POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

Development perspectives of Sub-Saharan Africa under climate policies

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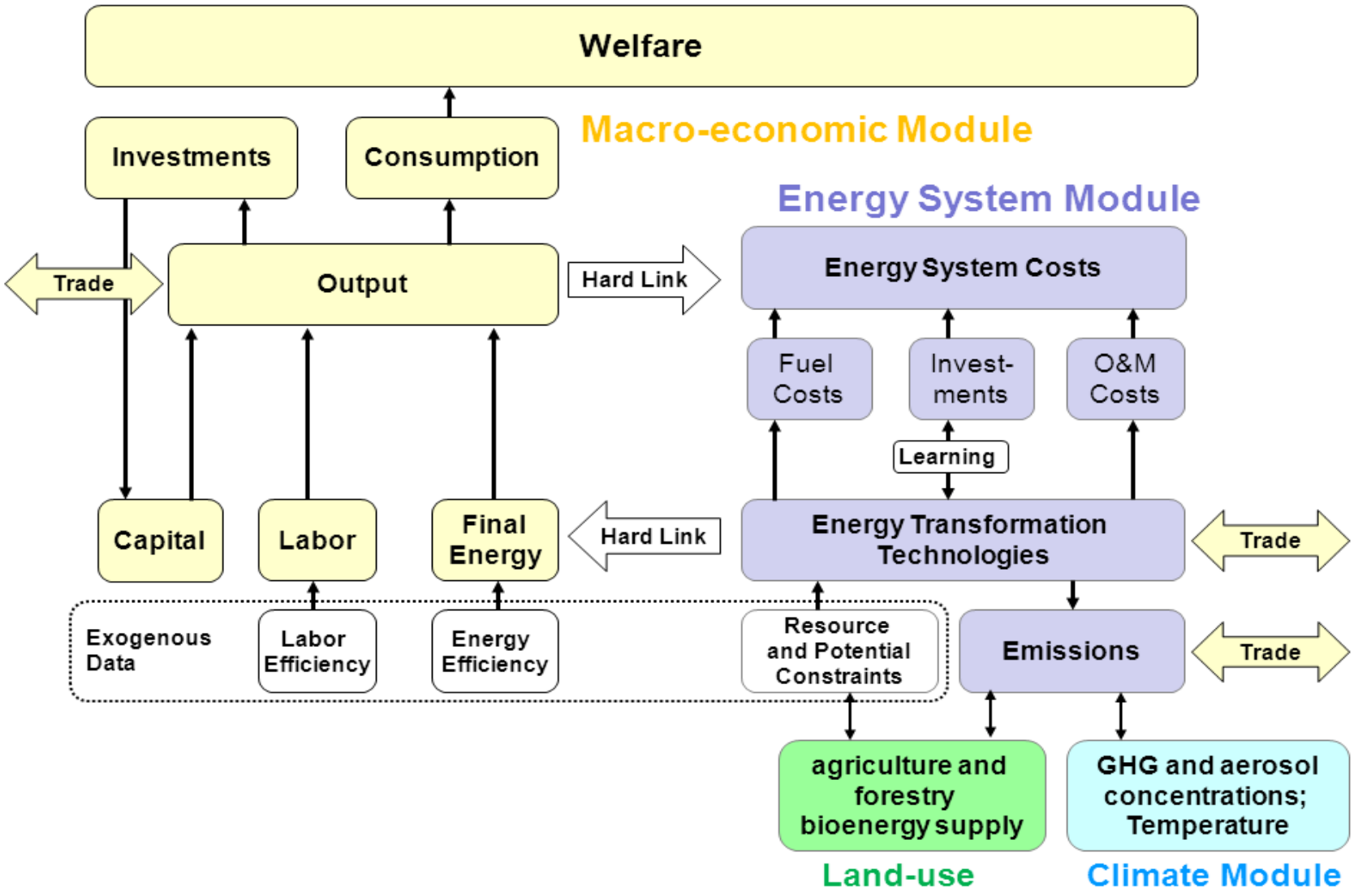
Research Questions

- **Reduction of global greenhouse gas emissions at acceptable costs requires the inclusion of developing countries into a climate policy regime**
- **Developing countries fear to suffer in terms of economic growth and domestic wealth**
- **Does climate policy slow economic growth of Sub-Saharan Africa (SSA)?**
- **Cheap fossil based development or transition based on renewables?**
- **Technology diffusion and cooperation matters**
- **Equity matters: Without enhancing global equity, greenhouse gas emissions will not significantly be reduced**
- **How to respect legitimate interest to increase material wealth and opening the way for SSA to join the global coalition that strives to stop climate change?**

