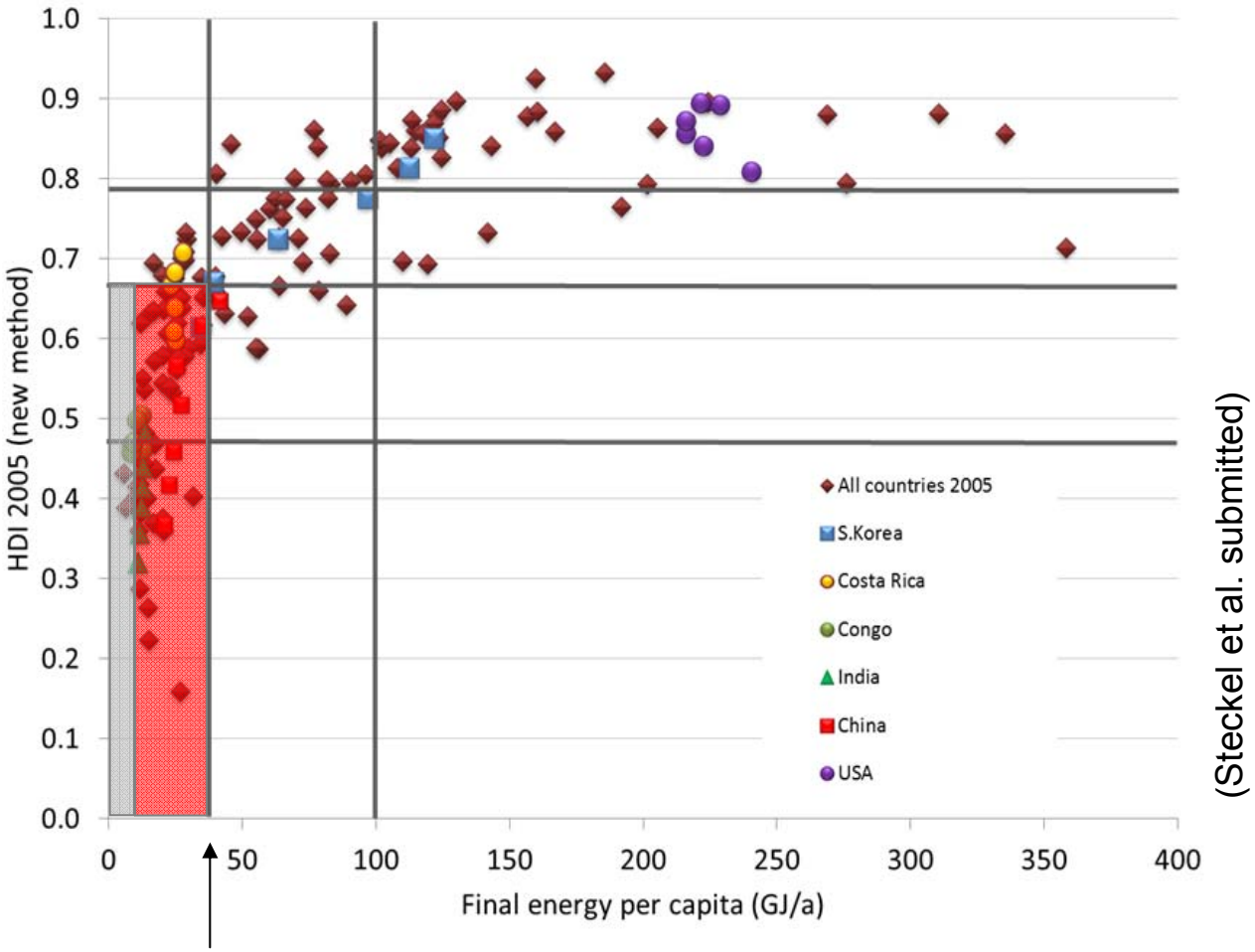
Energy Access

REGION	2009		
	Rural	Urban	Total
Africa	466	121	587
Sub-Saharan Africa	465	120	585
Developing Asia	716	82	799
China	8	0	8
India	380	23	404
Other Asia	328	59	387
Latin America	27	4	31
Developing Countries[1]	1,229	210	1,438
World[2]	**1,232**	**210**	**1,441**

Number of people (millions) without access to electricity

(Edenhofer et al. 2011)

