5th IAMC Annual Meeting

Consequences of shifting pathway from RCP8.5 to RCP4.5

Asbjørn Aaheim, Bård Romstad, Taoyuan Wei
CICERO

Utrecht, 12. – 13. November 2012

RCP8.5:

- ➢ A high emission scenario
- ➢ Relatively slow economic growth and technological improvement
- ➢ High population growth (6.2 bill in 2100)
- ➢ Little convergence between low-income and high-income regions
- ➢ Here: Emissions of CO_2, population and GDP by region sustained

**GDP in PPP by region 2004 – 2100 in RCP8.5. Without climate change**
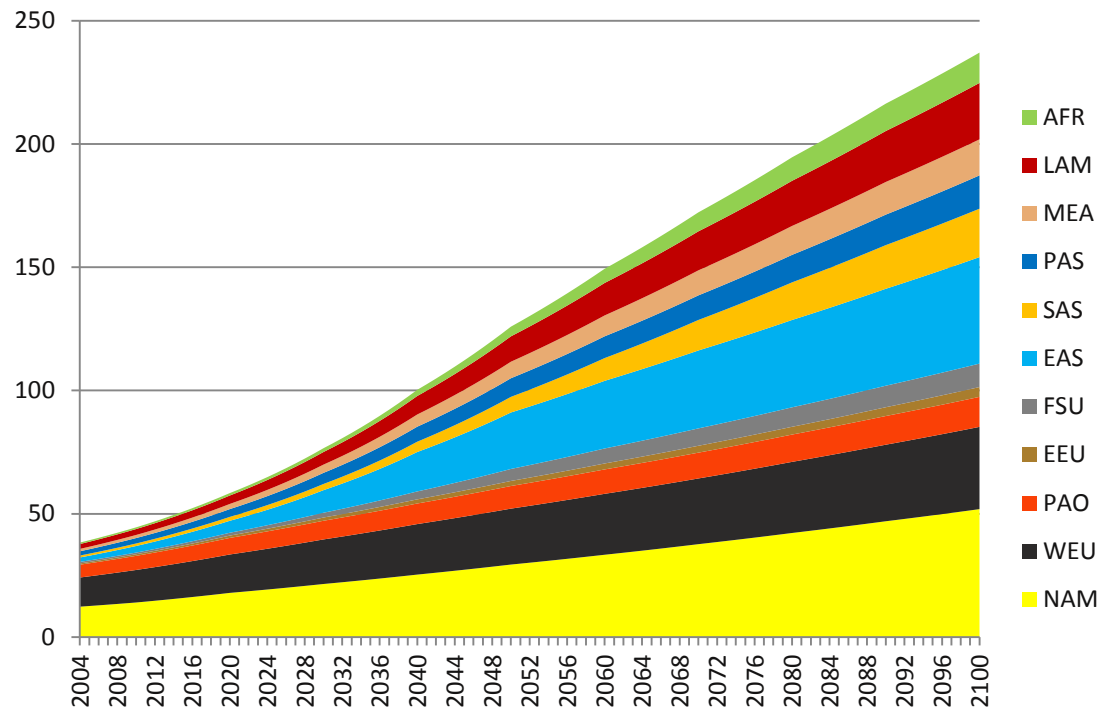
Integration of impacts of climate change in the GRACE model

	Agric Forestry Fish … Energy … Services	Consume Investment
Agriculture Forestry Fisheries … Energy (5) … Transport (3) Services	← Energy use →	Energy use Tourism Tourism
Labour Capital Nature	← Impacts on health → ← Natural disasters, sea-level rise → Land Bio growth Stock … Run-off	

Equilibrium: Supply = Demand

Relationships between productivity of land and changes in climate indicators

a) Based on interpretations of European studies
b) Climate indicators are restricted to annual totals or means
c) Positive or negative impacts of a given change in temperature depends on the present mean

$$dX = a*TdT + b*dT^2 + c*dP$$
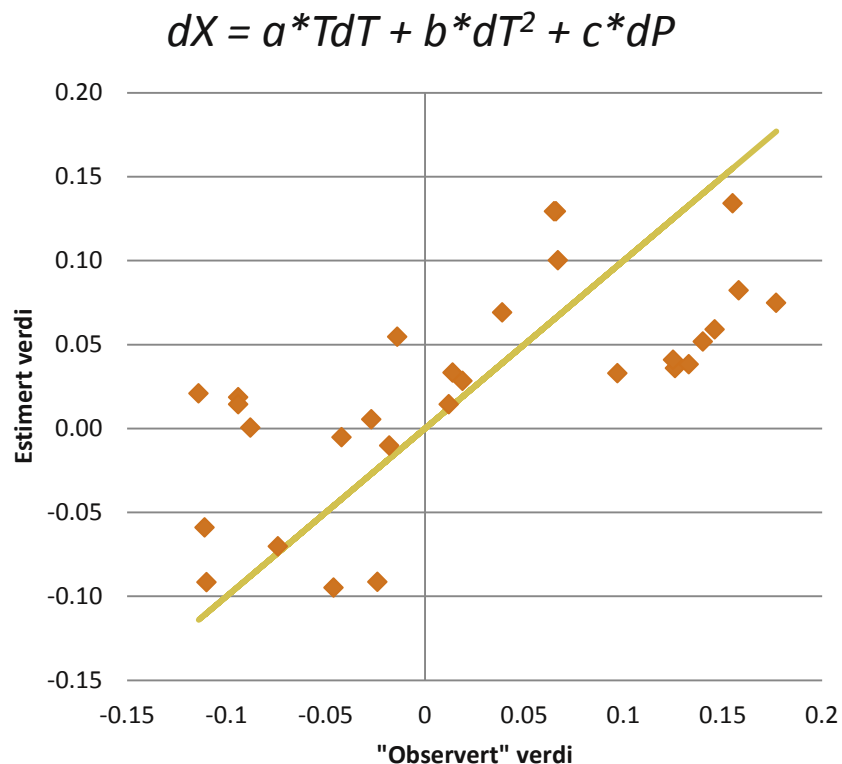
	Estimate	Std. dev.
a (TdT)	-0.0025	0.0018
b (dT^2)	0.0092	0.0053
c (dP)	0.2213	0.1774
R^2	0.485	

Impacts of climate change in agriculture: Estimates from five studies.
Adjusted to +2.5 °C global warming in 11 regions