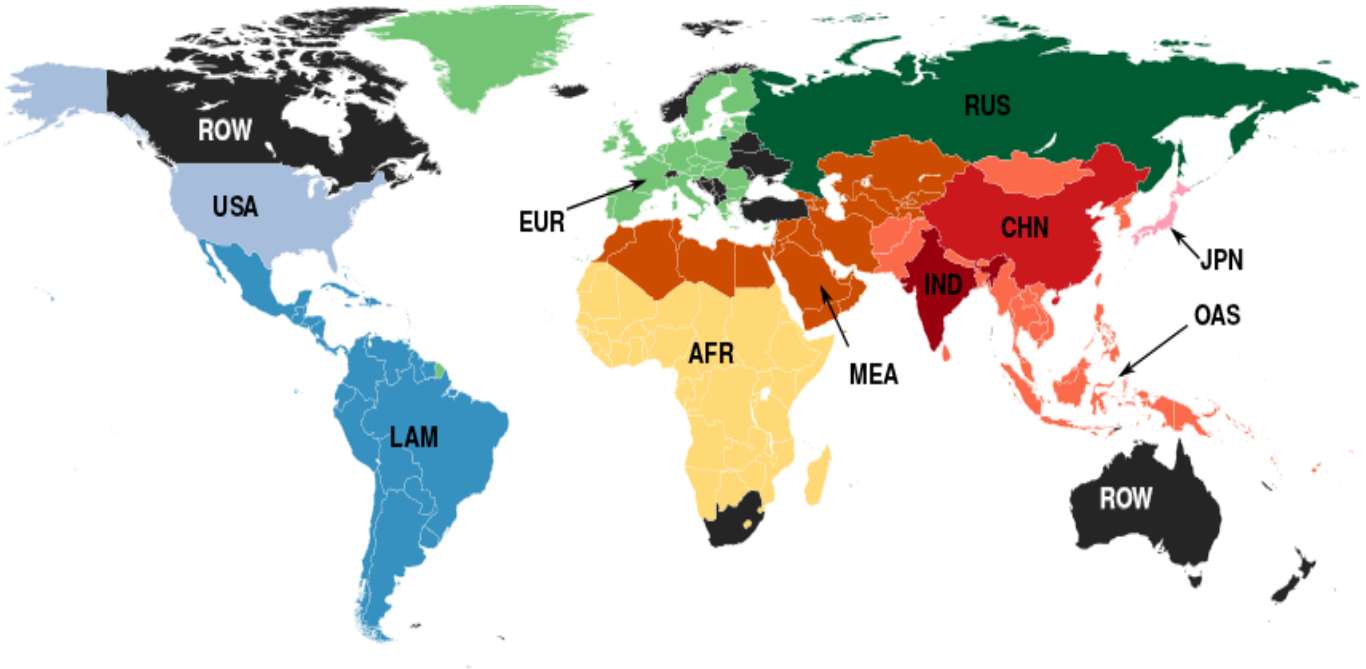
Research Method

- **Integrated Assessment (REMIND model)**
- **Scenario analysis along three dimensions:**
  1. **Climate stabilization target**
  2. **Cooperation**
  3. **Burden Sharing**
- **Ex-post analysis of distributional effects**

Schematic Overview of REMIND



Region Definition



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Scenario Matrix

Climate target	Cooperation		Allocation		
			Equal marginal abatement costs	Population share	Per capita convergence
Baseline		BAU			
450 ppm	Cooperative		450TAX	450POP	450CC
550 ppm			550TAX	550POP	550CC
450 ppm	Non-cooperative		450SPA		
550 ppm			550SPA		

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Scenario Design

Technological cooperation:

- Anticipation of external effect of investment into learning technologies

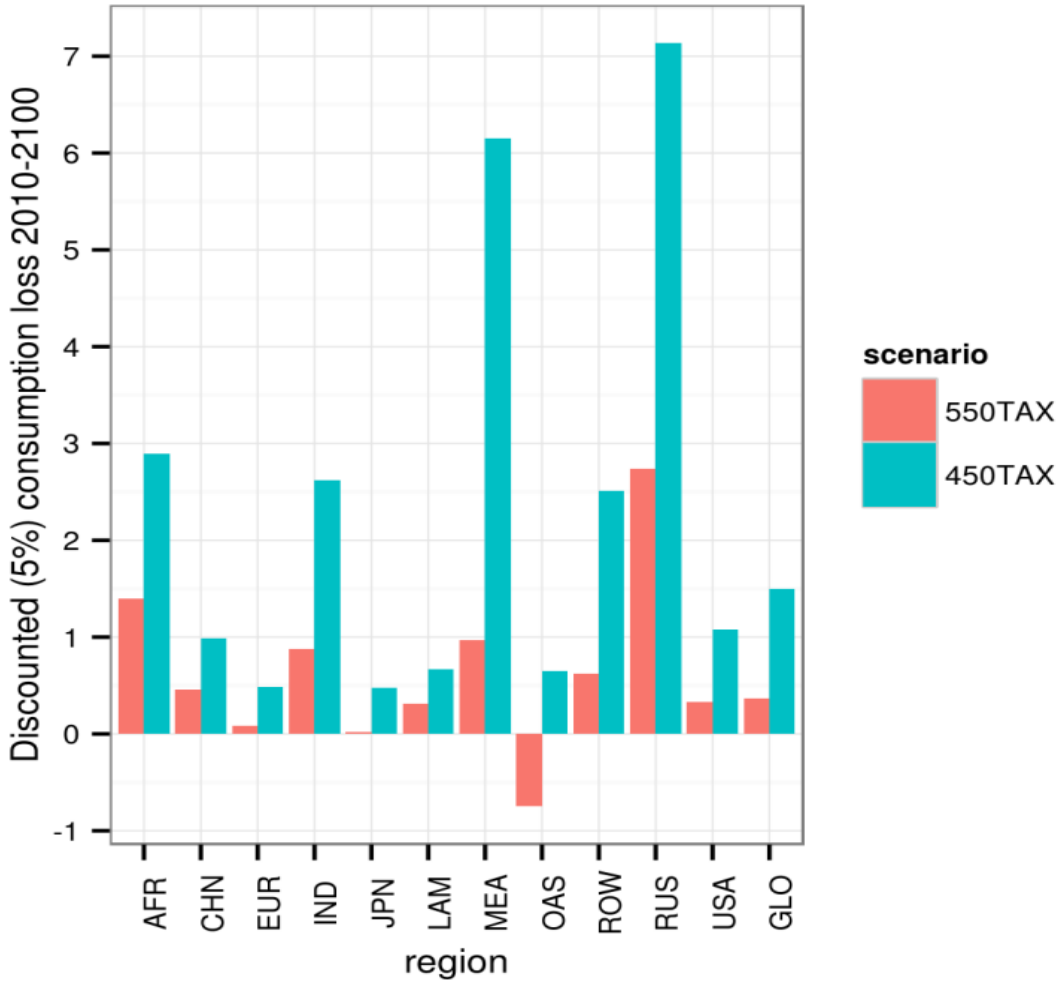
Climate policy cooperation:

- global climate policy regime (uniform carbon tax/global cap-and-trade regime) vs.
- Delayed action: fragmented climate policy regime (regional carbon taxes until 2040)

