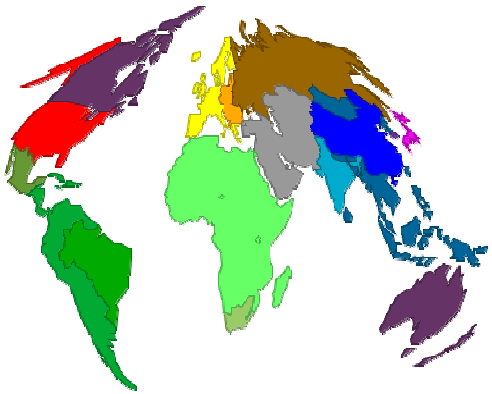
INFRAS; Consulting, Policy Analysis and Research, CH 8045 Zurich

Per Capita Emission Paths for Developed and Developing Countries

A Swiss contribution
for discussion



Presented by Dr. Othmar Schwank
INFRAS, Consulting, Policy Analysis and Research, Zurich/Switzerland

Poznan, 6th December 2008

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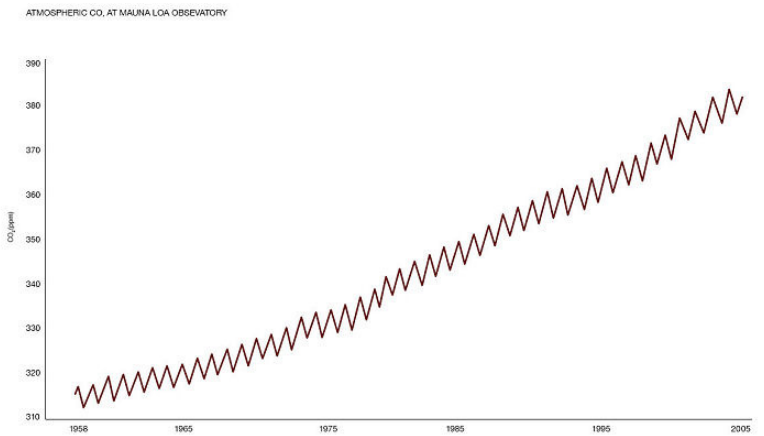
Challenges and key questions

- BAP towards a joint vision!
- Exploring fair sharing of the atmospheric space under the 2°C / 470 ppm stabilization objective
- Which indicators help to reach a consensus on 2°C compliant emission paths according to BAP?
- Deviation from baselines globally urgent as emissions raising faster than ever before in 2007