- ➤ W. Cline
- ➤ R. Mendelssohn and Schlesinger
- ➤ W. Nordhaus and Boyer
- ➤ R. Tol
- ➤ World Bank
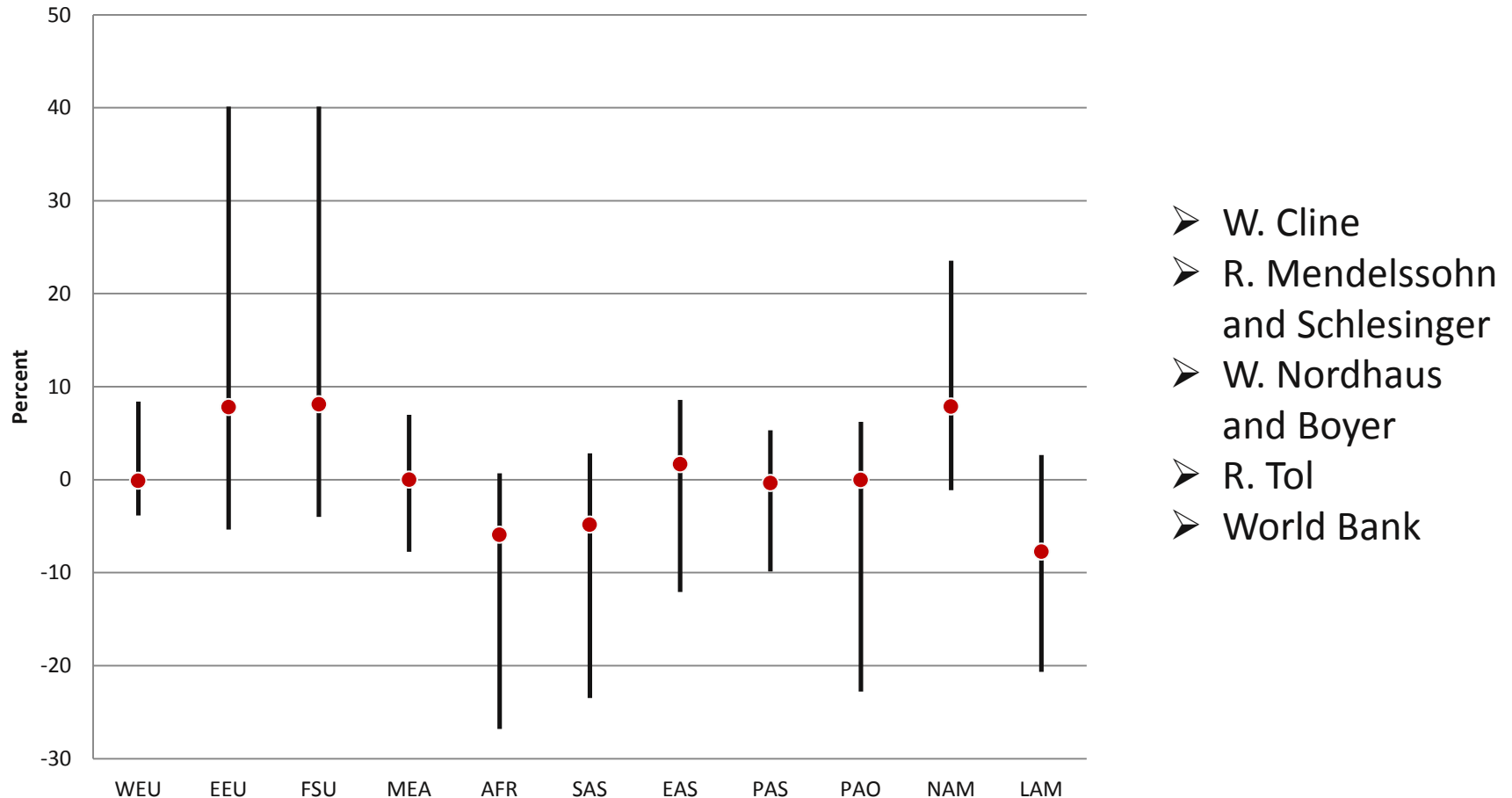
Variations may be due to different assumptions about changes in precipitation

Transforming functions for countries in Europe to functions for world regions
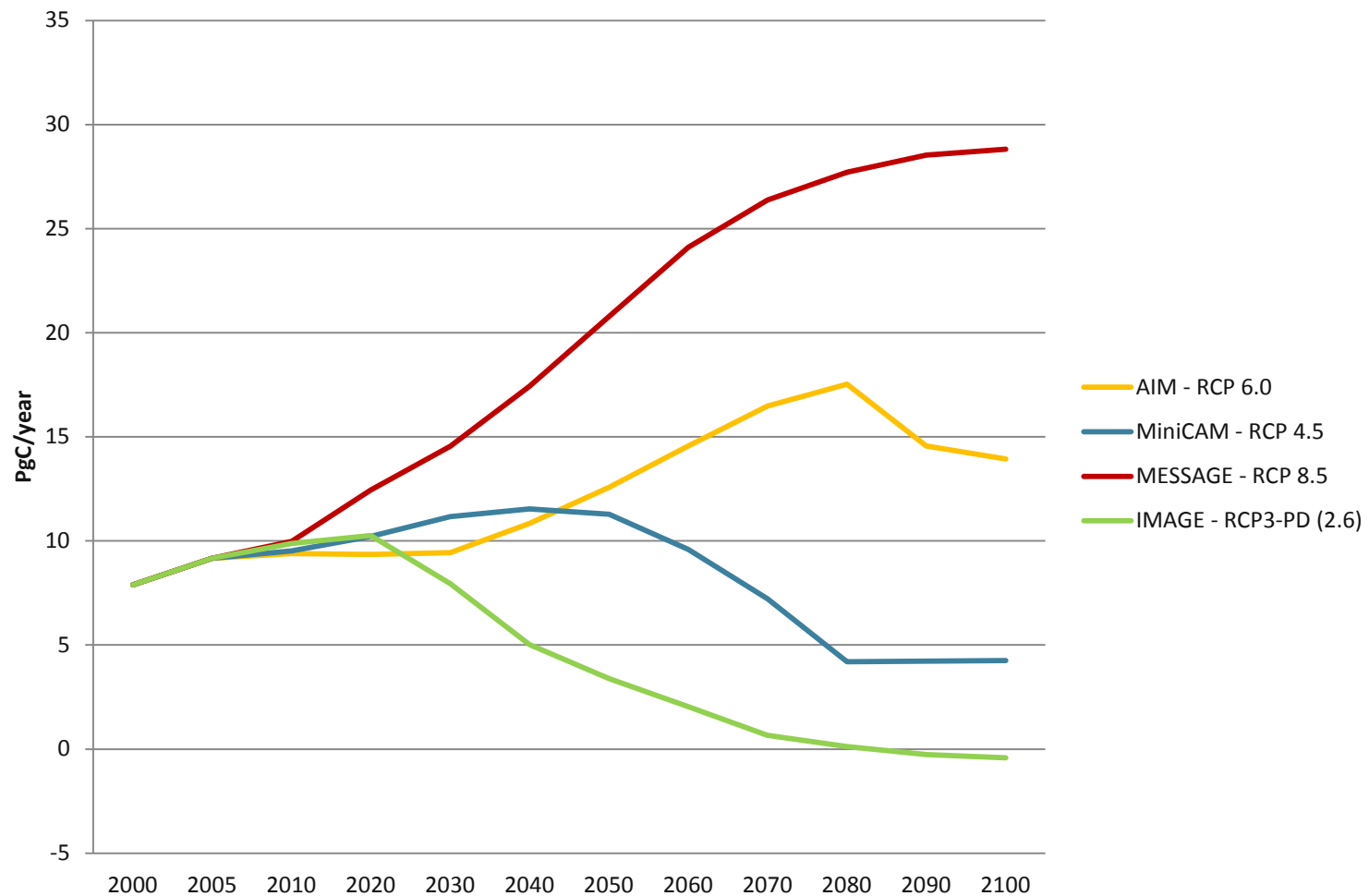
➤ Based on the same functional relationships as in the EU-study