Burden sharing

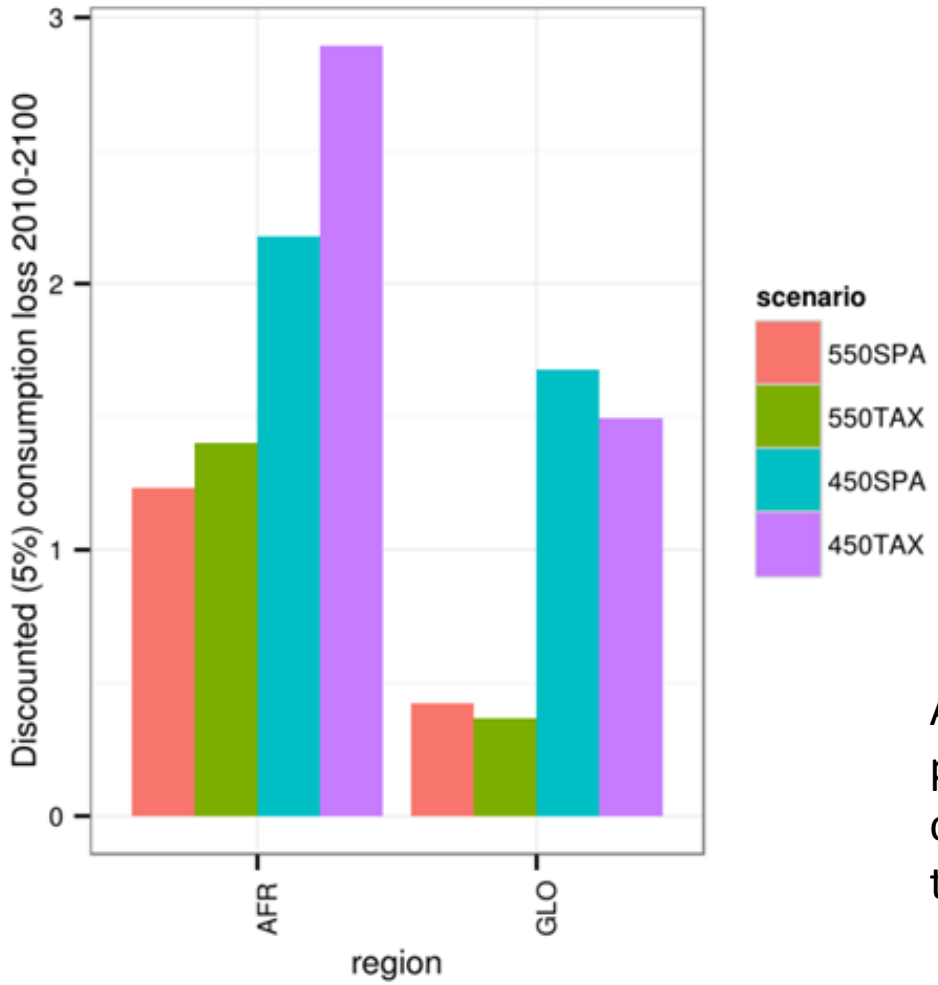
- Equal marginal abatement costs (= global carbon tax)
- Per capita convergence
- Cumulated population share (novel)

Mitigation Costs (I) – Ecological Dimension



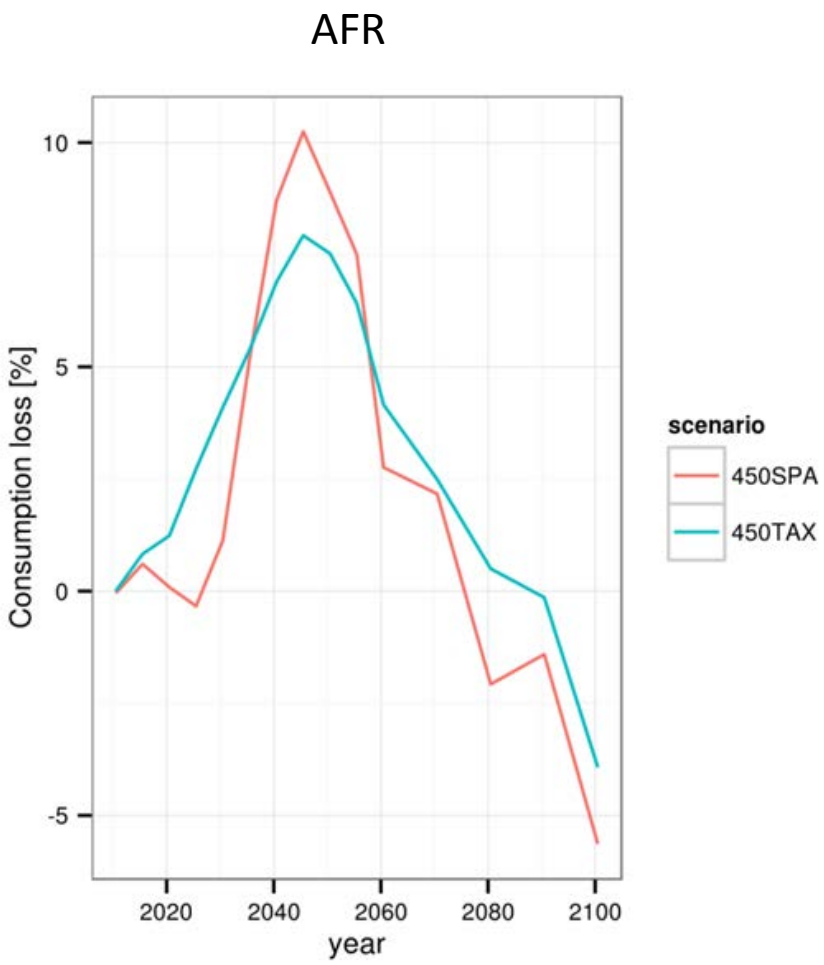
Above global average mitigation costs in AFR