Energy and Human Development Index

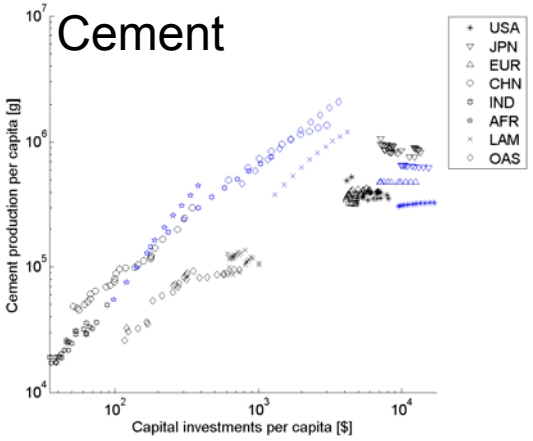


(Steckel et al. submitted)

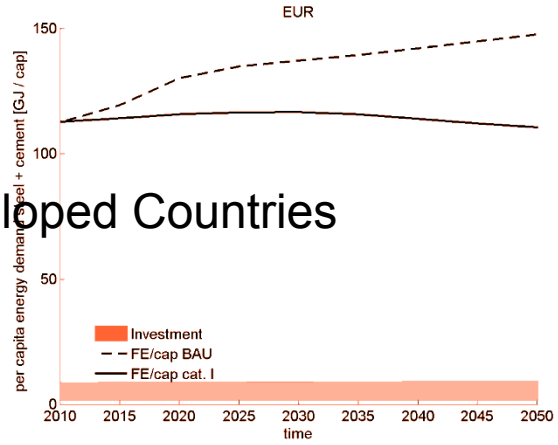
Threshold at around 40 GJ per capita

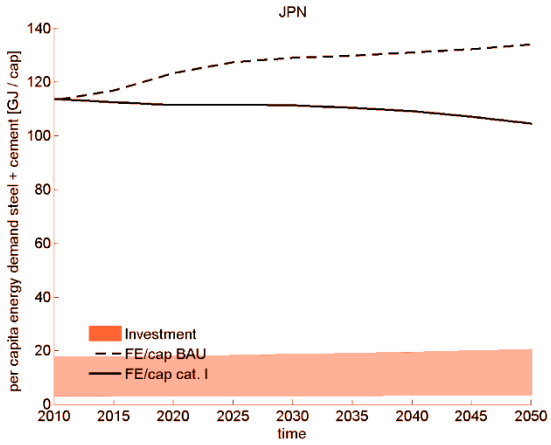
10 GJ per capita can be explained by subsistence needs (e.g. Pereira et al. 2011)

Infrastructure needs can explain parts of the gap

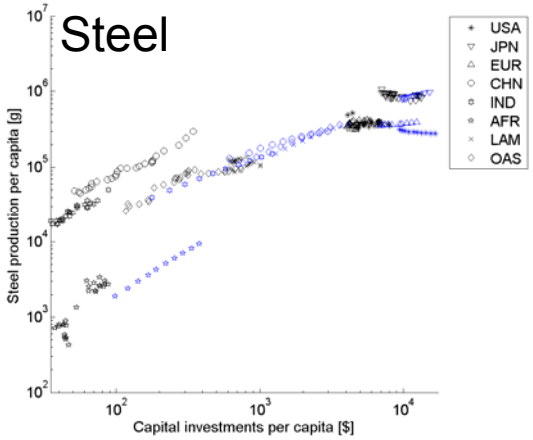


Developed Countries

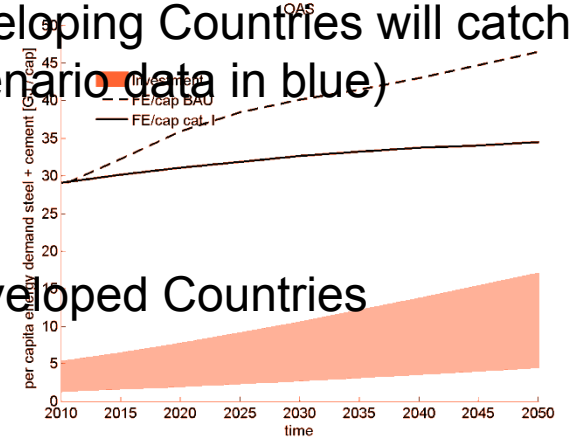


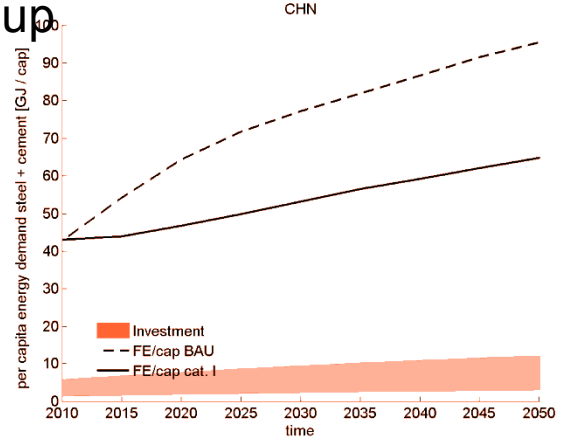


Developing Countries will catch up
(Scenario data in blue)