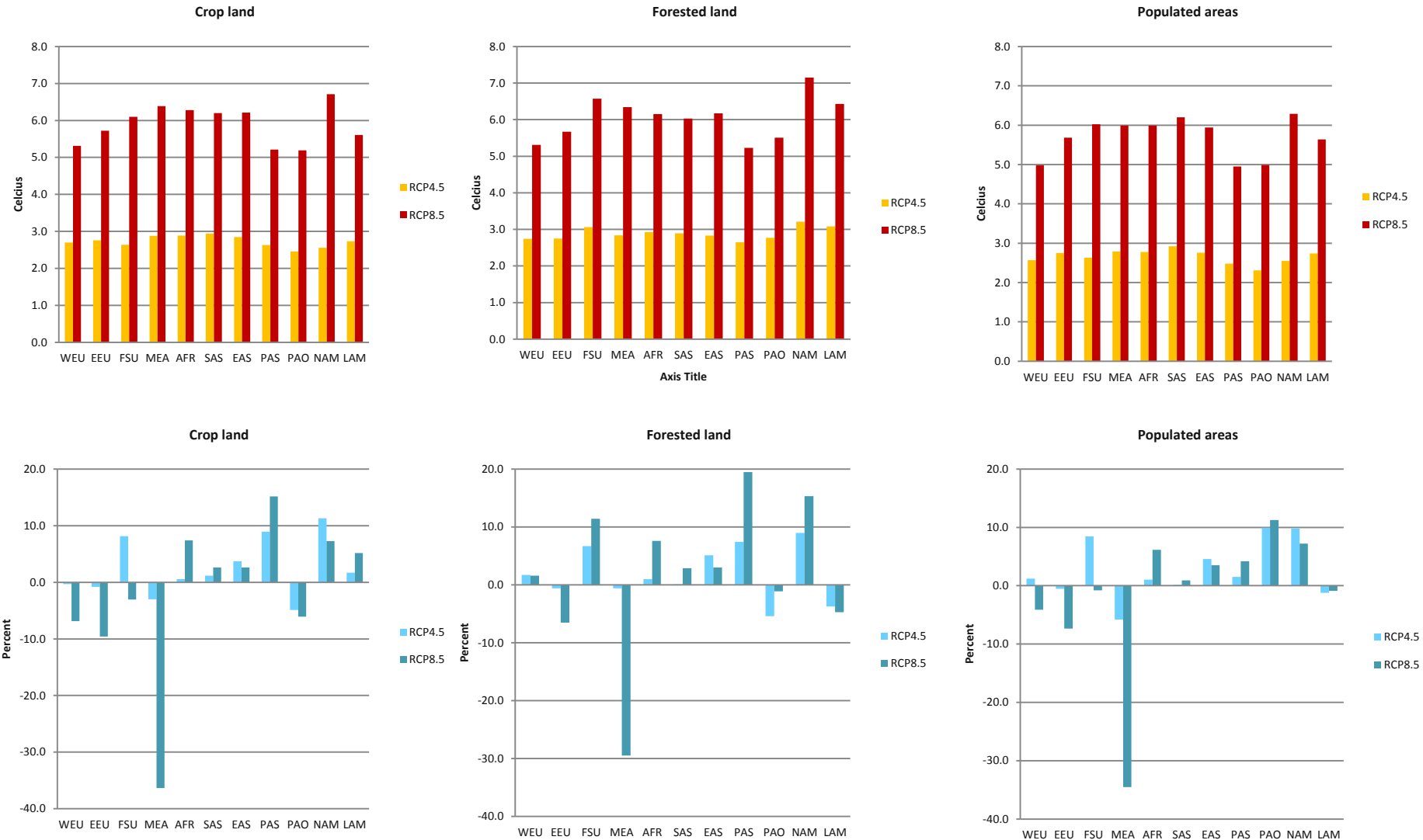➤ Calibrated through estimates for direct impacts by region
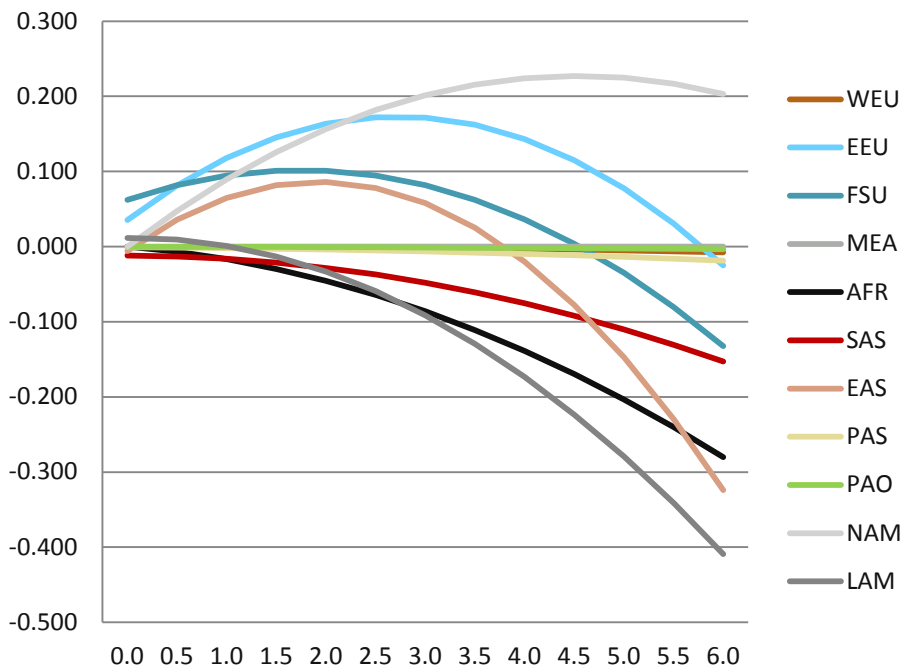
Calibration