Mitigation Costs (II) – Cooperation Dimension



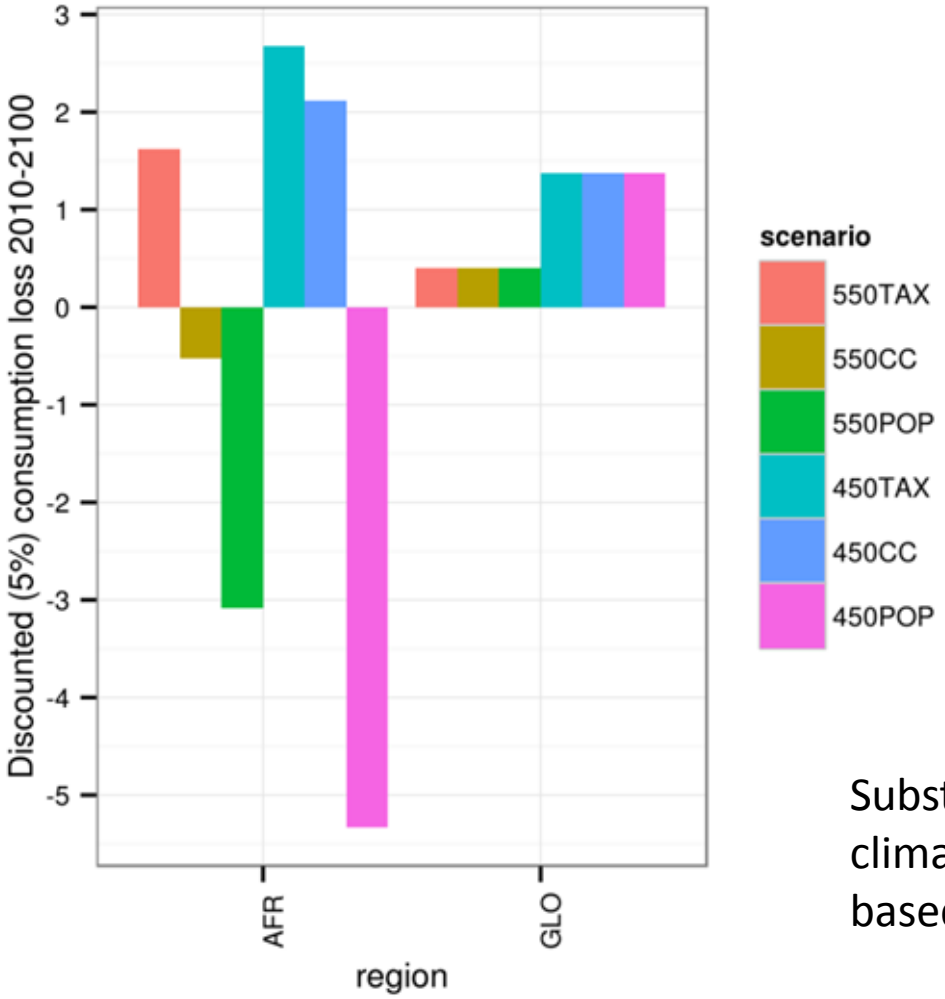
AFR profits from fragmented policy regime due to low initial carbon price and higher long-term demand for biomass

Mitigation Costs (II) – Cooperation dimension



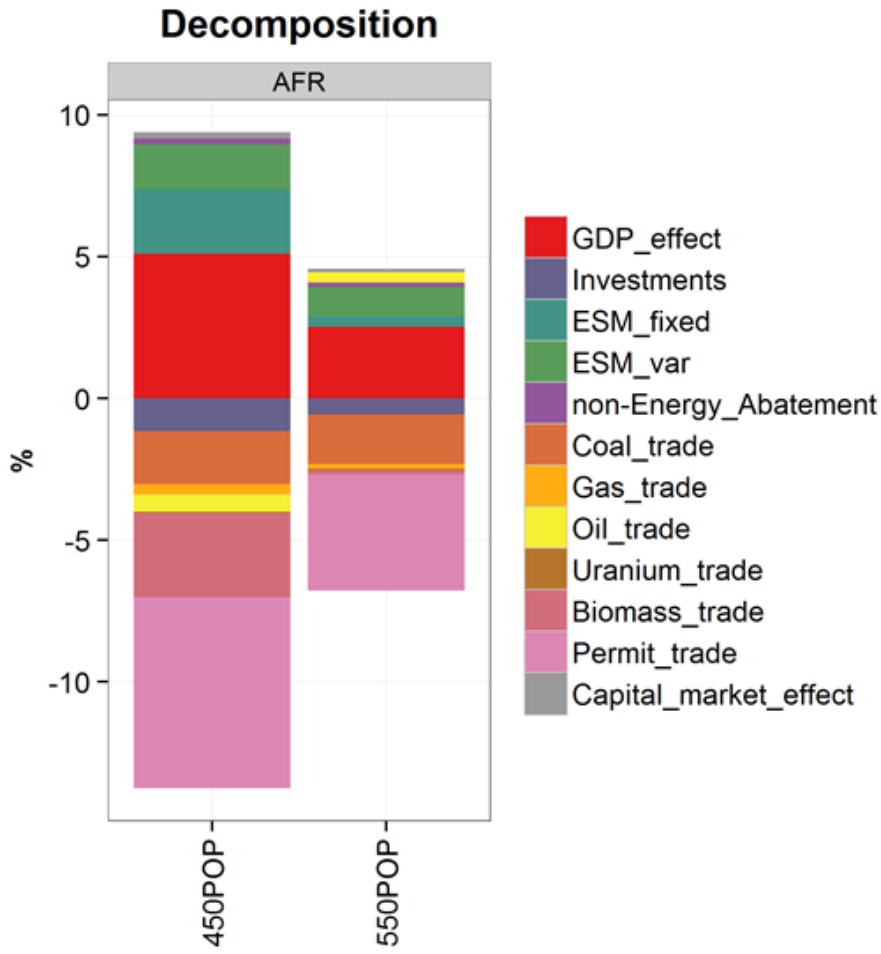
Fragmented policy regime implies more extreme intergenerational burden sharing

Mitigation Costs (II) – Allocation dimension



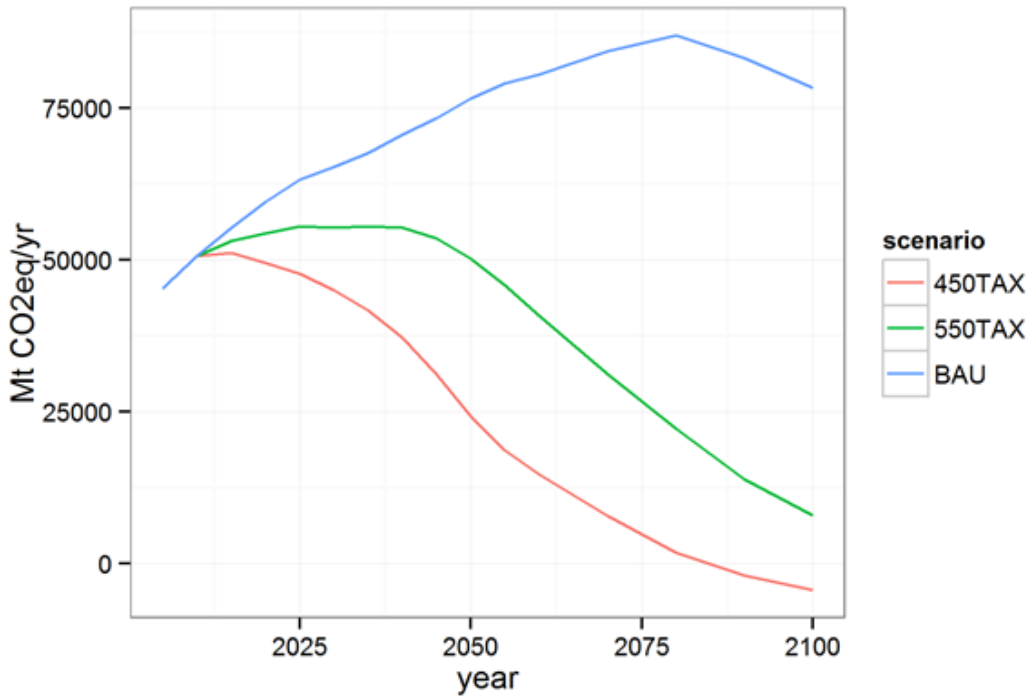
Substantial gains under cap-and-trade climate policy regimes with equity-based permit allocation