Developed Countries

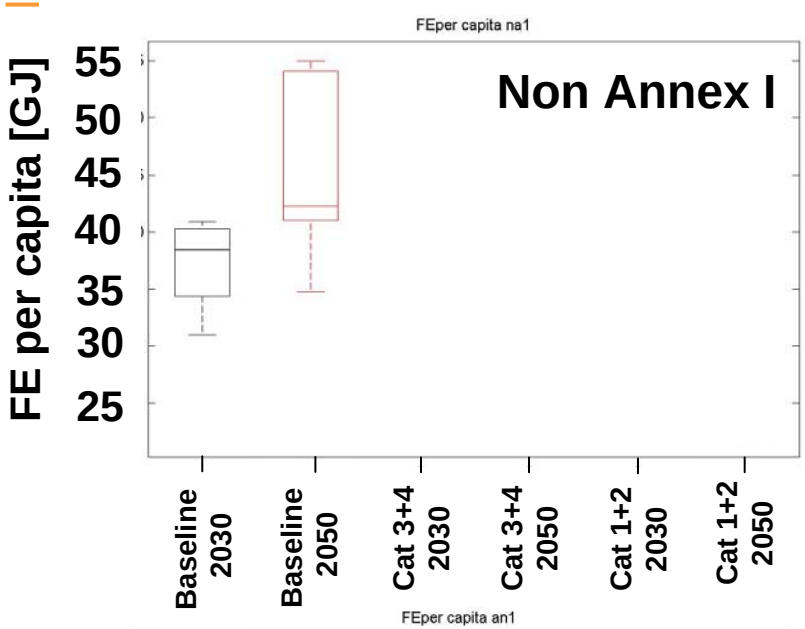


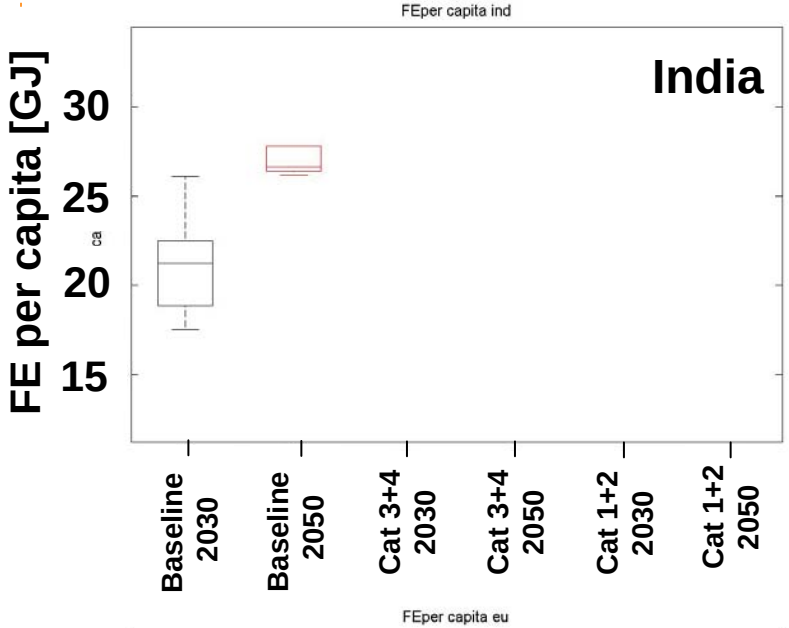


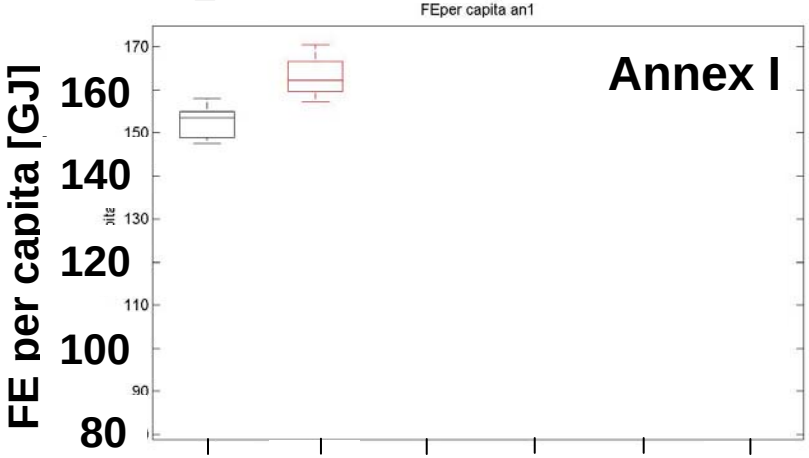
A per capita energy demand of 10 to 20 GJ in developed countries seems to be stable given today's technologies.

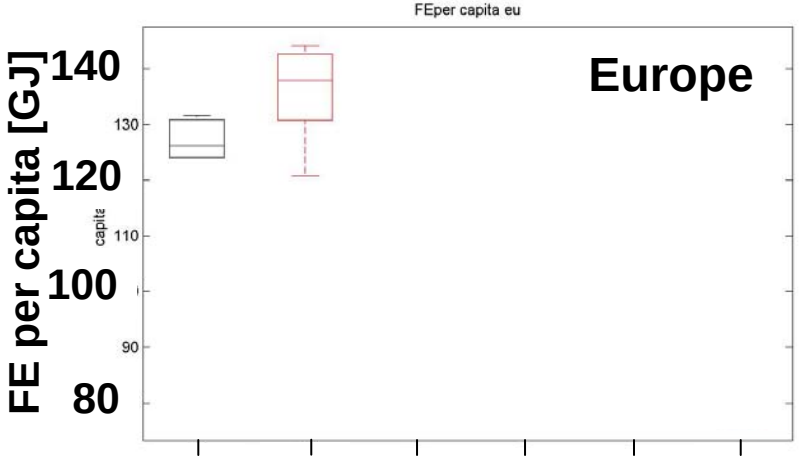
(Steckel et al. submitted)