➤ Apply EU estimates to calculated the impacts in EU in the new study

➤ Scale all the parameters linearly to the regional estimate
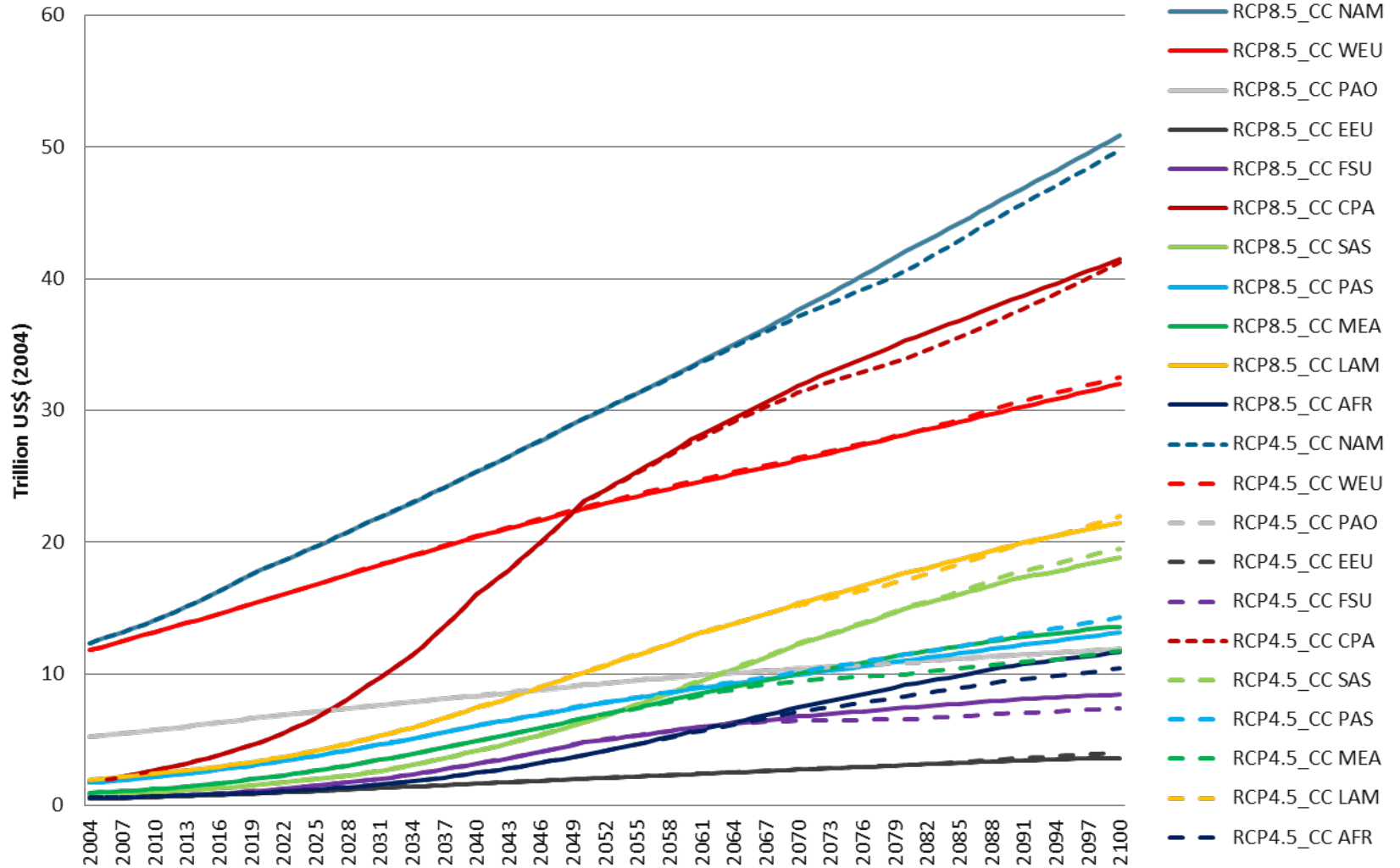
➤ Restriction: Keep the sign on all parameters

