Preliminary IAM scenarios based on the RCP/SSP framework

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International Institute for Applied Systems Analysis

CCI/IA Workshop
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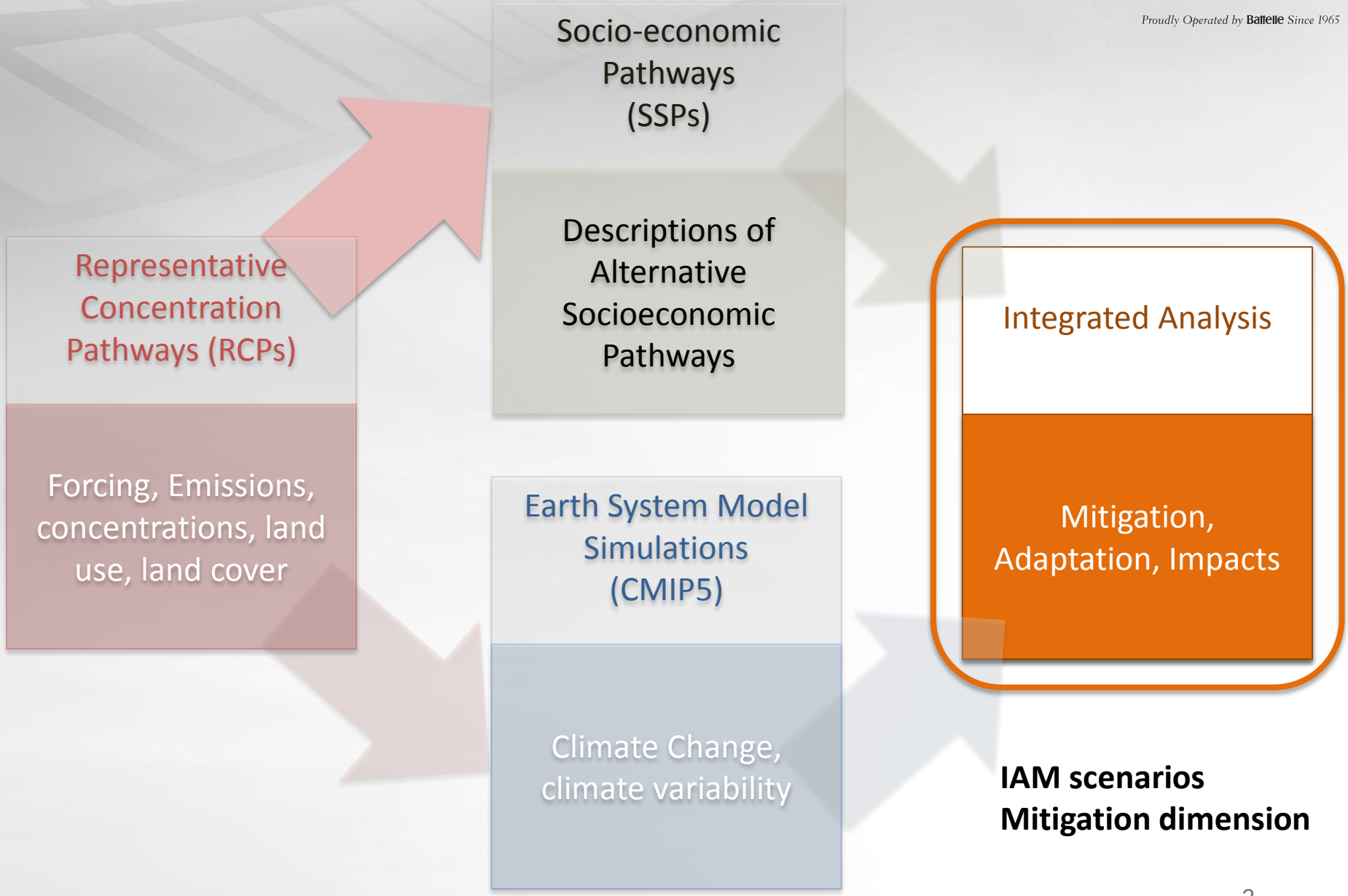
Snowmass, Colorado

SSPs and Integrated Analysis



IAM scenarios
Mitigation dimension

Moss, Edmonds, et al. (2010)