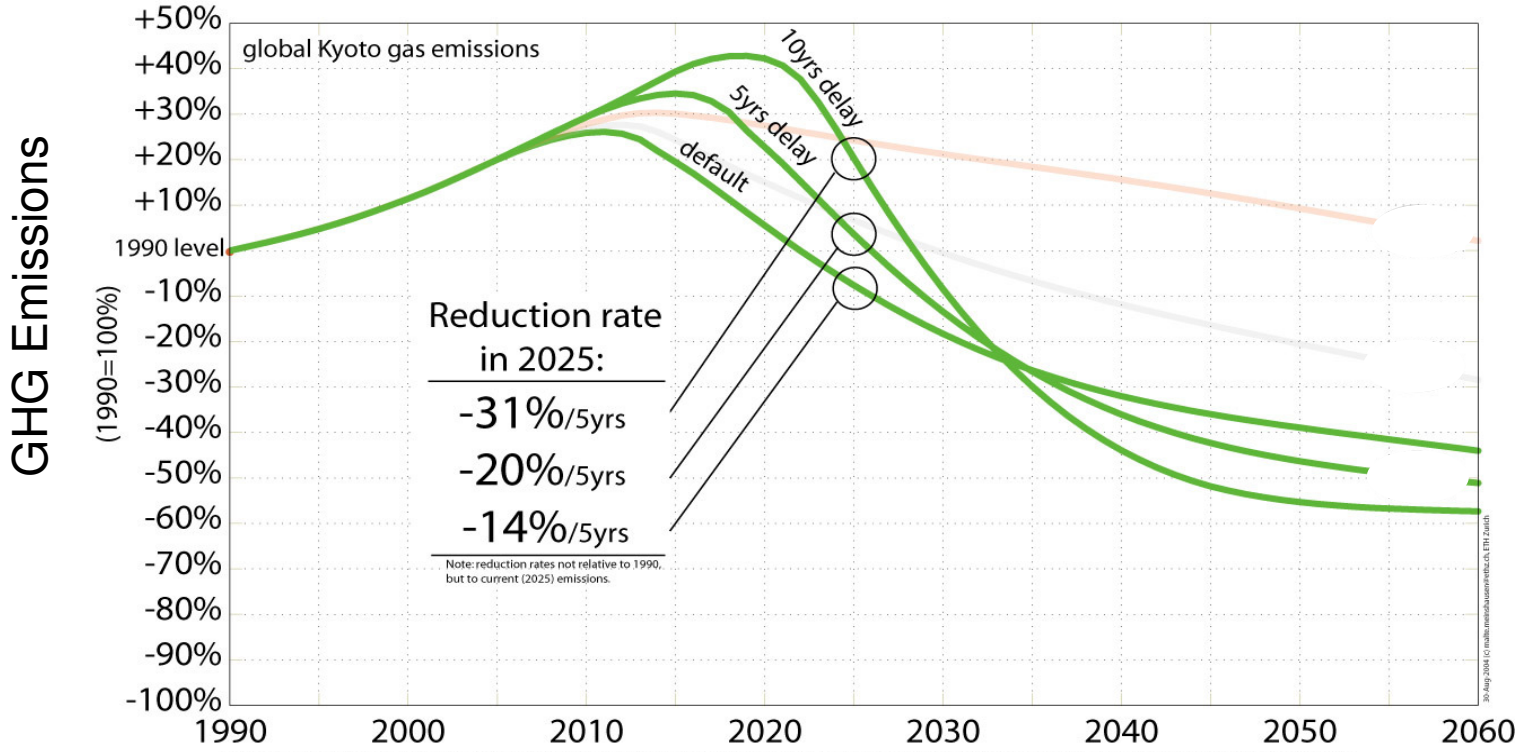


Climate change is accelerating its pace

The Triftglacier in the Bernese Alps. Copyright: © Ges. f. ökologische Forschung

Challenges implied in 2°C goal compliant emissions pathways

- Stabilization to be reached in the next 10 years, otherwise next generation has to reduce emissions at much higher rates!

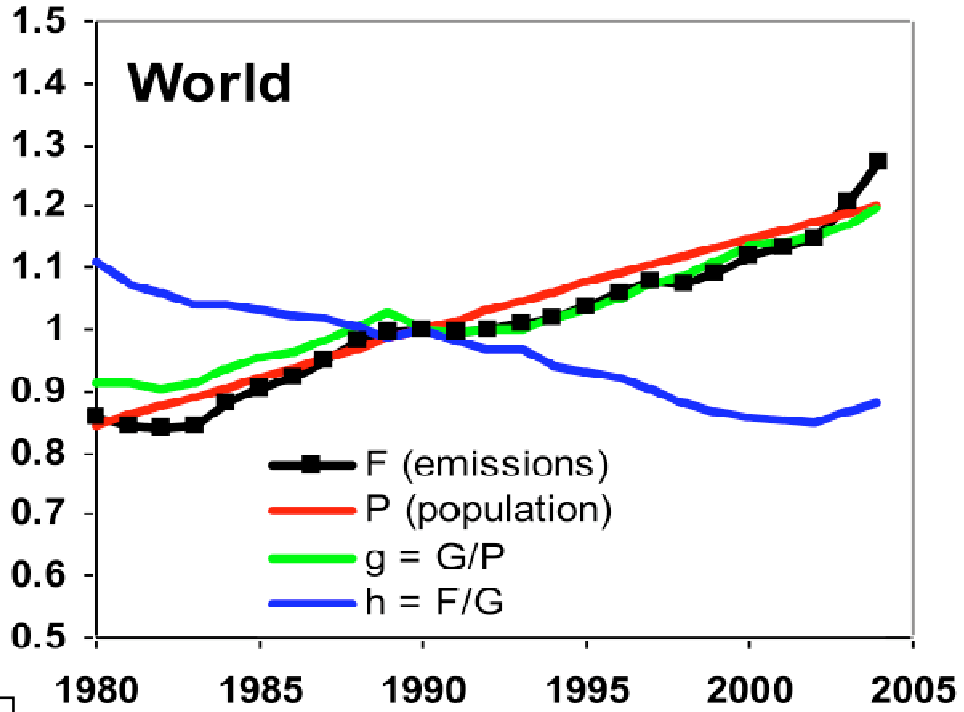


Meinshausen et al. 2004

Why accelerated emission increase in recent years?

$$F = P \times \frac{G}{P} \times \frac{F}{G}$$

- F: fossil CO_2-emissions
- P: population
- $\frac{G}{P}$: GDP per capita
- $\frac{F}{G}$: CO_2-intensity (emissions/GDP)