Decomposition of mitigation costs

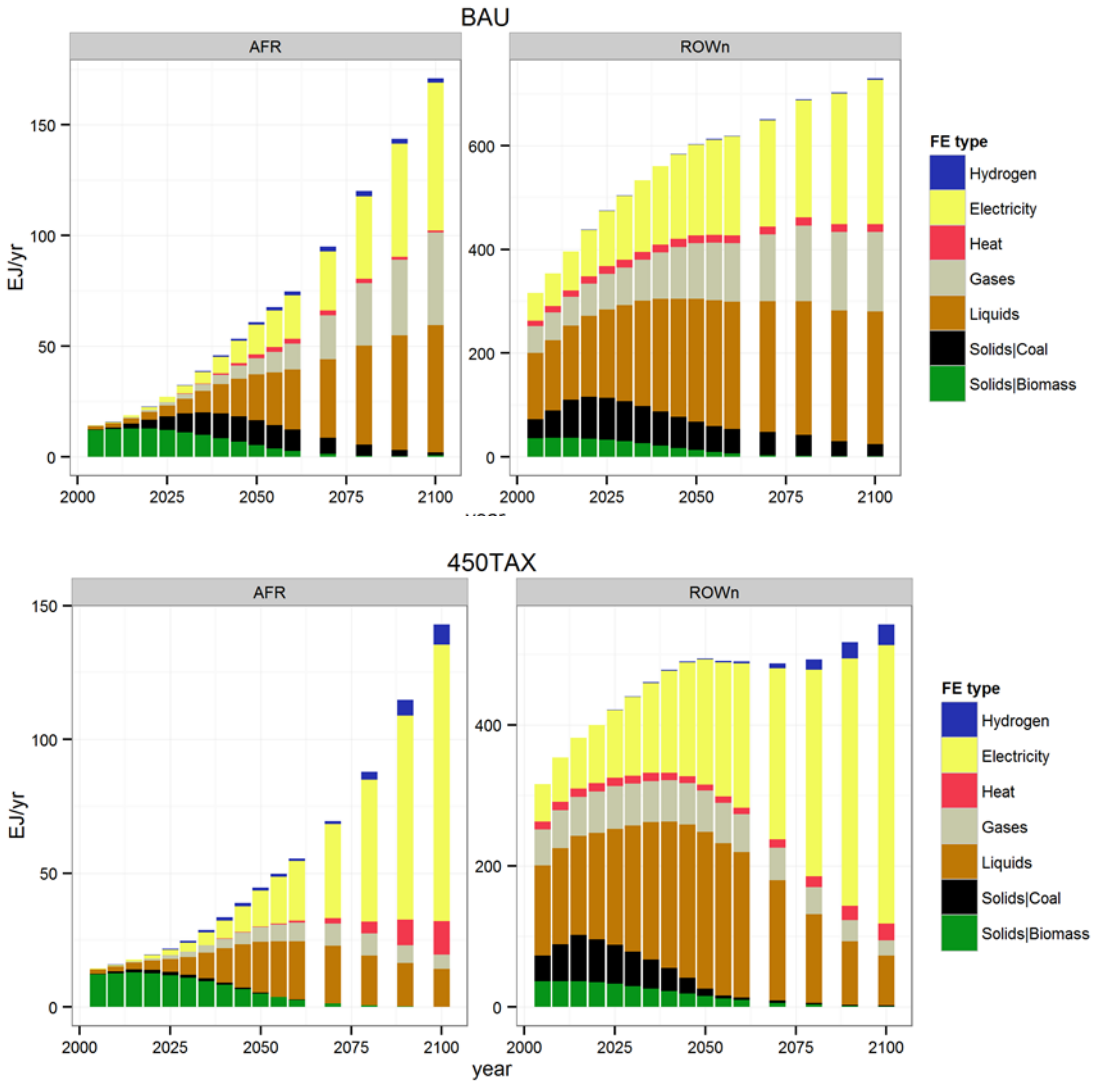


GDP losses and higher energy system costs are overcompensated by revenues from biomass exports and sales of emission permits