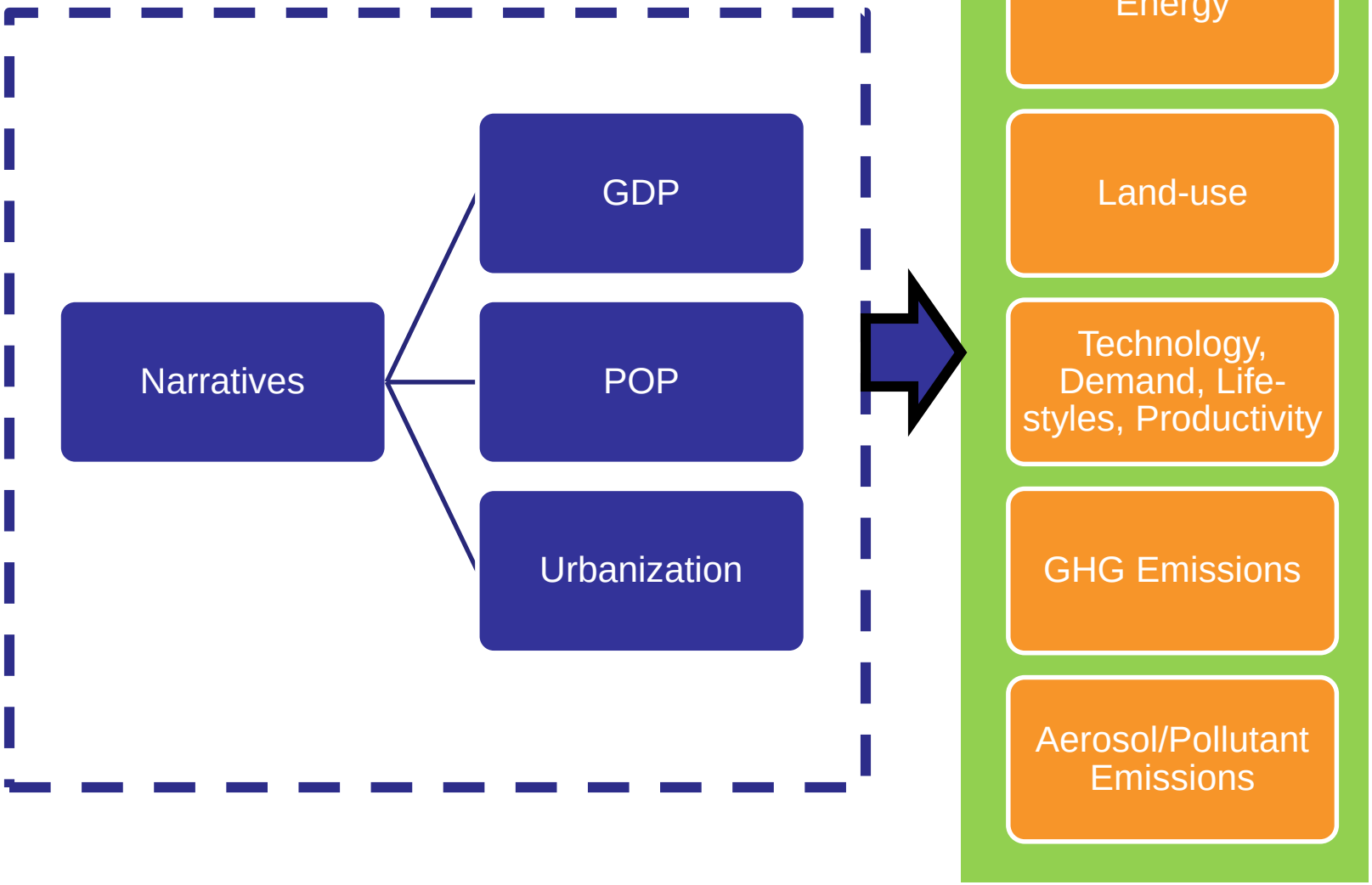
SSP Process

- Conceptual framework and nature of the SSPs established
- Quantification of key elements of the SSPs has been completed
- Narratives completed
- Refined (but not final) IAM reference scenarios developed
- Preliminary SPAs defined
- Initial climate policy scenarios
- Preliminary IAM SSP marker selected

- Still to do:
  - Continue vetting and development of SSP IAM scenarios
  - Check SPAs for refined stabilization analyses

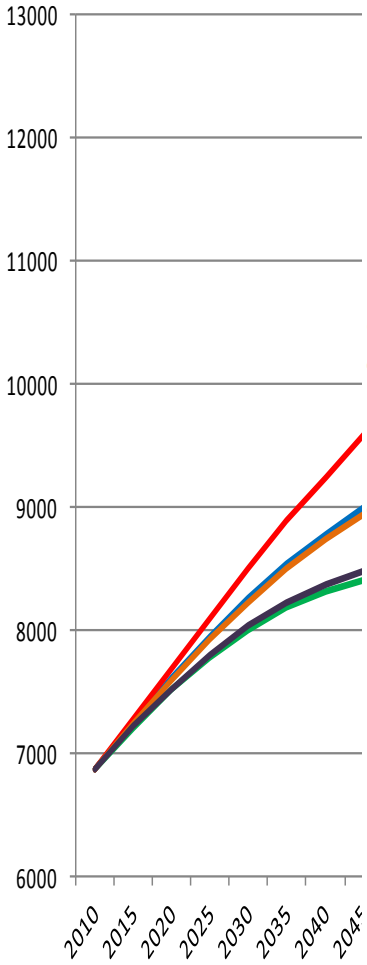
IAM Models

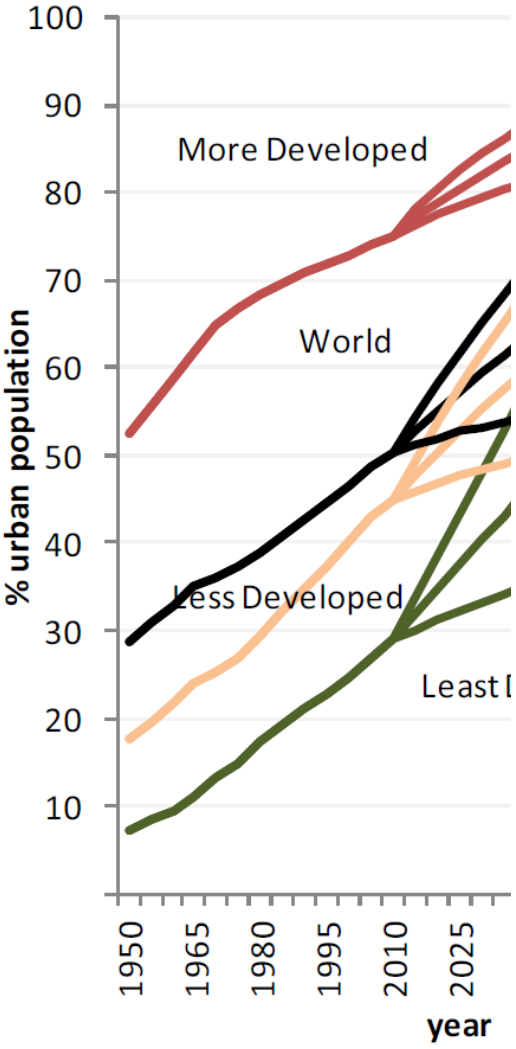
SSPs (Assumptions)