Raupach et al. (2007) PNAS

CO_2- intensity increases in some countries with emerging markets

Improve technology and technology transfer

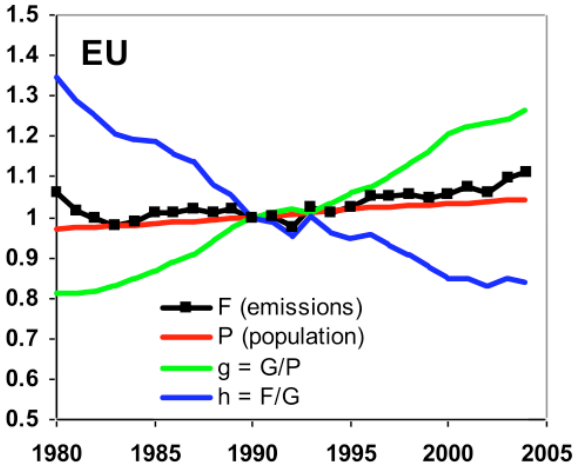
$$F = P \times \frac{G}{P} \times \frac{F}{G}$$

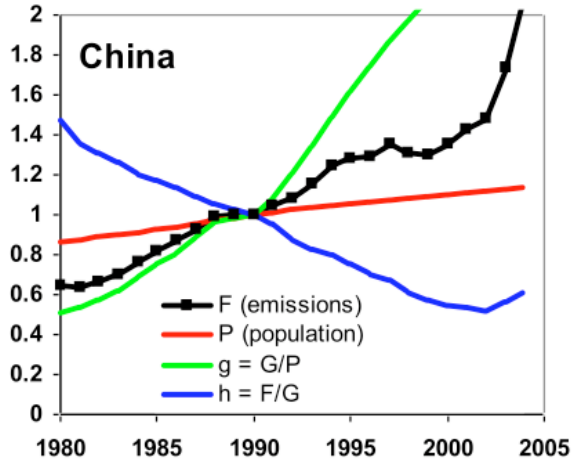
fossil CO_2-emissions

population

GDP per capita

CO_2-Intensity (emissions/GDP)

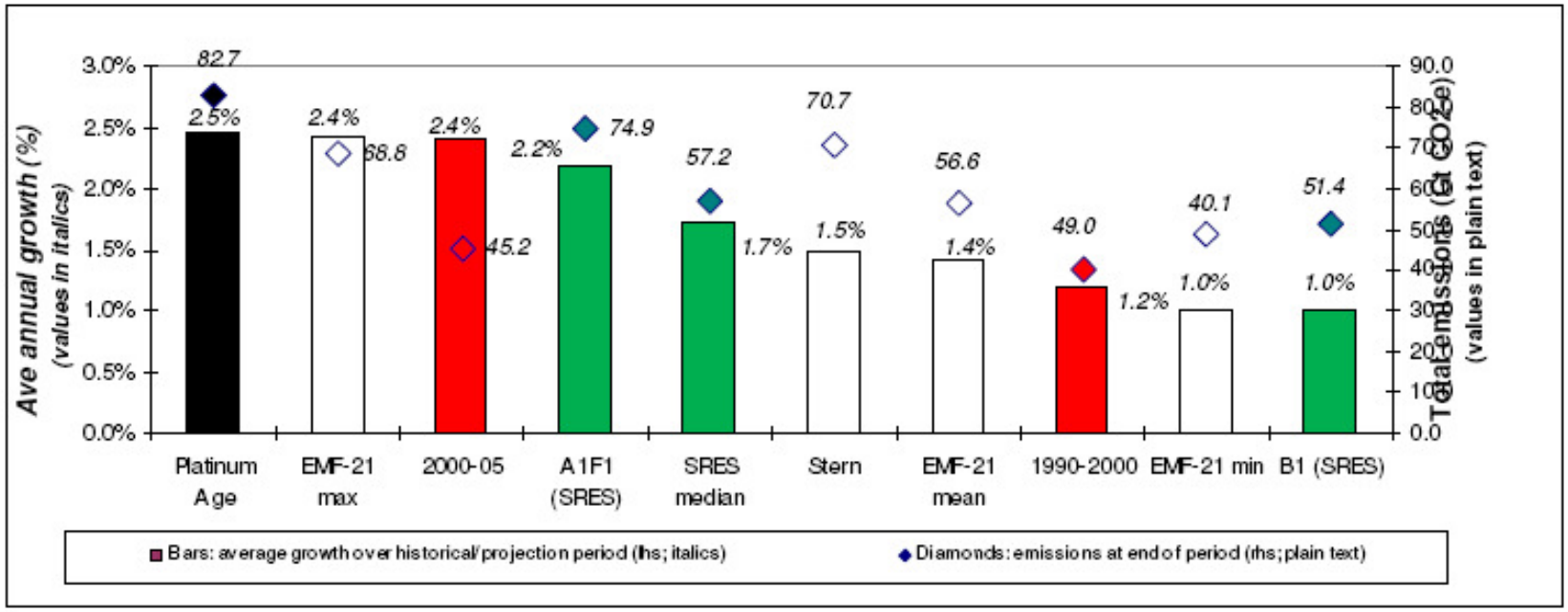




Raupach et al. (2007) PNAS

Emissions rising faster this decade than last

- Global emission trends until 2007 are significantly higher than the highest IPCC scenario A1F +4-6°C