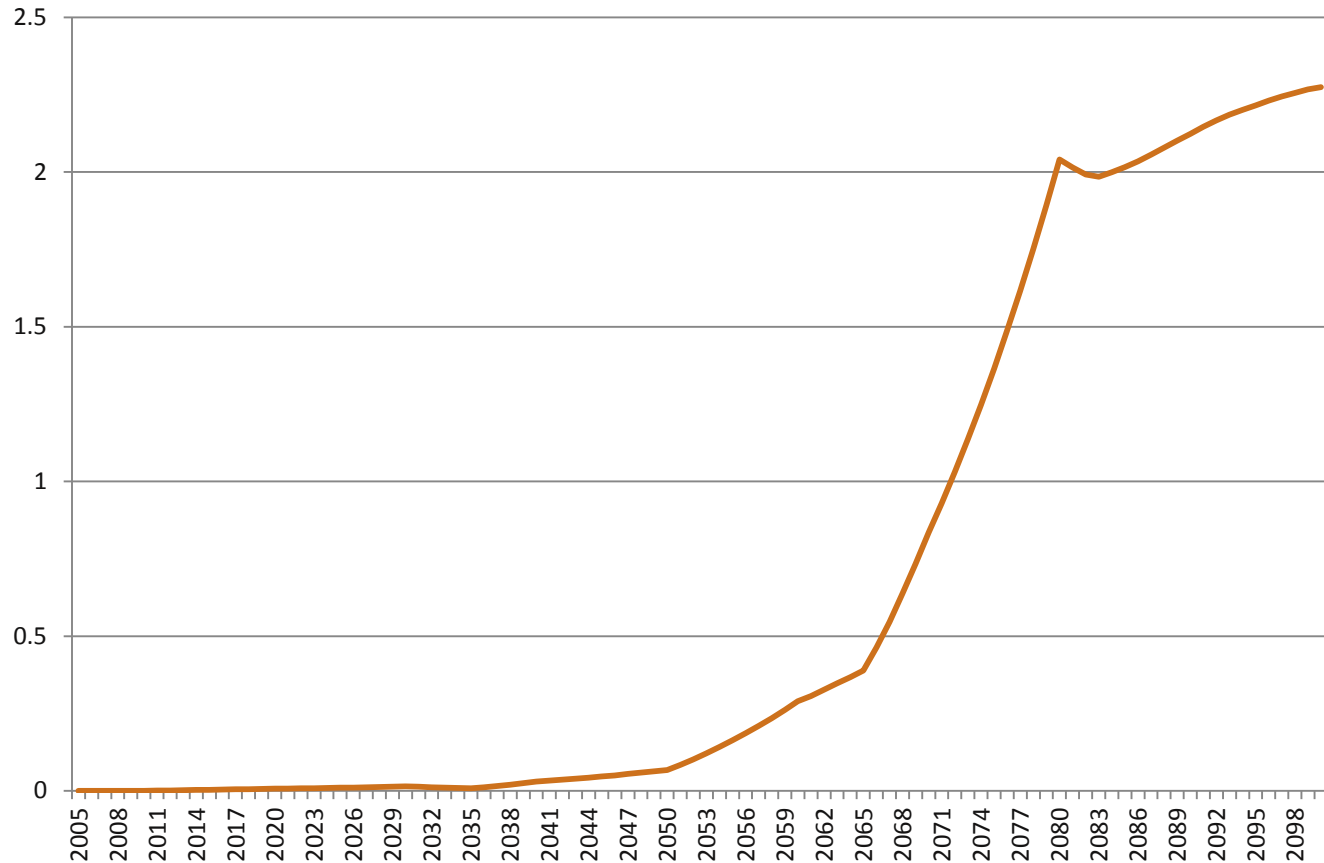# Global scenarios: CO_2 emissions 2000 – 2100 in RCP

Change in annual mean temperature (°C) and annual precipitation (percent) by region in 2100 in RCP4.5 and RCP8.5 (Max Planck Inst.)

GDP by region 2004 - 2100 in RCP8.5 and RCP4.5

Trillion US$ (2004)

Legend:
- RCP8.5_CC NAM
- RCP8.5_CC WEU
- RCP8.5_CC PAO
- RCP8.5_CC EEU
- RCP8.5_CC FSU
- RCP8.5_CC CPA
- RCP8.5_CC SAS
- RCP8.5_CC PAS
- RCP8.5_CC MEA
- RCP8.5_CC LAM
- RCP8.5_CC AFR
- RCP4.5_CC NAM
- RCP4.5_CC WEU
- RCP4.5_CC PAO
- RCP4.5_CC EEU
- RCP4.5_CC FSU
- RCP4.5_CC CPA
- RCP4.5_CC SAS
- RCP4.5_CC PAS
- RCP4.5_CC MEA
- RCP4.5_CC LAM
- RCP4.5_CC AFR

°CICERO Senter for klimaforskning   www.cicero.uio.no
Center for International Climate and Environmental Research - Oslo