Global GHG Emissions



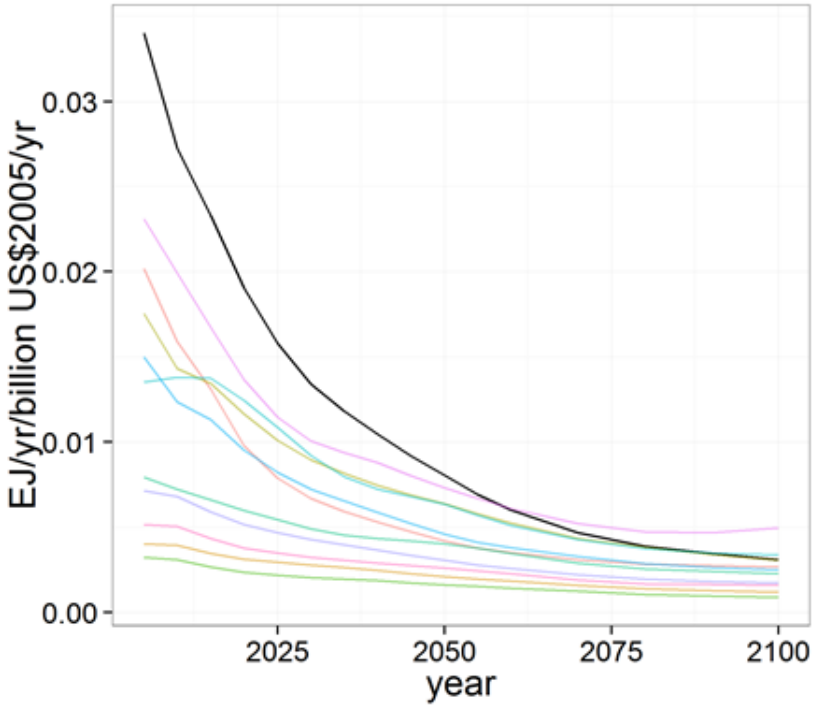
Final Energy Consumption



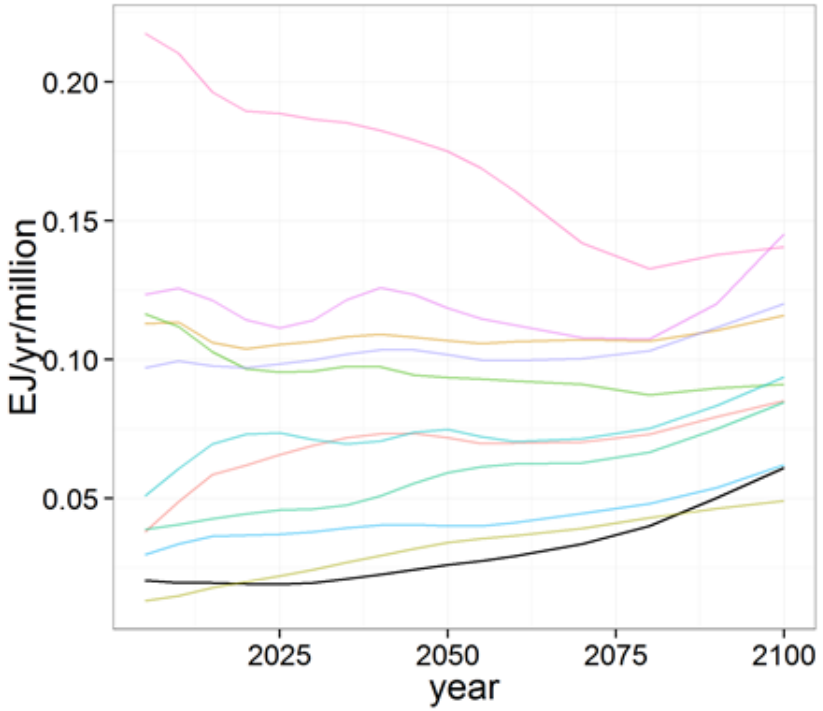
- 20% less final energy consumption as of 2050
- Electricity share in 2100 around 70% (40% in baseline)