Source: Garnaut (2008): Comparison of "Platinum Age" projections with other projections and historical data in terms of average growth rates (*bars:italics;left axis*) and total emissions (diamonds; plain text; right axis)

Objectives of the study

- Investigating options for enhanced national and international climate change action addressing in particular action:
  - undertaken by industrialized country Parties (G8 plus OECD 1990) taking the lead
  - by developing and particularly newly industrialized country Parties which would deviate from baseline on a voluntary basis as long as per capita emissions are below developed country average or level of the economic development has not reached critical threshold (e.g. USD 20 000 ppp/cap)

Objectives and Indicators

- When reaching a critical threshold (CO_2e/cap), countries emission path get gradually subjected to relative/absolute caps, meeting a joint vision to be agreed under **Bali Action Plan**
- **The maximum temperature rise at stabilization is 2℃ above preindustrial temperatures** the total global emissions are constrained by a scenario defined such that the global average temperature does not rise above 2℃
- The Indian Prime Minister announced, that India would not exceed at any time in future the average per capita emissions of developed countries. This proposal is applied to all developing country parties

Model design I

Generation of inverse scenarios to stabilize at the temp. target:

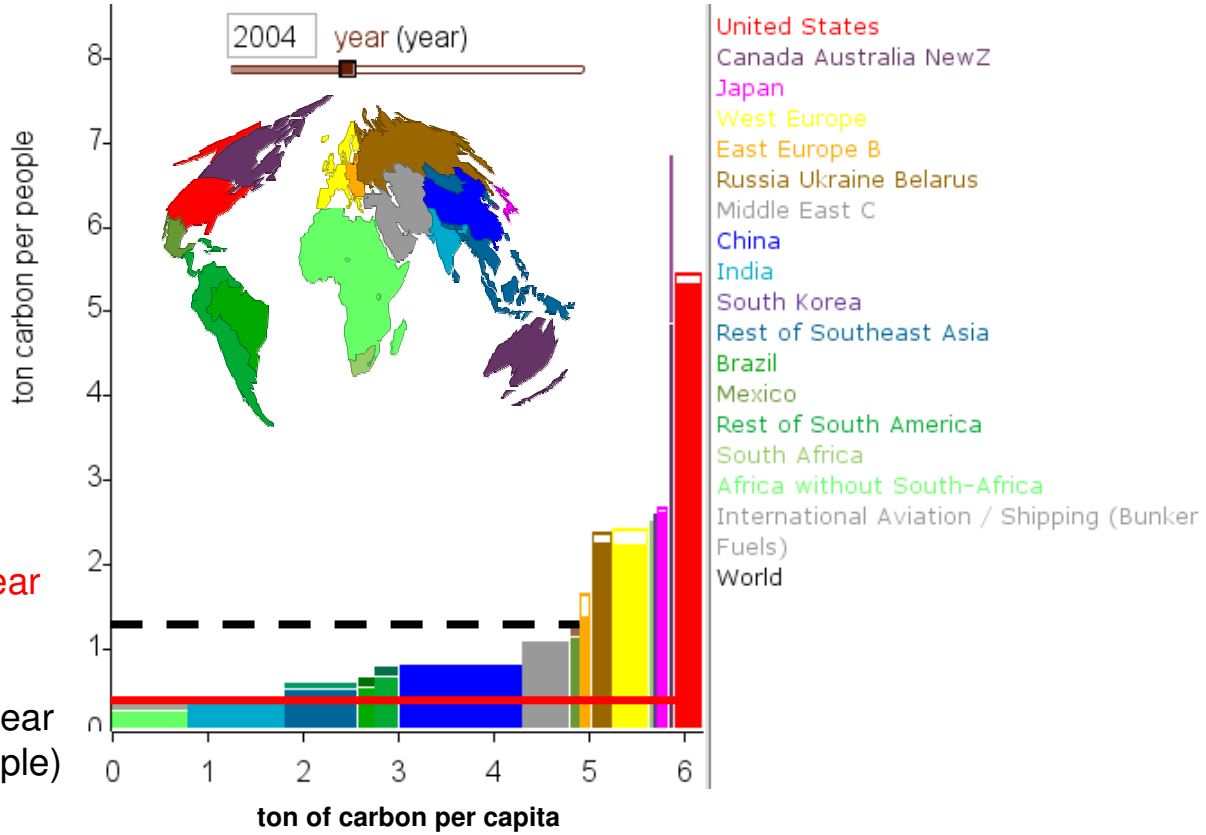
- Calculations based on the interactive “Java Climate Model” (abbrev. JCM) developed by B. Matthews, Université catholique de Louvain, Belgium, adapted for this analysis during summer 2008
- Set up uses the average climate sensitivity assumed in IPCC AR4 WG3 (3.0 ^{o}C)
- JCM assumes that non-CO_2 greenhouse gases, aerosols, and tropospheric ozone precursors are all mitigated, by an equal proportion as fossil CO_2 compared to their respective baseline (SRES A1B) scenarios