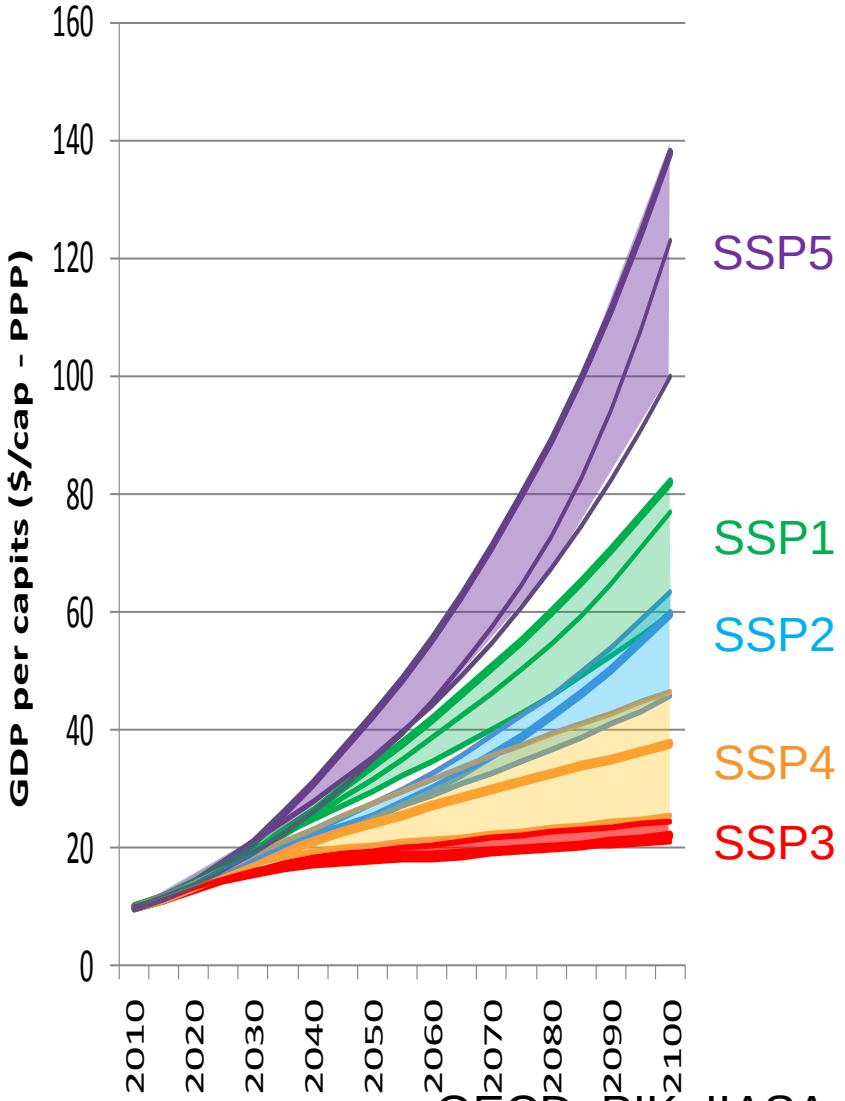


SSP ASSUMPTIONS

Global Driver Assumptions





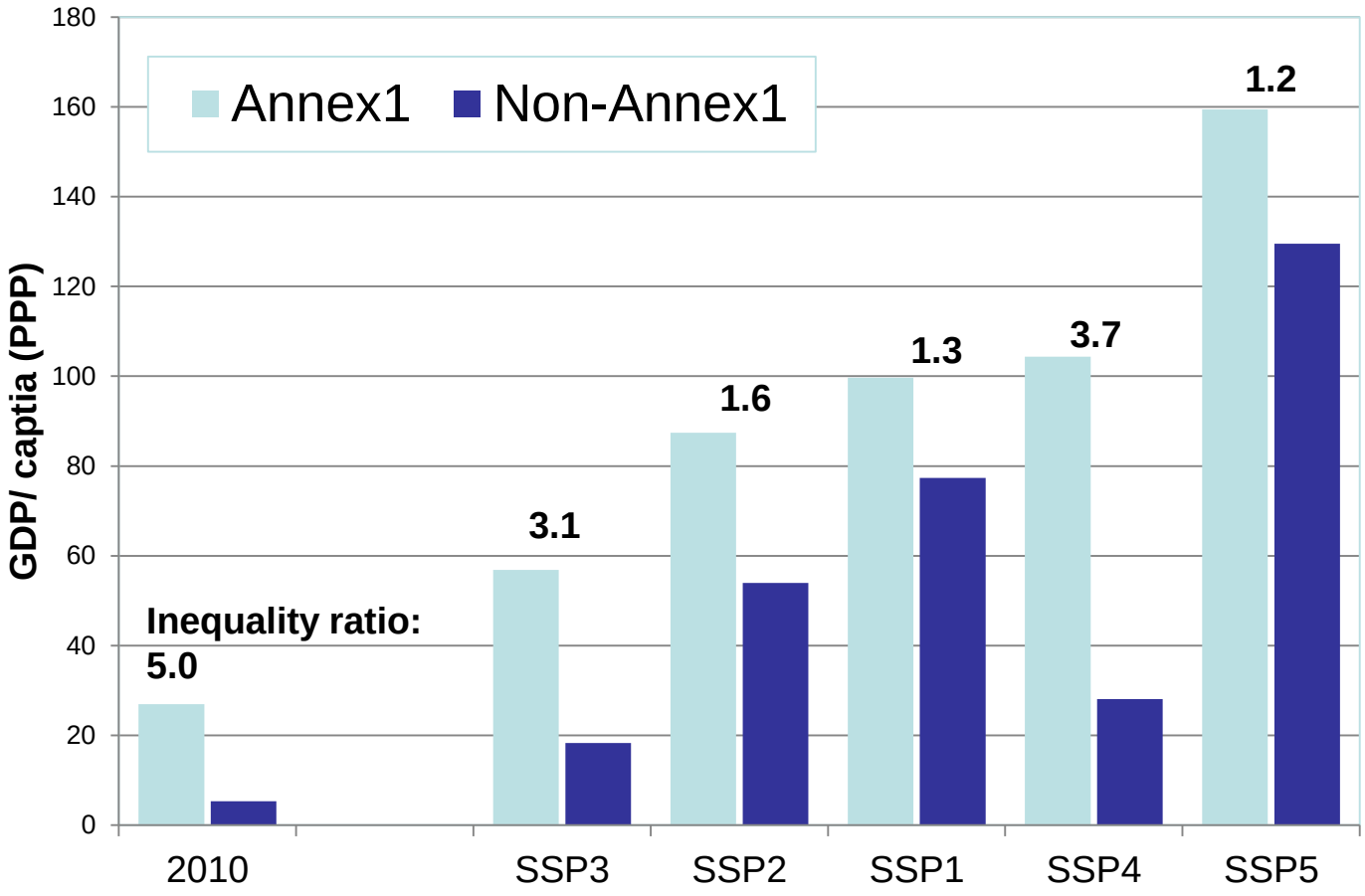


Lutz & KC, 2014

Jiang & O'Neill

OECD, PIK, IIASA

Inequality assumptions across SSPs



OECD Projections

Assumptions about other drivers

Energy demand (access, intensity of services, environmental awareness, etc..)

	SSP 1			SSP 2			SSP 3			SSP 4			SSP 5		
	Country Income Groupings														
SSP Element	**Low**	**Med**	**High**	**Low**	**Med**	**High**	**Low**	**Med**	**High**	**Low**	**Med**	**High**	**Low**	**Med**	**High**
Non-climate Policies															
Traditional Fuel Use	fast phase-out, driven by policies and economic development			intermediate phase-out, regionally diverse speed			continued realiance on traditional fuels			continued traditional fuel use	some traditional fuel use among low income housholds		fast phase-out, driven by development priority		
Energy Demand Side															
Lifestyles	modest service demands (less material intensive)			medium service demands (generally material intensive)			medium service demands (material intensive)			low service demands	modest service demands		high service demands (very material intensive)		
Environmental Awareness	high			medium			low			low	high		medium (low for global level/high for local level)		
Energy Intensity of Services															
Industry	low			medium			high			high	low		medium		
Buildings	low			medium			high			medium	low/medium		medium		
Transportation	low			medium			medium		high	low/medium	low		high		
General Comments				some regional diversity retained											

Fossil resources (availability, costs, trade, etc..)

	SSP 1			SSP 2			SSP 3			SSP 4			SSP 5		
							Country Income Groupings								
SSP Element	**Low**	**Med**	**High**	**Low**	**Med**	**High**	**Low**	**Med**	**High**	**Low**	**Med**	**High**	**Low**	**Med**	**High**
Coal															
Macro-economy	cost driver			neutral			cost reducing			cost reducing	neutral	cost driver	cost reducing		
Technology	medium			medium			high			medium			very high		
National & environmental policy	very restrictive			supportive			very supportive			supportive	supportive	restrictive	very restrictive		
Conv. Hydrocarbons															
Macro-economy	neutral			neutral			neutral			cost driver			cost reducing		
Technology	medium			medium			medium			fast			very high		
National & environmental policy	restrictive			supportive			mixed (not supported in MEA/FSU)			supportive	supportive	restrictive	very restrictive		
Non-conv. Hydrocarbons															
Macro-economy	neutral			neutral			neutral			cost driver			cost reducing		
Technology	slow			medium			medium			medium			very high		
National & environmental policy	very restrictive			supportive			very supportive			supportive	supportive	restrictive	very restrictive		
General															
Trade barriers	Free			Barriers			High Barriers			Barriers			Free		

Qualitative descriptions

Modeling teams were flexible to make own interpretations

More assumptions….