Final Energy

Energy intensity

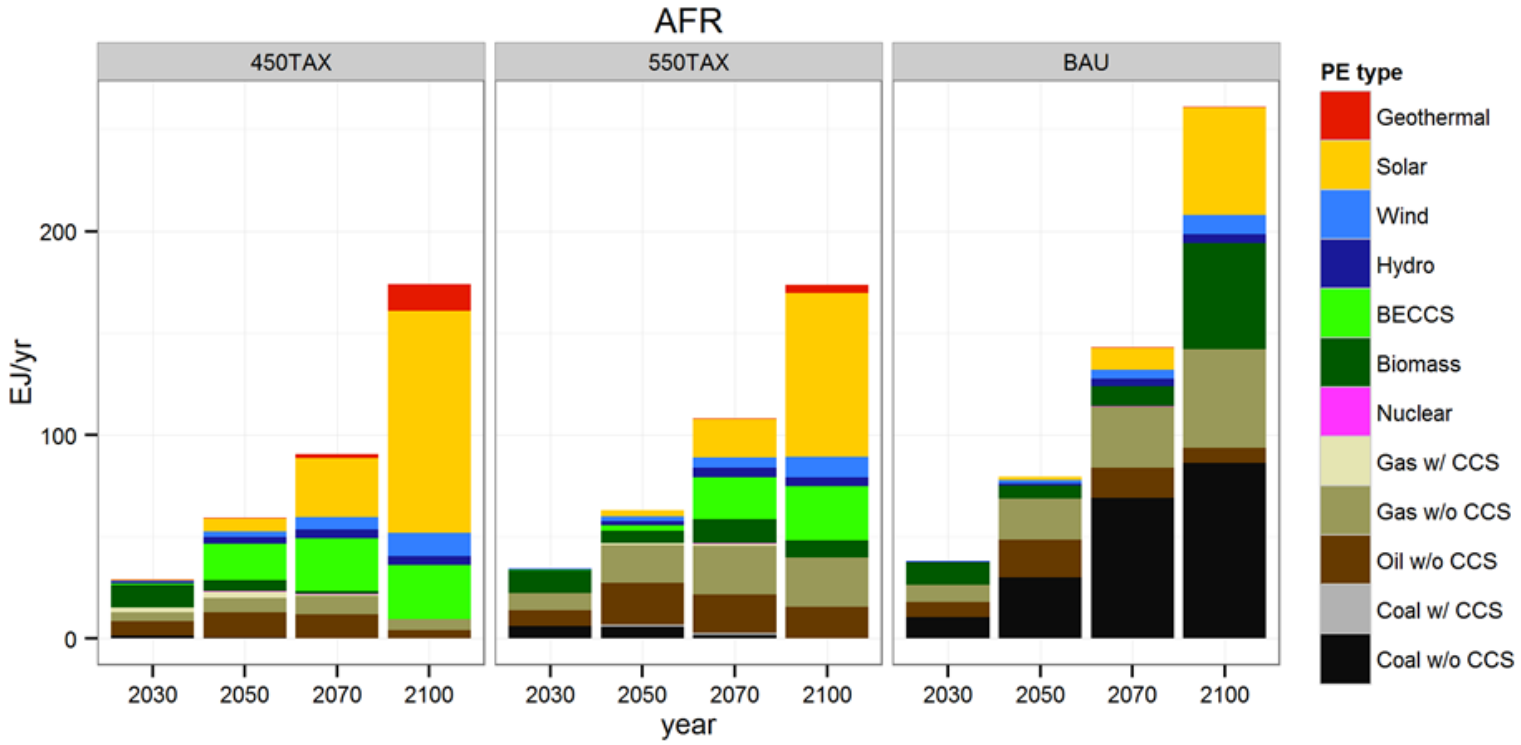


Final energy per capita

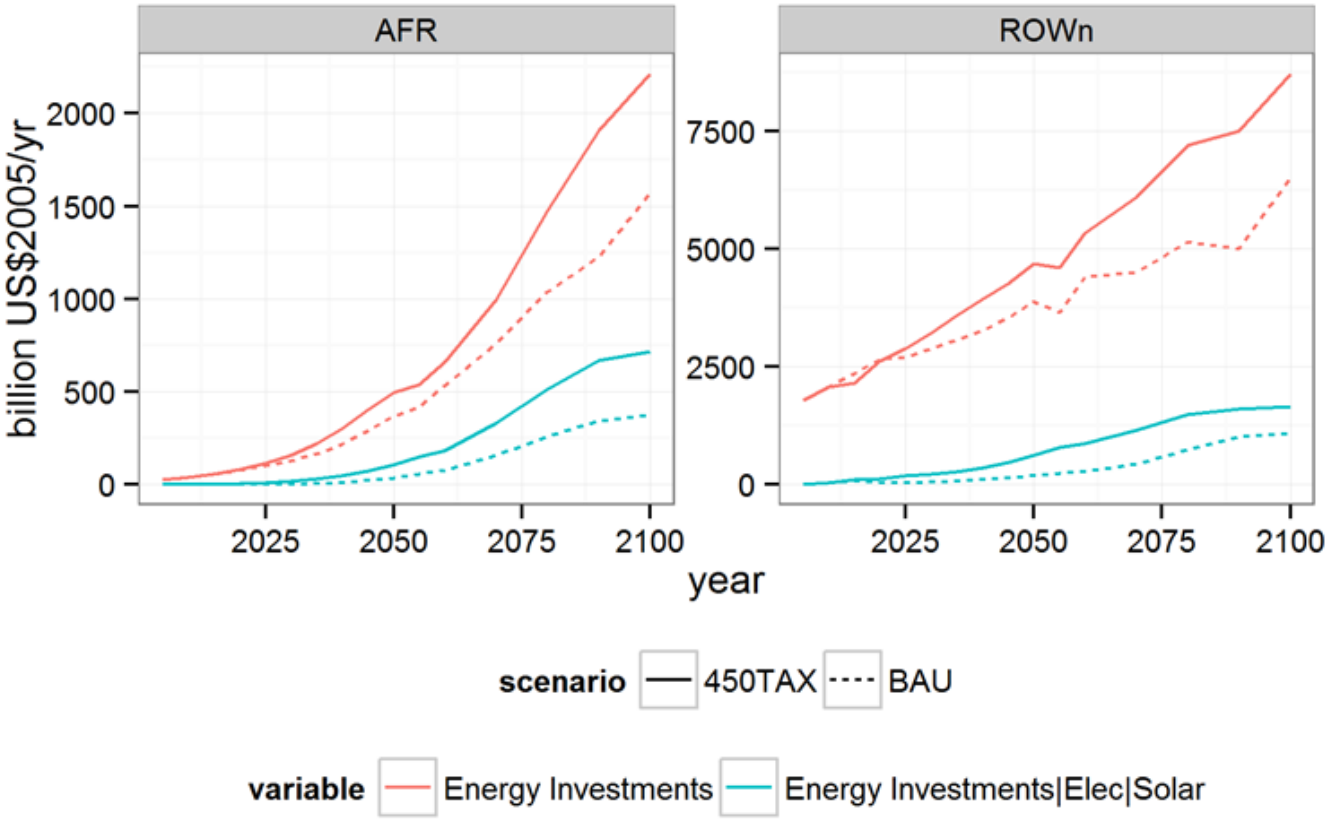


thick black line represents Sub-Saharan Africa

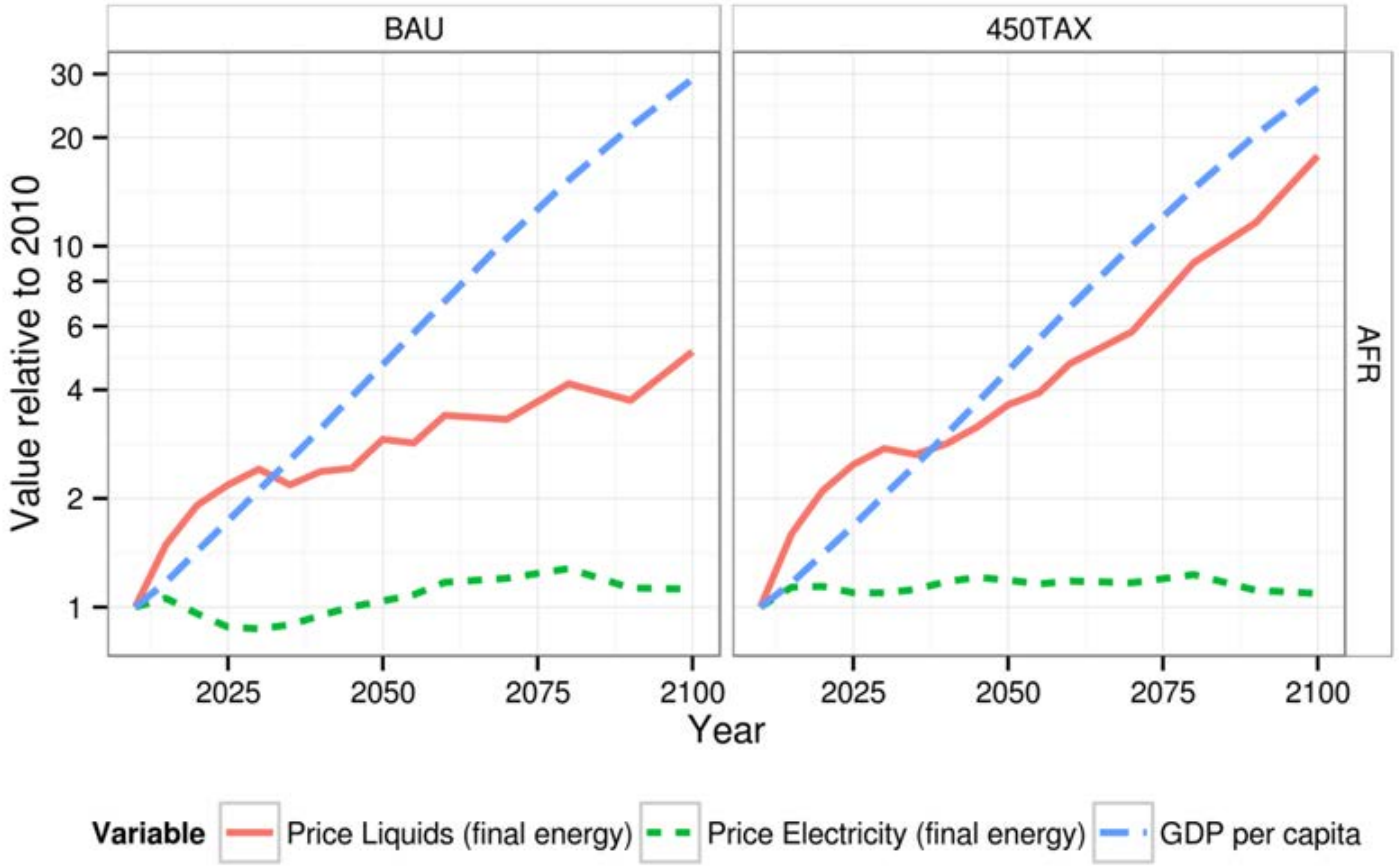
Primary Energy Consumption



Energy Investments



Energy Prices



Conclusions (I)

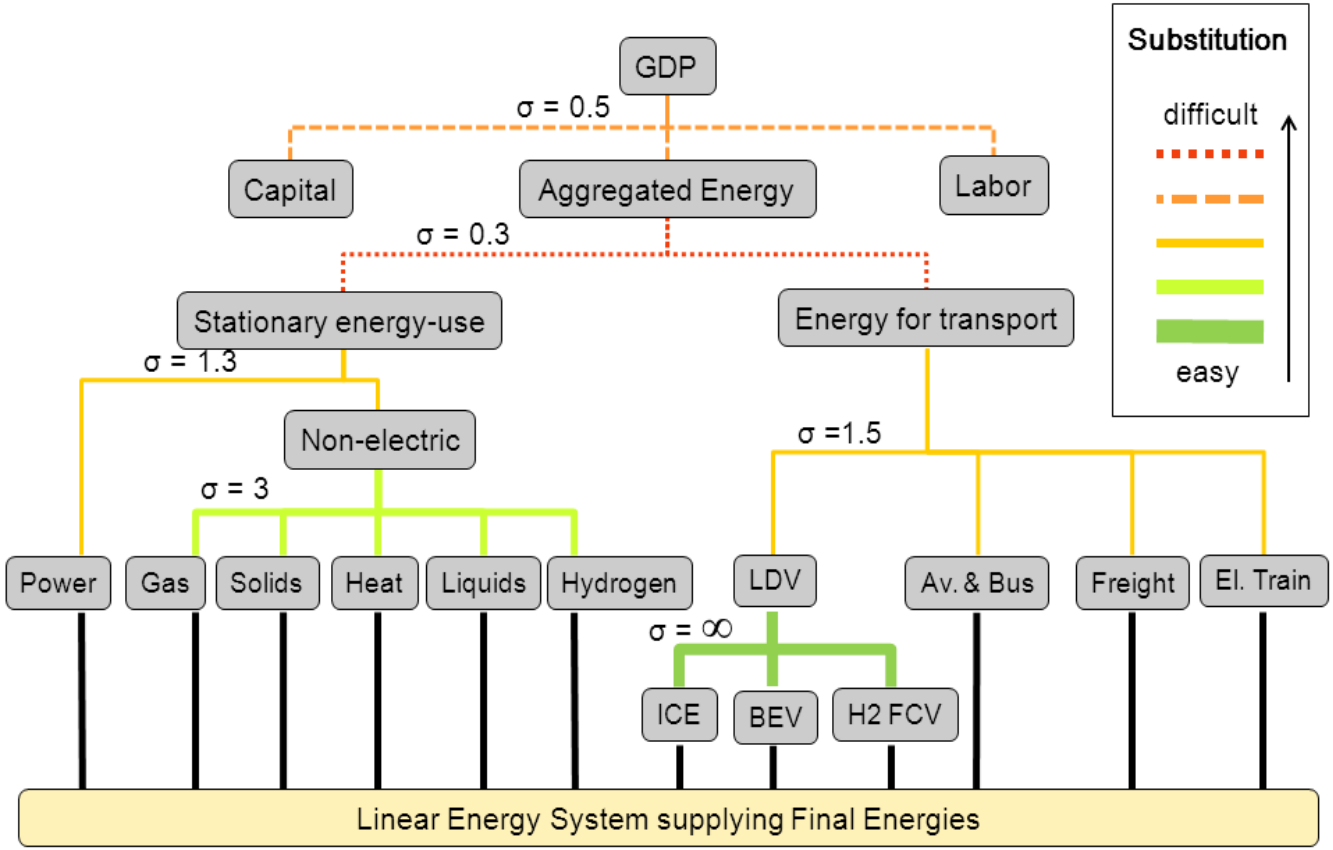
- Simulations yield mitigation costs for Sub-Saharan Africa in the range between -5% and 3%
- incentives of joining a global agreement can clearly be increased with a climate policy regime that includes a cap-and-trade system with an equity-based burden sharing
- The indirect effect of emission permit sales (under a cap-and-trade system with acknowledged equity principles) and sales of biomass are likely to be larger than the direct costs of domestic GHG abatement

Conclusions (II)

- Even with consumption gains, substantial challenges in transforming the energy system and in building up institutional capacities are implied:
  - Final energy intensity has to be reduced by 90%
  - use of coal has to be faded out completely and the electricity share has to be increased from less than 5% today to around 30% in 2050
  - Compared to the baseline scenario, final energy consumption has to be reduced by 20% in 2050 and additional energy system investments increase up to 30% until 2100
- Positive balance for the development perspectives will only hold if the financial means will be applied in a socially efficient way
- This includes investments into new energy conversion technologies, but also support for poor households which temporary may be confronted with a decline in non-energy consumption due to increasing energy prices

Thank you !

Production System



Abbr.: *Heat - District heat & heat pumps, LDV - Light Duty Vehicle, ICE - Internal Combustion Engine, BEV - Battery Electric Vehicle, H2 FCV - Hydrogen Fuel Cell Vehicle, Av.& Bus - Aggregate of Aviation and Bus, El. Trains* – Electric Tr.

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