Model design II

- JCM assumes that future LUC CO_2-emissions become negative for most regions after 2020/2030 relative to sink potential
- Calculation in 16 geographical regions, currently 6 AI, 10 NAI
- Model simulates “emission mechanics”, not “emission dynamics” based on “driving forces” or “least cost paths”;
- Model avoids abrupt changes

Point of Departure

- Worldwide disparity of per capita emissions
- Convergence of per capita emissions until 2100
- Convergence corridor for 2050 around 2-3 t CO_2e/cap

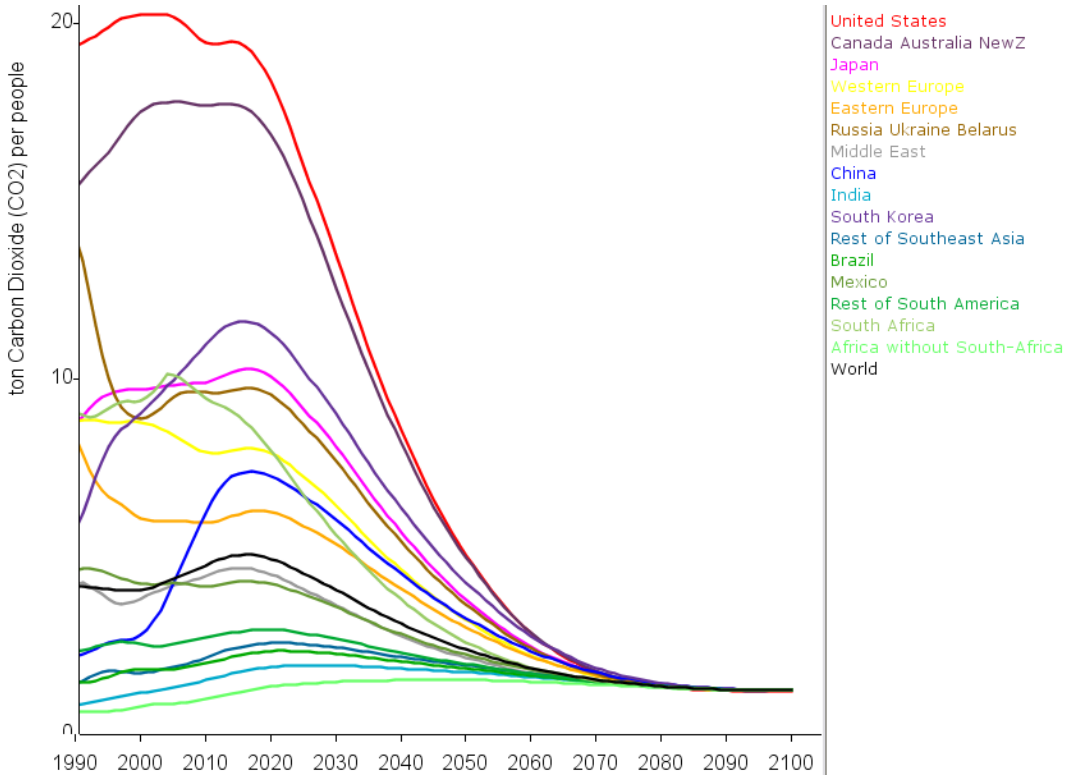


Switzerland today
5.5t CO_2/capita/year

Compare 2100:
1.1t CO_{2e}/capita/year
(at 7.2-8.6 bn people)