Energy technologies (Innovation, acceptance, costs, etc…)

	SSP 1			SSP 2			SSP 3			SSP 4			SSP 5		
	Country Income Groupings														
SSP Element	**Low**	**Med**	**High**	**Low**	**Med**	**High**	**Low**	**Med**	**High**	**Low**	**Med**	**High**	**Low**	**Med**	**High**
Conventional and Unconventional Fossil Fuel Conversion (synfuel and syngas in parenthesis if different)															
Technology Development		Med			Med			Low		Low	Med	Med		Med (High)	
Social Acceptance		Low			Med			High		High	Low	Low		High	
Commercial Biomass Conversion															
Technology Development		High			Med			Low		High	High	High		Med	
Social Acceptance		Low			Med			High		High	High	High		Med	
Non-bio Renewables Conversion															
Technology Development		High			Med			Low		High	High	High		Med	
Social Acceptance		High			Med			Med		High	High	High		Low	
Nuclear Power															
Technology Development		Med			Med		Low	Low	Med	High	High	High		Med	
Social Acceptance		Low			Med		High	High	High	High	Med	Med		Med	
CCS (under climate policy only)															
Technology Development		Med			Med			Med		High	High	High		High	
Social Acceptance		Low			Med			Med		High	Med	Med		Med	

Land use change (productivity, regulation, trade, diets, etc…)

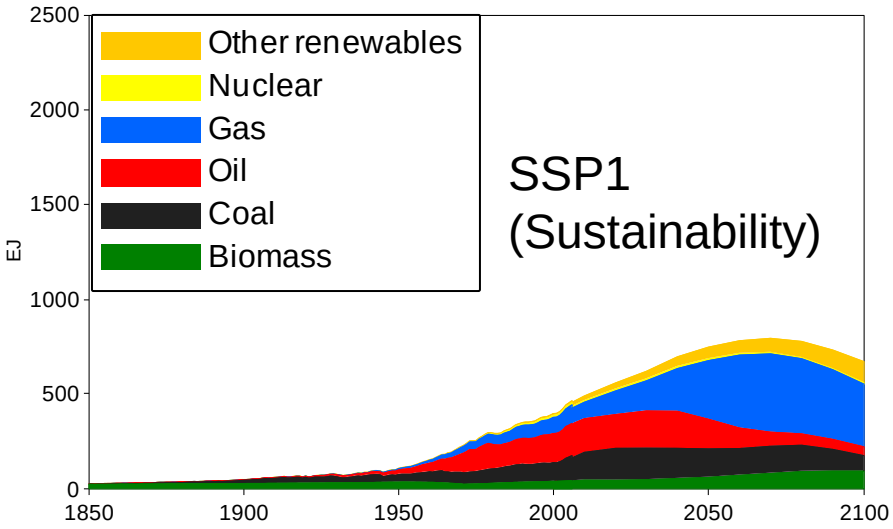
	SSP 1			SSP 2			SSP 3			SSP 4			SSP 5		
	Country Income Groupings														
SSP Element	**Low**	**Med**	**High**	**Low**	**Med**	**High**	**Low**	**Med**	**High**	**Low**	**Med**	**High**	**Low**	**Med**	**High**
Land use change regulation		strong			medium			weak		weak	medium	strong		medium	
Agriculture															
Land productivity growth	rapid	rapid	medium		medium			slow		slow	medium	rapid		rapid	
Environmental Impact of food consumption		low			medium			high			medium			high	
International Trade		globalized			regionalized			regionalized		limited access	globalized	globalized		globalized	

REFERENCE SCENARIOS (NO CLIMATE POLICY)

Energy – SSP Reference Cases

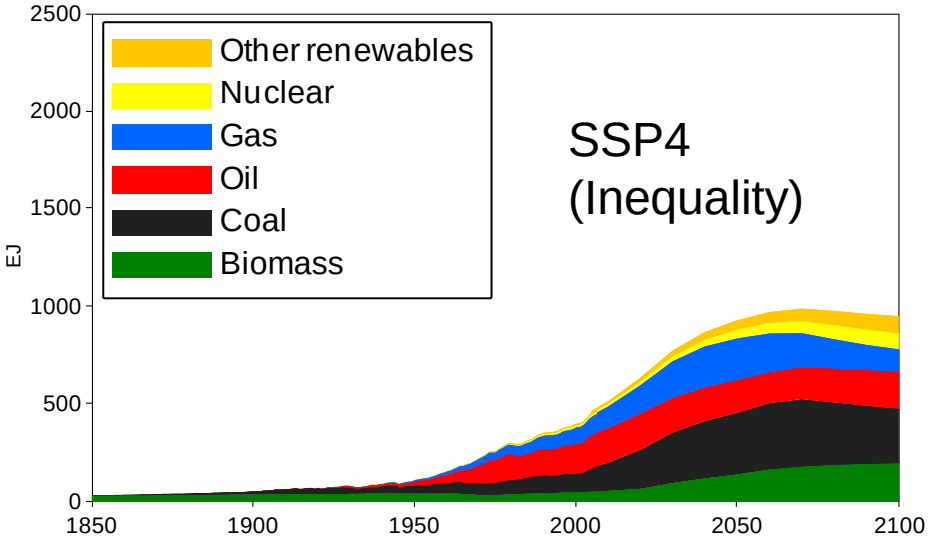
Two scenarios where mitigation is relatively easy

IMAGE



Transition away from coal/oil
Low demand

GCAM

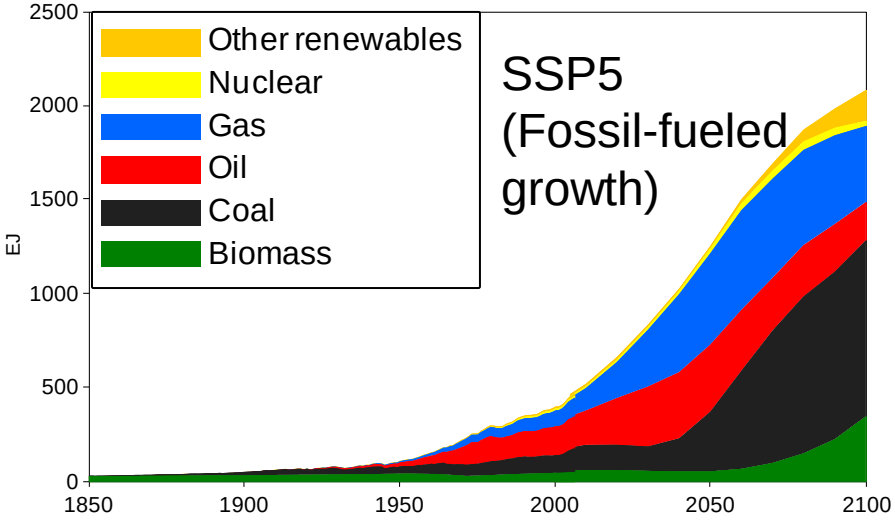


High share of poor with low emissions
Low/intermediate demand
Technology available to the “elite”