Price of tradeable quotas 2005 – 2100 in RCP4.5. 1000 US$/tC

Impacts of climate change on GDP by region. 1000 trill. US$ PPP.
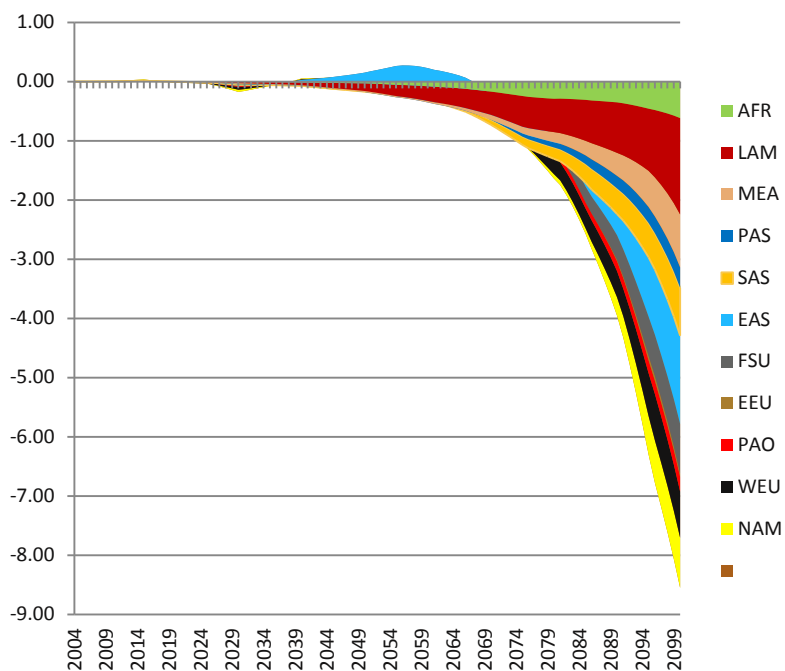
RCP8.5
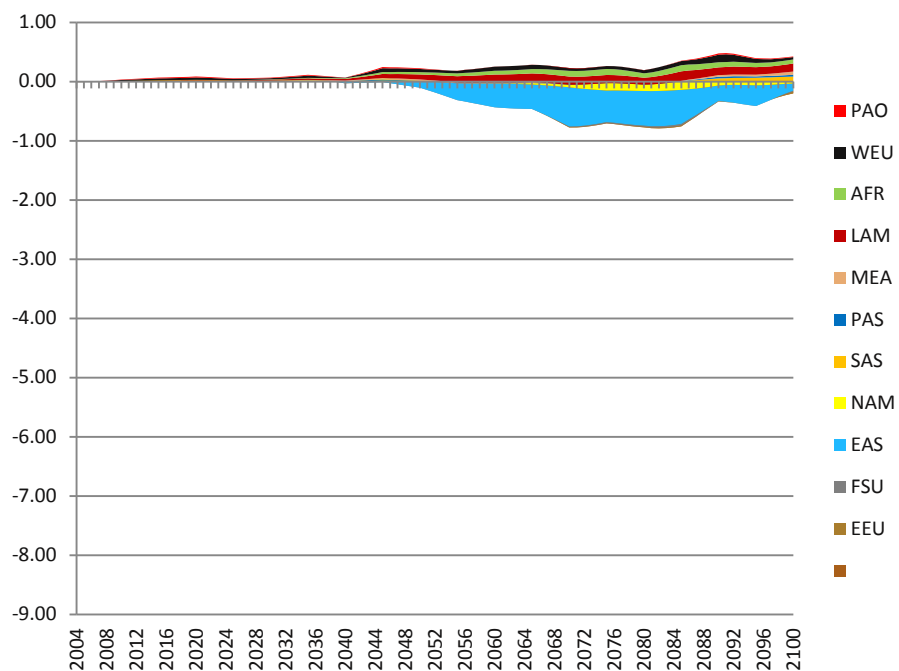
RCP4.5
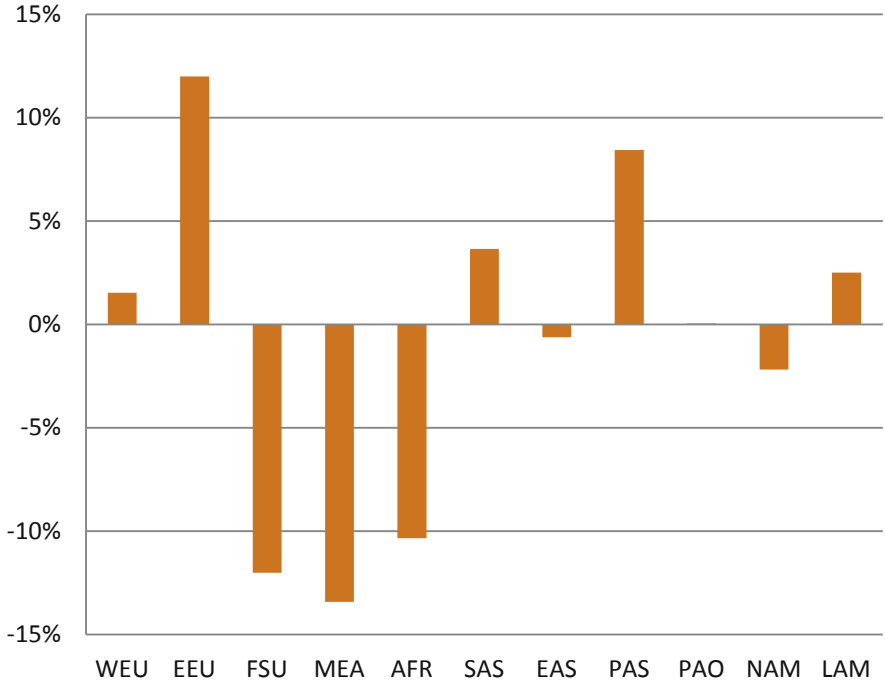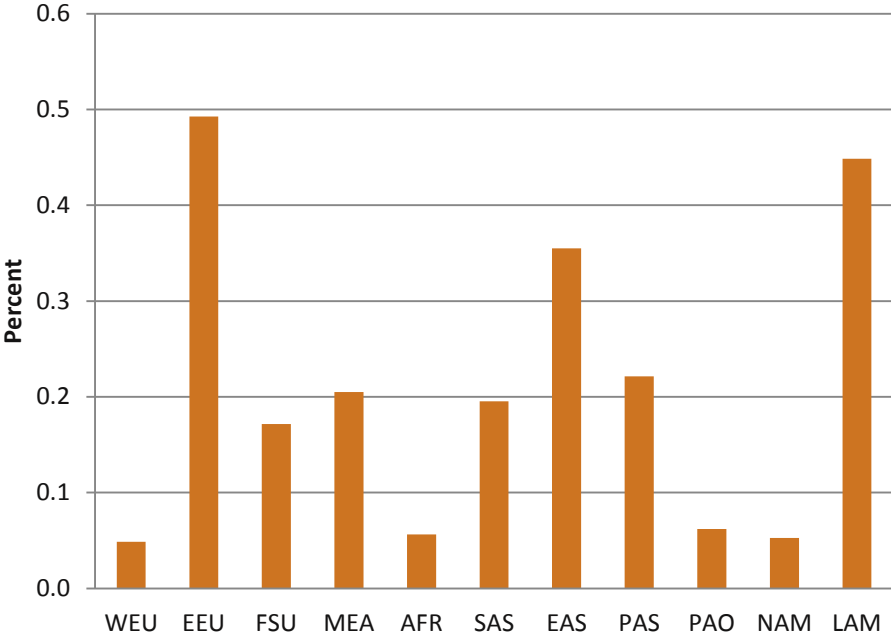