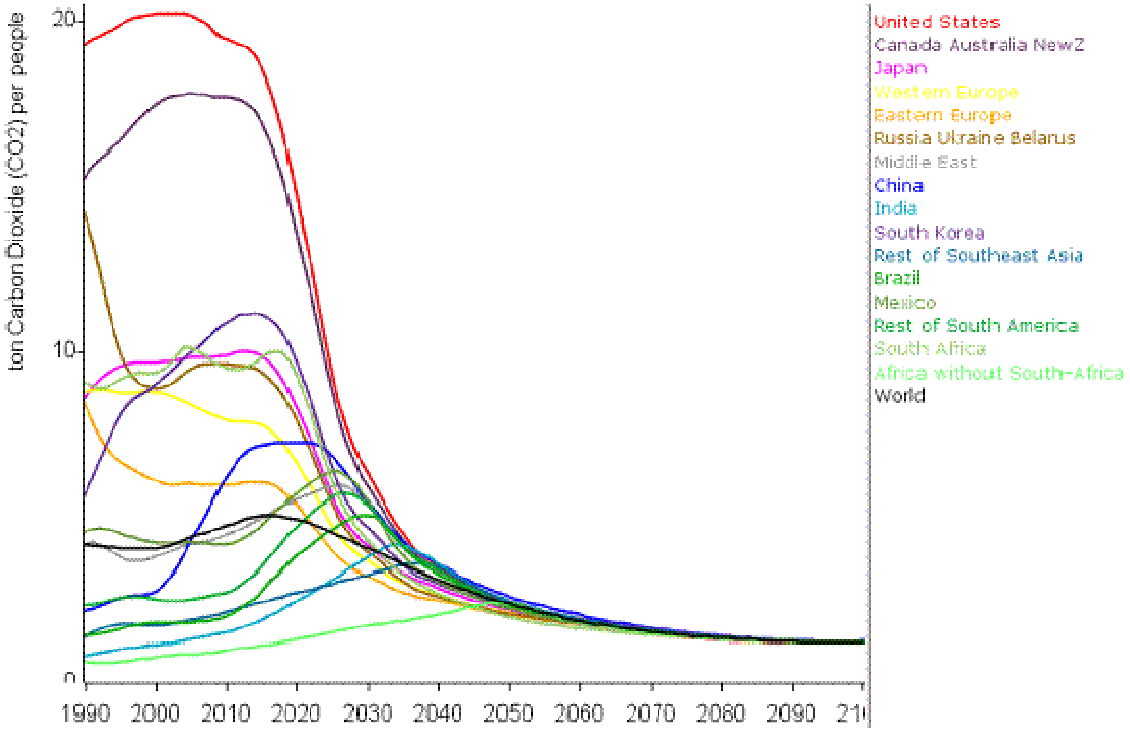
Scenario 1: full participation

- Full participation in action from 2013 onwards (theoretical reference case)
- Per capita emissions of all countries converge in 2100 compliant with 2°C constraint (1.1 tCO_{2e} per capita)



Scenario 2: Emission convergence after reaching „developed countries average“ for NAI

- Korea and Brazil join participating group upon reaching GDP/Cap indicator
- South Africa first NAI country to reach developed countries CO_2e/cap average by 2020



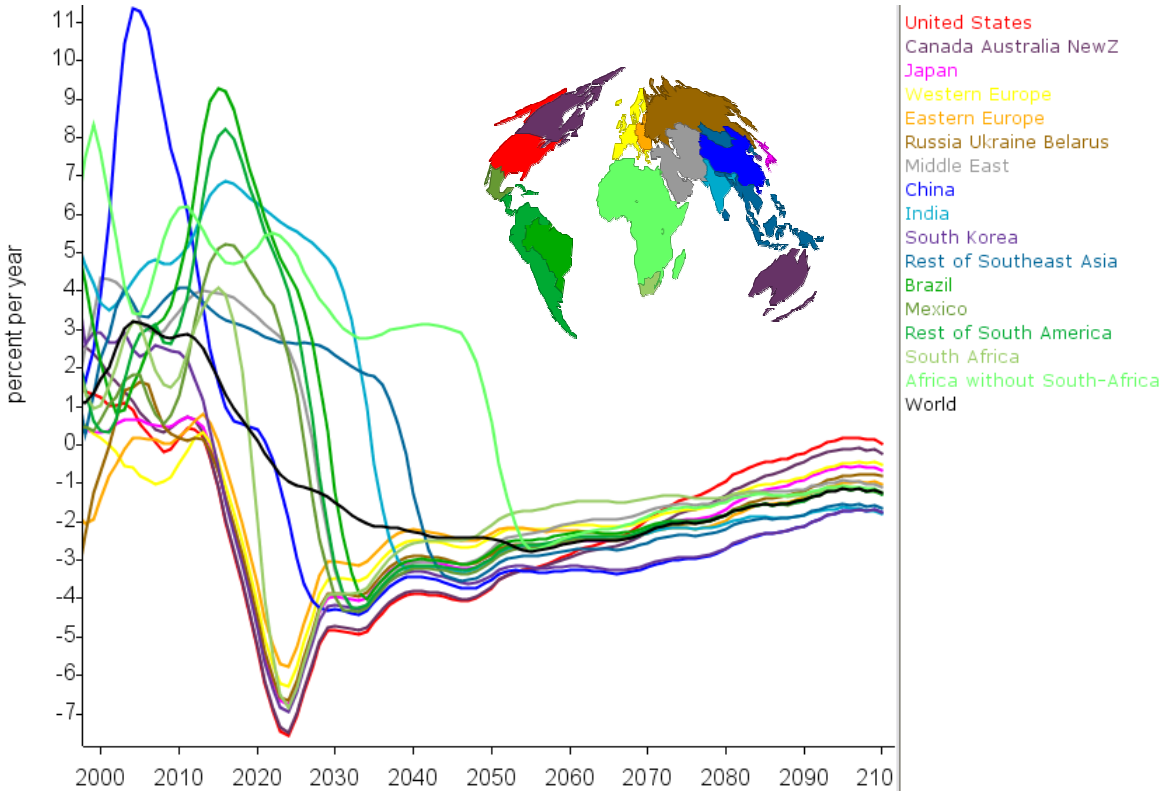
Scenario 2: Year for NAI regions entering the participation group