Energy – SSP Reference Cases

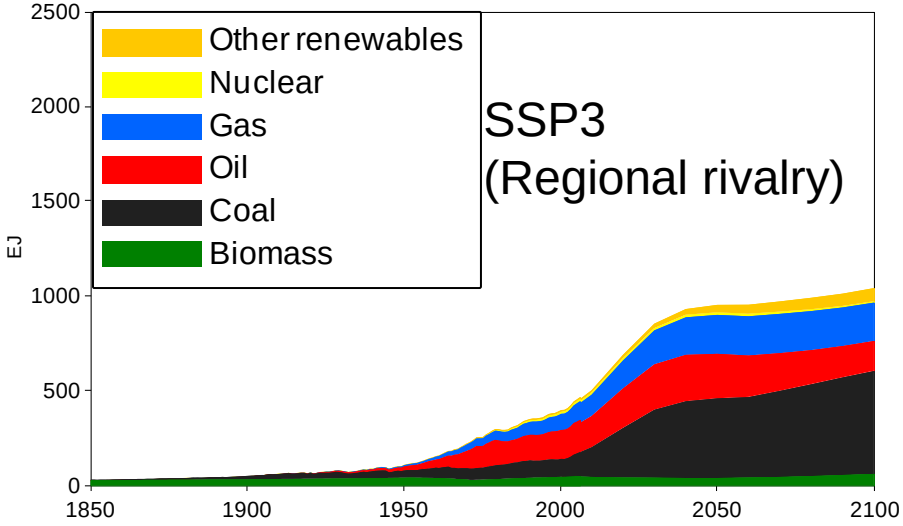
Two scenarios where mitigation is relatively difficult