Impact on GDP by switching from high emission (RCP8.5) to low emission (RCP4.5)
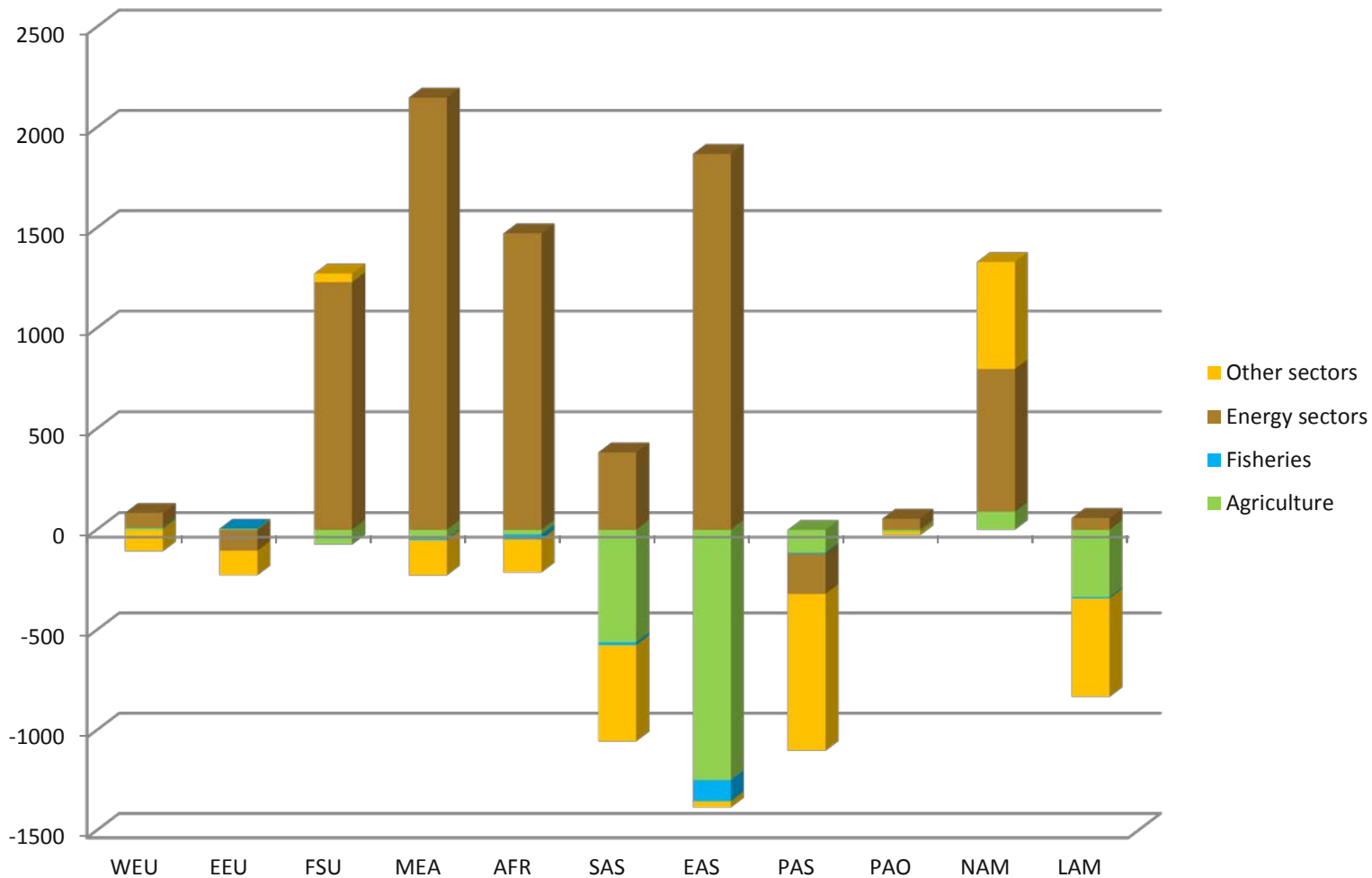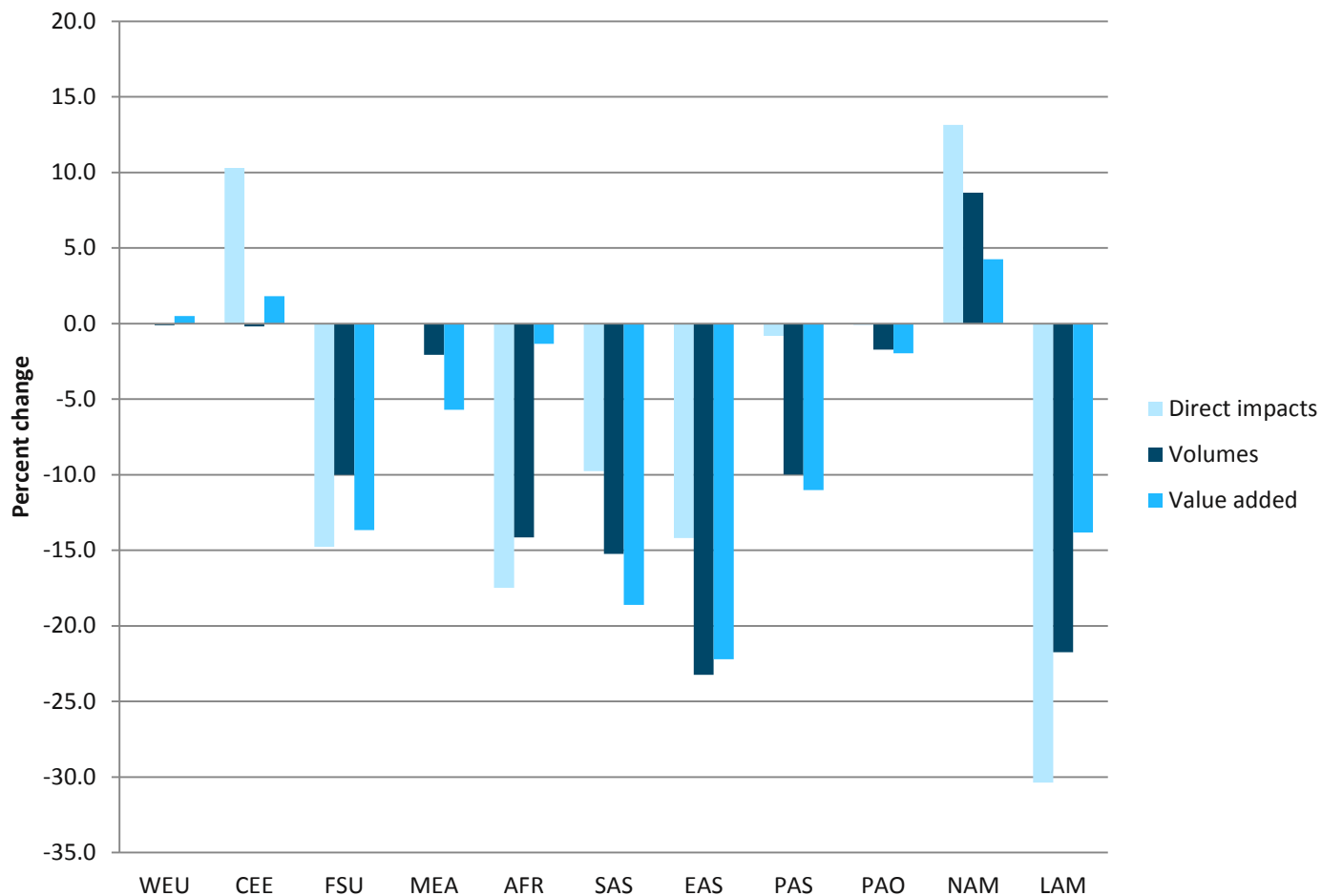
Costs of commencing on a low-emission pathway (RCP4.5) instead of a high-emission pathway (RCP8.5) in 2100 by sector. Trill US$