Countries/regions from Annex I participating from the beginning
United States
Canada, Australia, New Zealand
Japan
West Europe
East Europe
Russia Ukraine Belarus

Further members in subgroups participating to reduction efforts, year of change from initial grouping, criteria for this change		
Region	**Year of change into participating group**	**Criteria for change (average in tC/cap and t CO_2/cap**
South Korea	joins 2013	GDP/cap > 20000 $/cap
South Africa	joins 2020	emit/cap > avg (10.1 tCO_2/cap)
China	joins 2025	emit/cap > avg (6.8 tCO_2/cap)
Mexico	joins 2027	emit/cap > avg (6.3 tCO_2/cap)
Rest of South America	joins 2028	emit/cap > avg (6.0 tCO_2/cap)
Middle East	joins 2028	emit/cap > avg (6.0 tCO_2/cap)
Brazil	joins 2030	GDP/cap > 20000 $/cap
India	joins 2035	emit/cap > avg (4.3 tCO_2/cap)
Rest of Southeast Asia	joins 2040	emit/cap > avg (3.6 tCO_2/cap)
Africa without South-Africa	joins 2051	emit/cap > avg (2.4 tCO_2/cap)

Scenario 2: Annual Emission Reduction rates

- Some of the abrupt rate changes illustrate “fitting” challenge historic trends-SRES scenarios-participation
  (example China, India…)
- Transition to participating group clearly visible for developing countries