REMIND-MAGPIE



Coal-intensive development
Very high demand

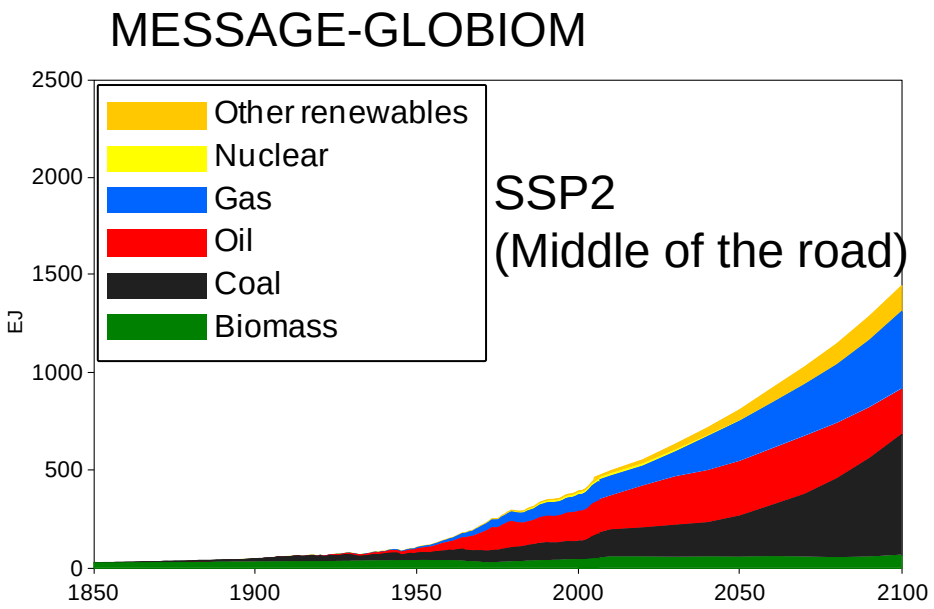
AIM



Fossil-intensive
High poverty
Slow technological change
Strong fragmentation

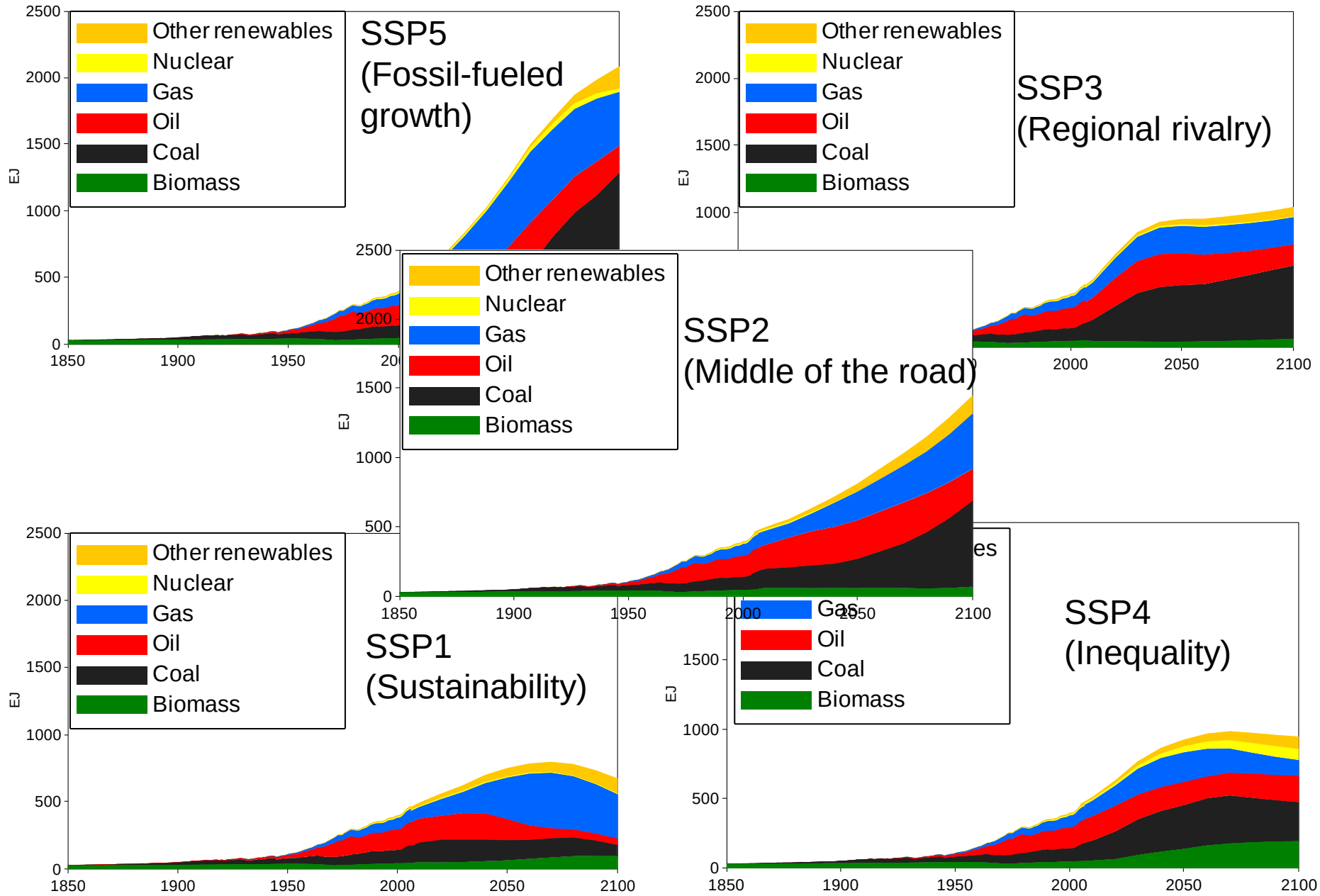
Energy – SSP Reference Cases

A central scenarios with intermediate mitigation challenge



Balanced Technology
Intermediate demand

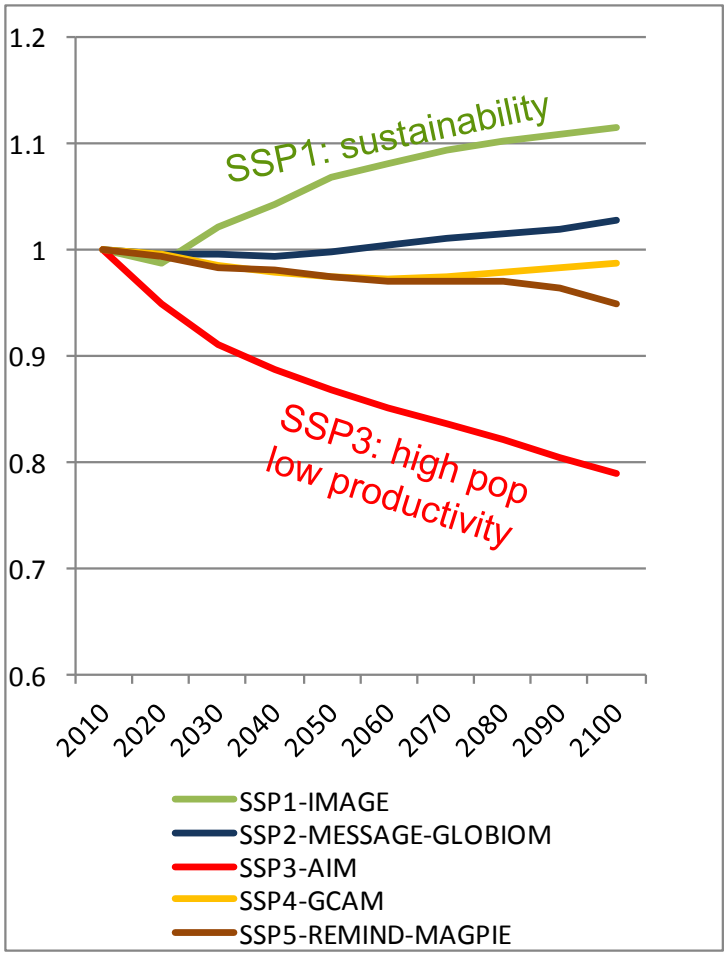
Energy – SSP Reference Cases



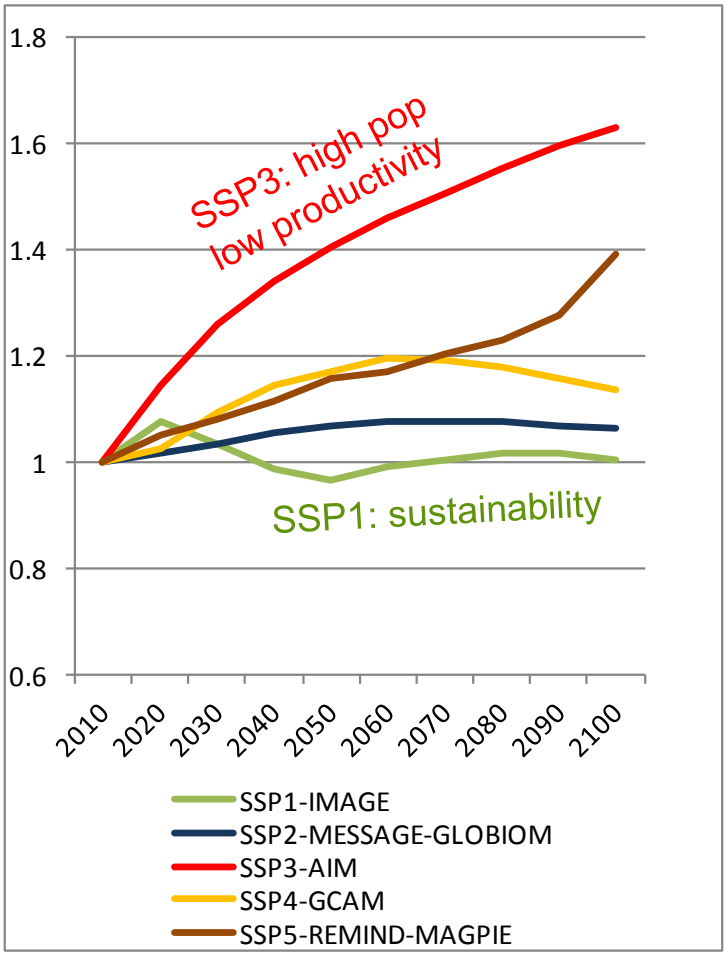
Land-use Change

(index 1=2010)