Alternative measures of impacts to agriculture of switching from low (RCP4.5) to high (RCP8.5) emissions in 2100

Economic contributions and welfare of food-production

➢ Small-holding farmers in poor countries consume a large part of their own product

➢ Alternative income opportunities are important to their welfare
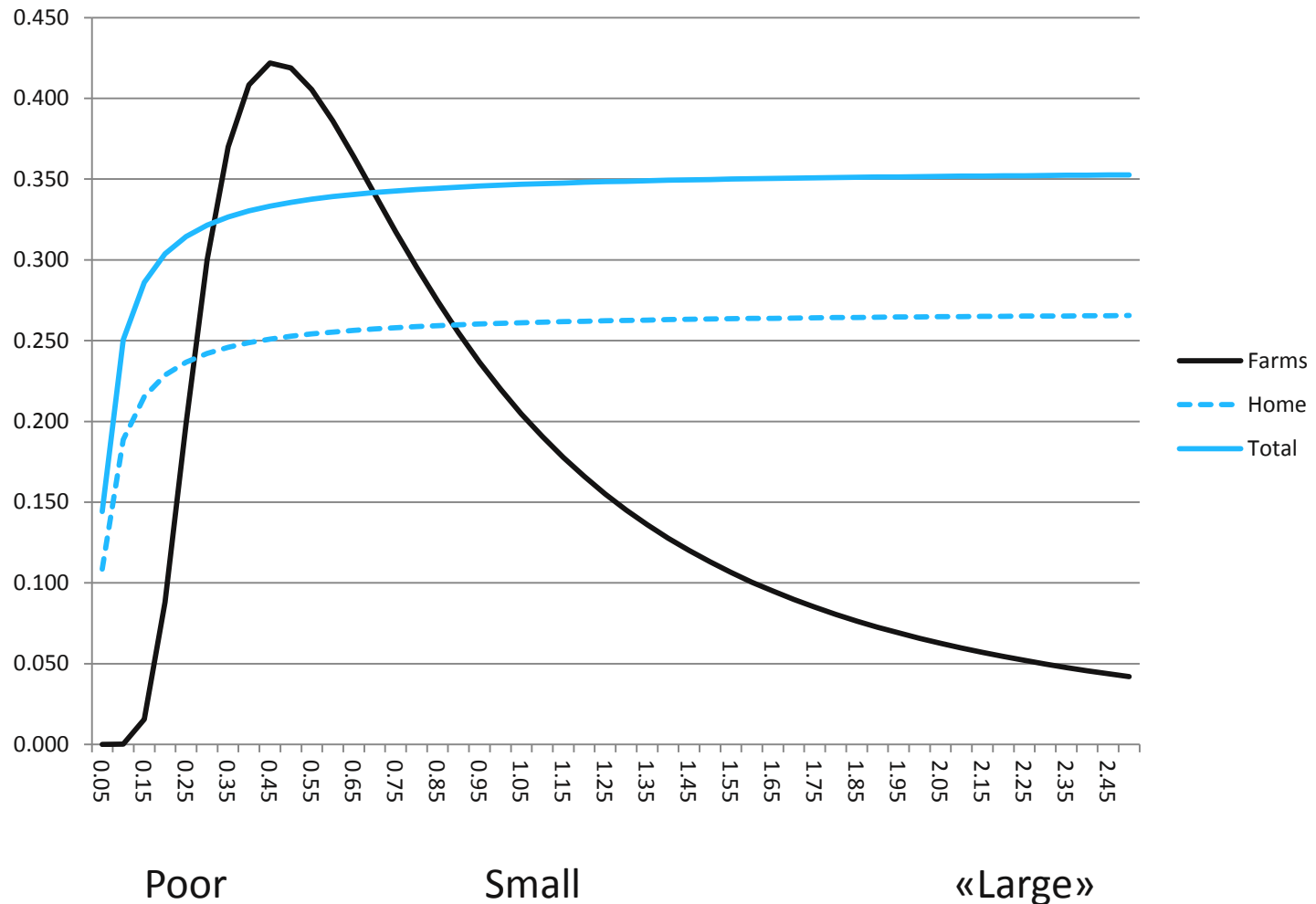
The budget constraint changes from:

*Income from production = total consume and savings*

to:

Output consumed + income from sold output + other income

= Consumption of food + other consumption (+ savings)

=> The sector is no longer independent on scale

Distribution of farms by size in Malawi (black) and modeled food consumption per output unit

Poor   Small   «Large»

Perecent change in consumption at a combination of 10% increase of agricultural prices and 10% increase in productivity by farm type - illustration
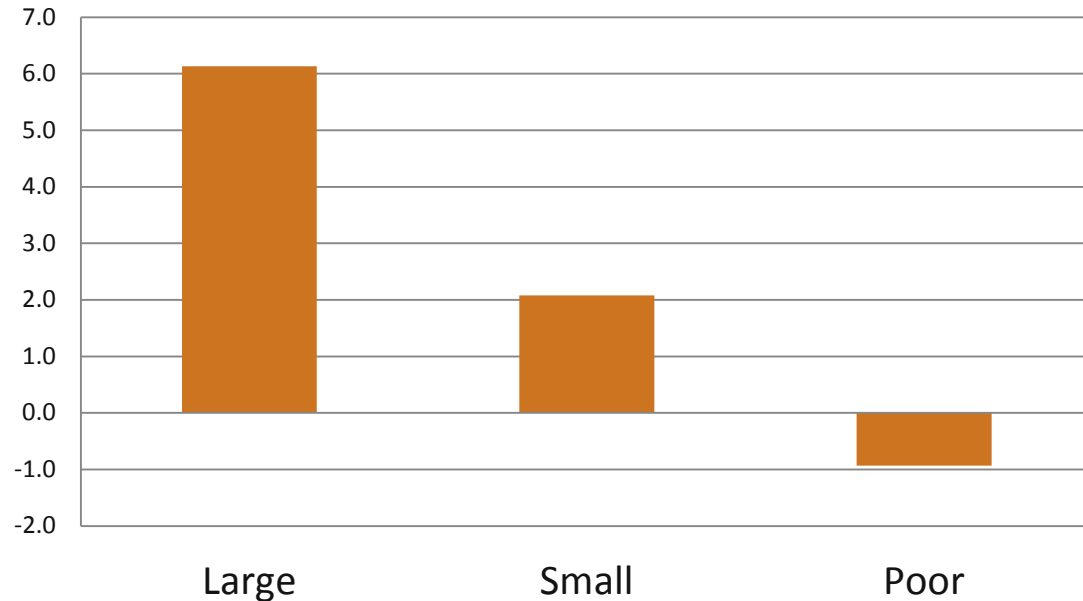
Dependent on

➢ Alternative income opportunities to small-holding farmers
➢ Output composite (subsistence, cash-crops) – flexible production systems
➢ Market access – transaction costs
➢ …

Summary:

➢ We know little about aggregated impacts og climate change, and present estimates are based on moderate changes.

BUT:

➢ Cross-sectoral conflicts seems stronger than regional conflicts, and the costs to those who suffer from mitigation are more tangible than the costs to those who will suffer from absence of mitigation

➢ Action is being postponed, and future generations will have to pay for further delay of action. It may still go 40 – 50 years before reasons to regret the delay become obvious

➢ Impacts on economic activities are inappropriate measures of welfare among the poor, who stand to loose the most if mitigation is further postponed

°CICERO Senter for klimaforskning   www.cicero.uio.no
Center for International Climate and Environmental Research - Oslo