Model results



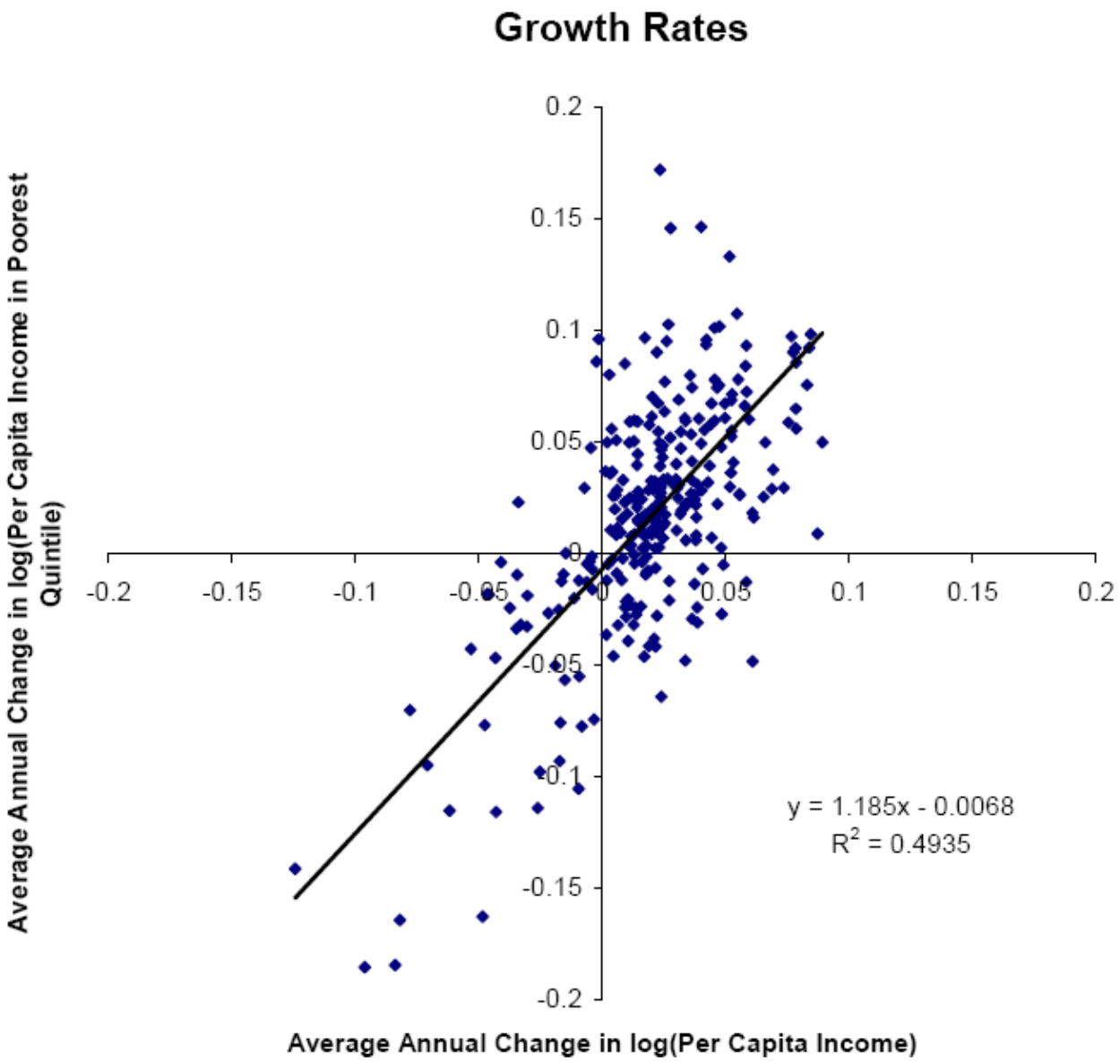






IAMs predict large scale reduction of energy use
In developing countries!

Can climate policy impact growth?



(Dollar and Kray, 2002)

Mitigation trap in a Solow model

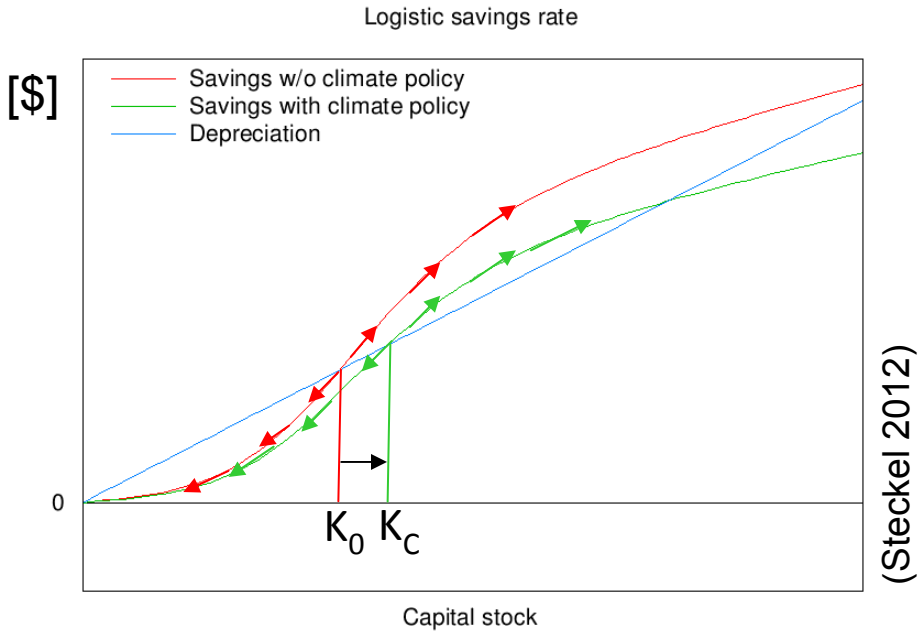
Production function:

$$Y = \beta \cdot k^{\alpha}$$

Capital formation:

$$\dot{k} = k + s(k) \cdot Y - \delta k$$

In the case of climate policy β decreases.



The trap gets more likely in the presence of climate policy in the form of βK(s) [Independent from the form of the function s(k)]

Conclusions 3rd part

- Leapfrogging is not taking place
- Economic growth particularly in newly industrializing countries drives CO_2 emissions
- A structural transformation of the energy system is possible at modest costs (according to state-of-the art models); but without historical precedent
- How to design climate policy in developing countries is a key issue

- Infrastructure can next to subsidiary needs explain an energy threshold for development

- For low development levels climate policy might have the potential to induce a poverty trap

→ Further research needed !

Thank you for your attention!