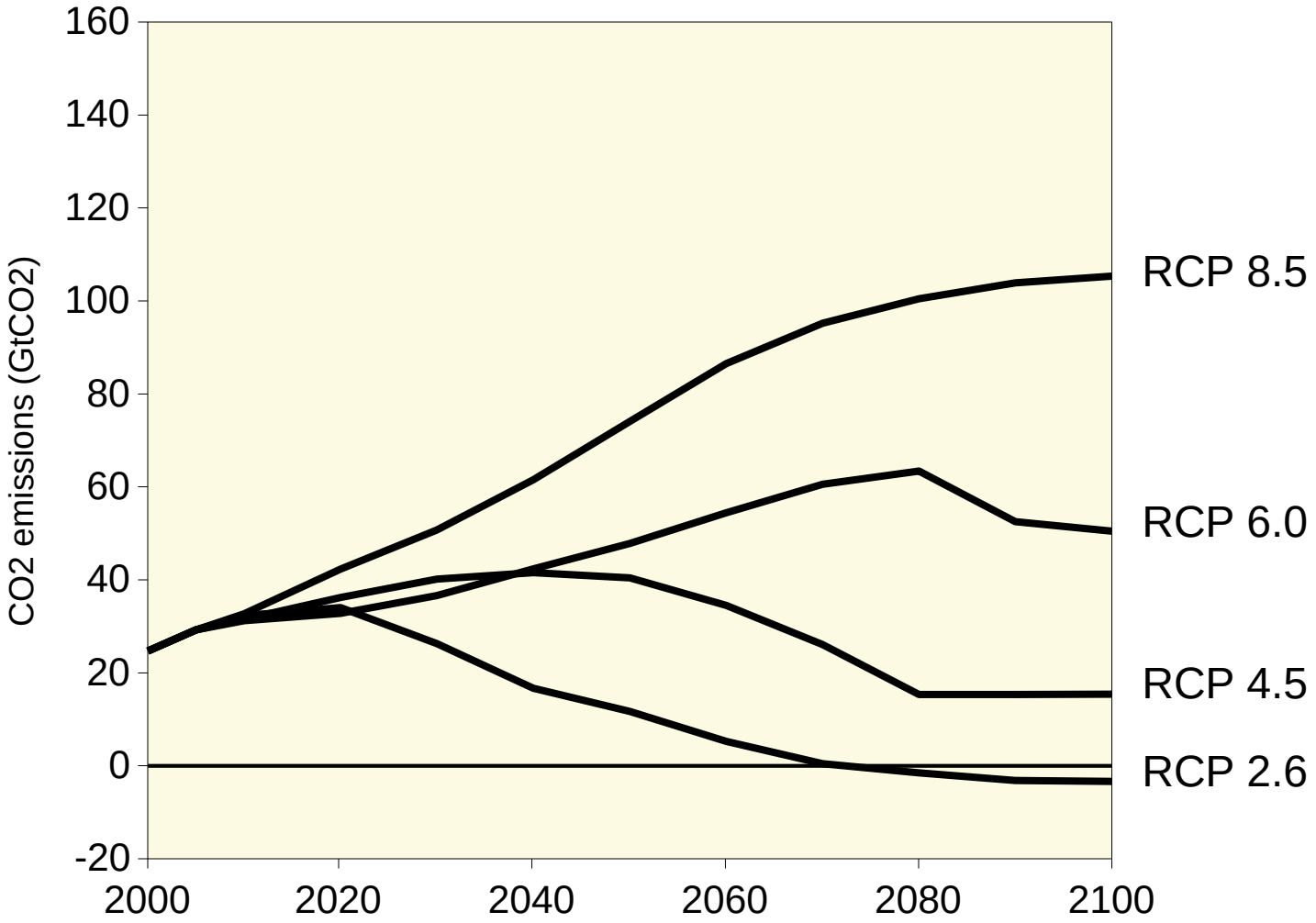
Forest land



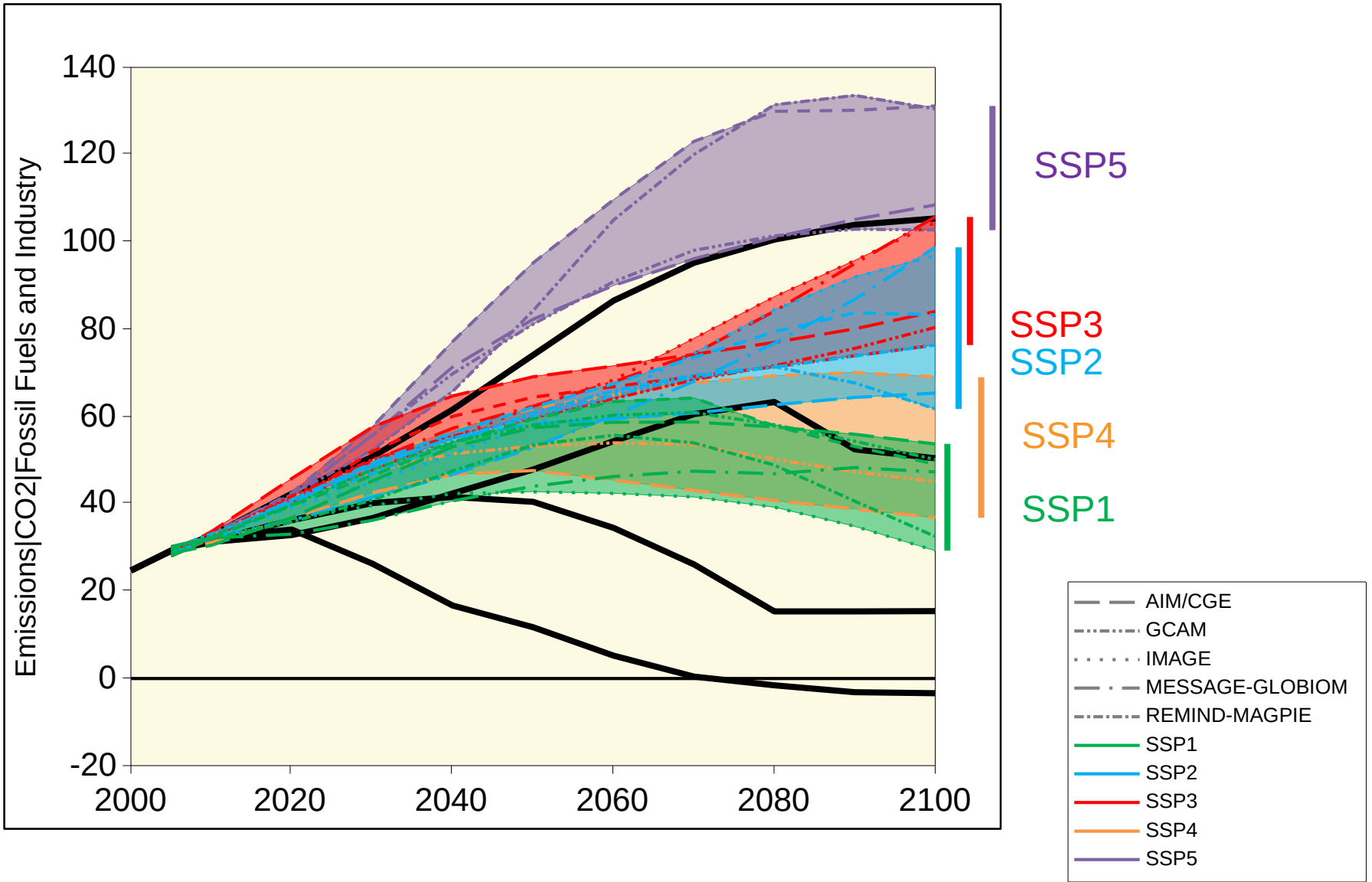
Cropland



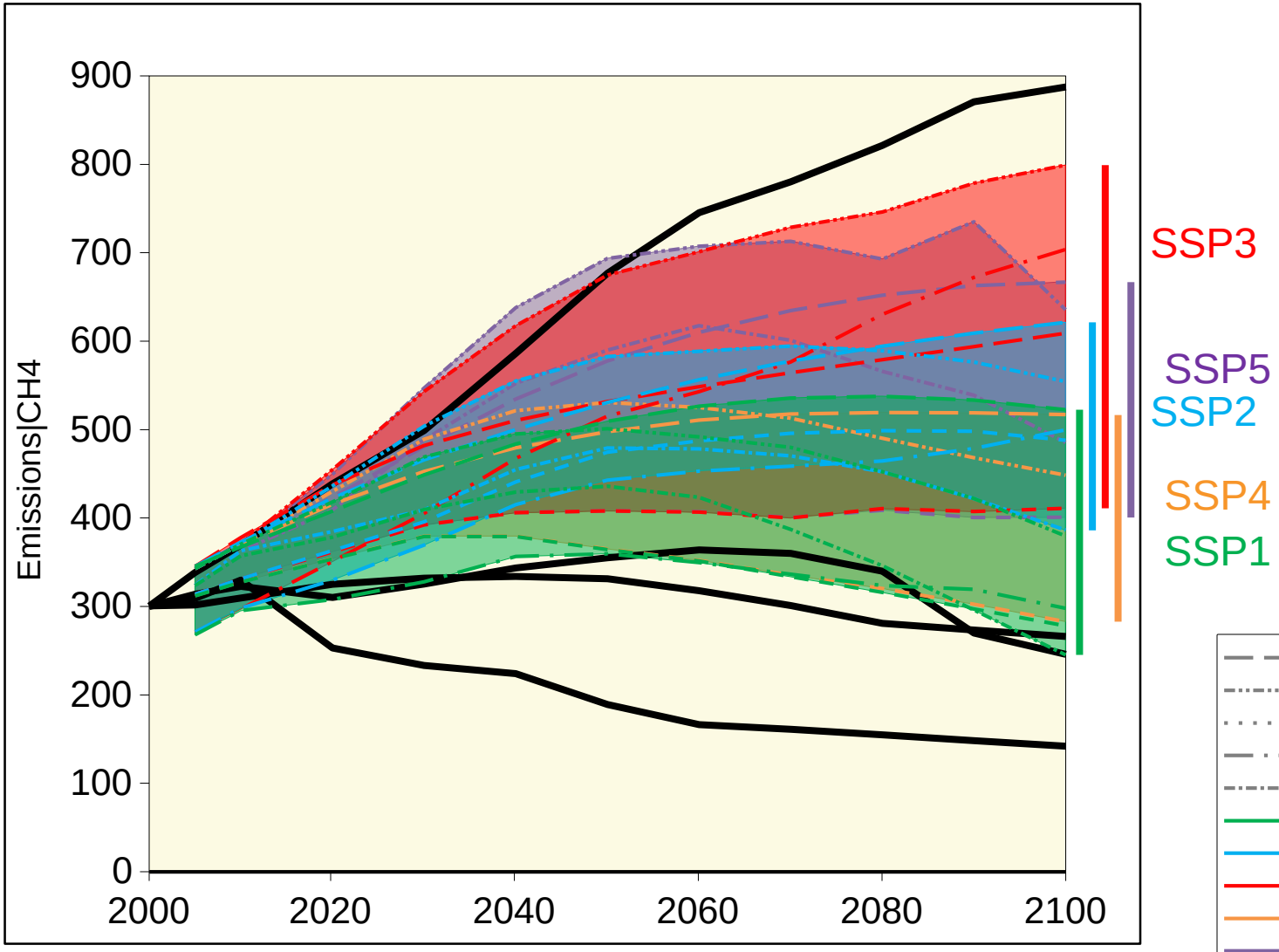
RCP CO2 Emissions, World (Fossil fuels and Industry)