Scenario 2: Development of Emission reduction rates in 20 yr. intervals

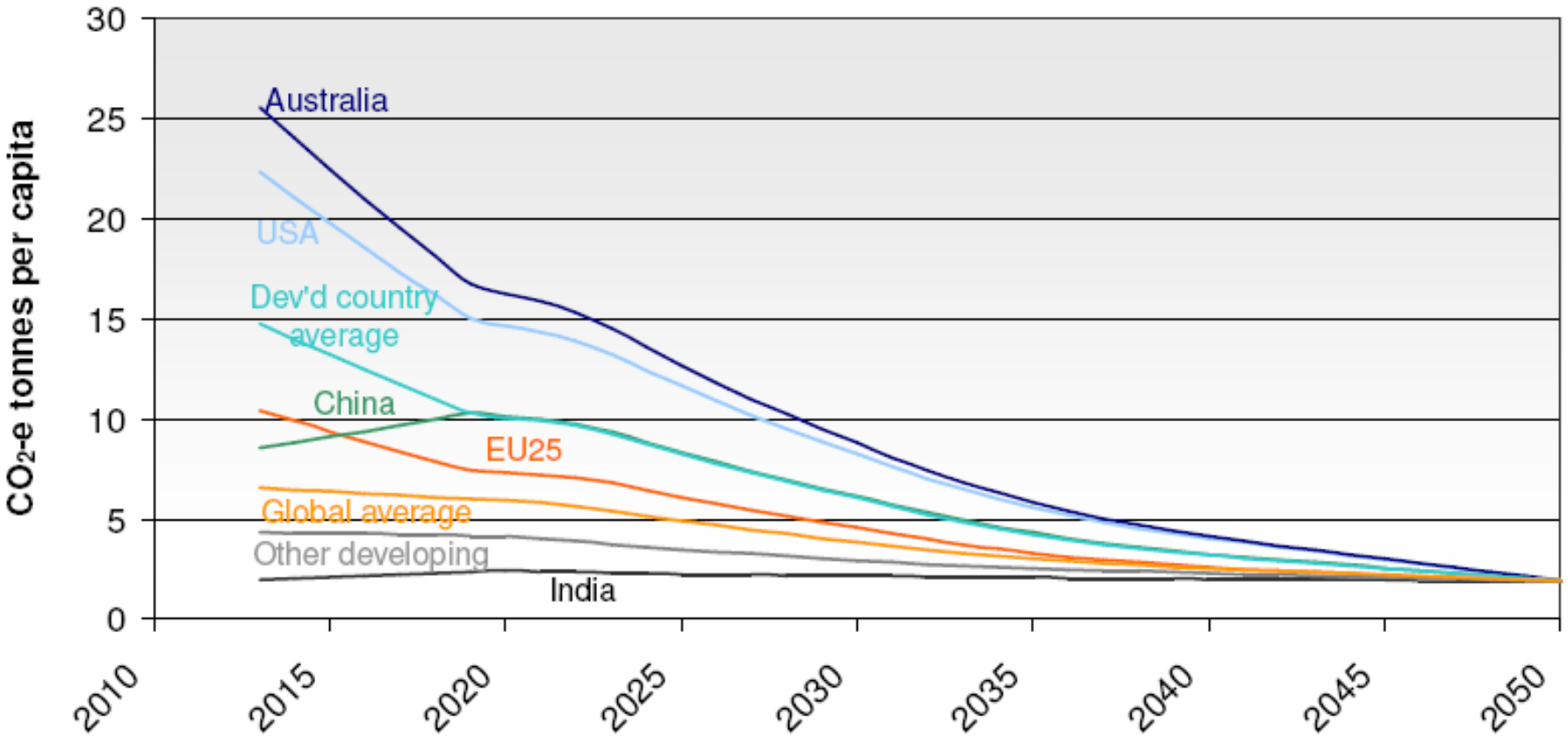
- South Korea, South Africa and China reducing in 2010-2030
- Except Africa, all regions reducing emissions in 2030-2050

Regions	1990-2010	2010-2030	2030-2050	entering part. group
	average reduction rate per year			
United States	0.8%	-4.0%	-4.3%	from start
Canada-Australia-New Zealand	1.4%	-4.0%	-4.2%	from start
Japan	0.7%	-3.4%	-3.4%	from start
Western Europe	-0.4%	-3.1%	-2.9%	from start
Eastern Europe	-2.3%	-2.6%	-2.6%	from start
Russia-Ukraine-Belarus	-2.1%	-3.4%	-3.3%	from start
South Korea	4.1%	-3.4%	-3.7%	2013
South Africa	1.9%	-1.5%	-3.0%	2020
China	6.4%	-0.4%	-3.9%	2025
Mexico	0.6%	2.4%	-3.6%	2027
Middle East	2.5%	2.3%	-3.5%	2028
Rest of South America	2.4%	4.3%	-3.6%	2028
Brazil	3.2%	5.6%	-3.4%	2030
India	4.8%	5.9%	-1.9%	2035
Rest of Southeast Asia	3.6%	3.0%	-1.2%	2040
Africa without South-Africa	5.0%	4.9%	2.9%	2051
World	1.9%	0.3%	-2.3%	

Consistency of results with other models? Garnaut 2008

- Cross comparison with Garnaut 450 ppm scenario:
  - most Annex I regions to reduce emissions by 80-90% until 2050, compliant with JCM5
  - Proposes “convergence in per capita emissions” at around 2.5 t CO_2/cap by 2050
  - No phased grace period for developing countries in “joining the participating group”
  - Explores dynamics of ”early action” in deviation from baseline with financial support from AI countries (CDM plus new BAP finance instruments)

Comparison with Garnaut
Participation in 450 ppm scenario (2°C)



Garnaut et al. 2008

Conclusions, next steps

- Indicator constrained emission path analysis helps to better understand margins for negotiation under a 2°C climate objective
- More advanced modelling efforts required for assessing "dynamics" of BAP 1B(i)/1b(ii) action through flexible mechanisms and financial support towards "cap and trade"
- Assessment of Impacts (energy security, GDP) need further investigation
- leading to understanding of indicators to be used in fair allocation of emission space under BAP joint vision
- Governance/monitoring of convergence approaches as key challenges as LUC and other GHG emission sources are assumed to be mitigated in parallel

Contact for opinions and feedback:
Interactive JCM5 model available, documentation to follow soon

jose.romero@bafu.admin.ch
othmar.schwank@infras.ch
www.infras.ch

Thank you