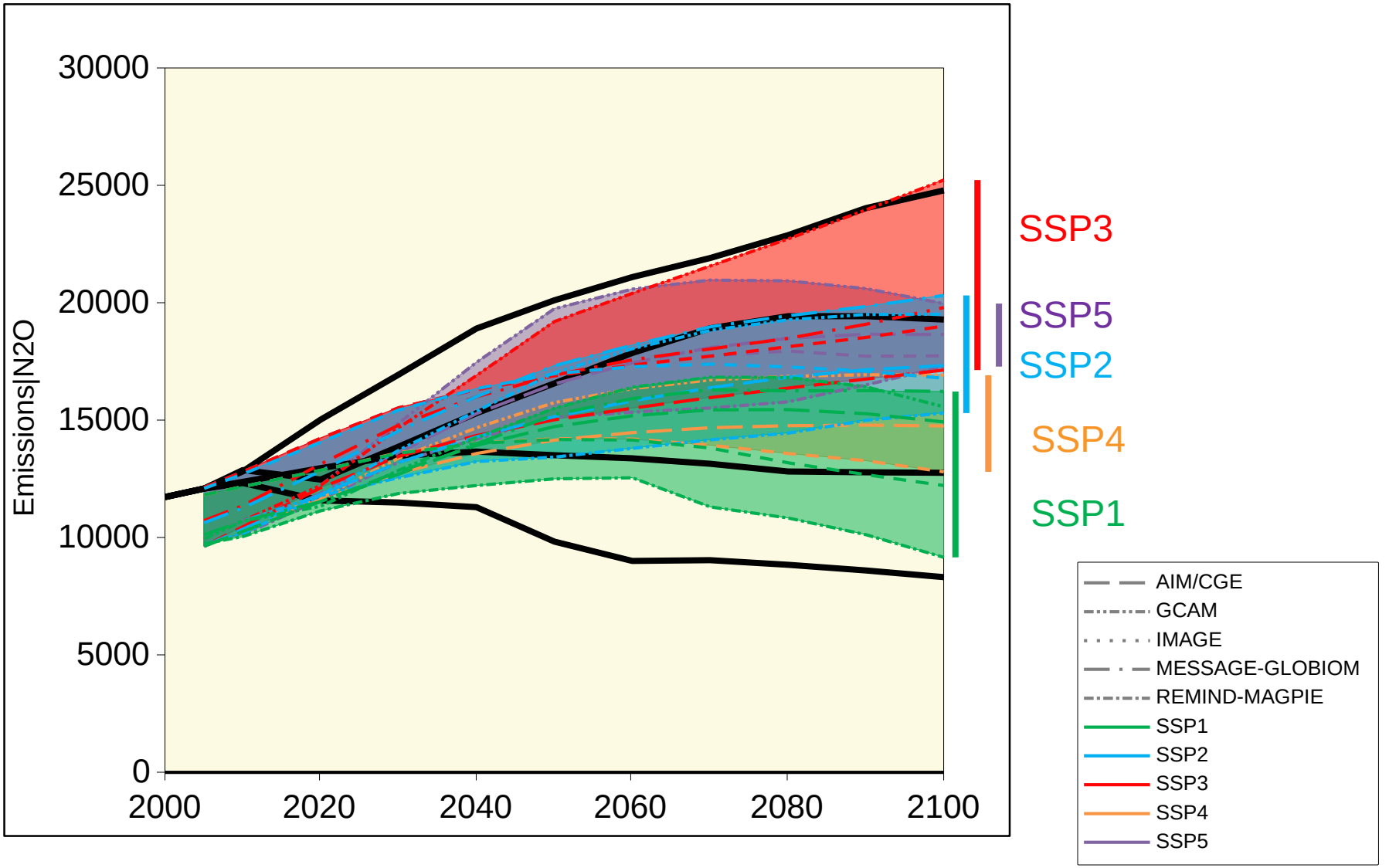
Fossil fuels and Industry CO2 Emissions, World (Reference Scenarios)



CH4 Emissions, World
Reference Scenarios

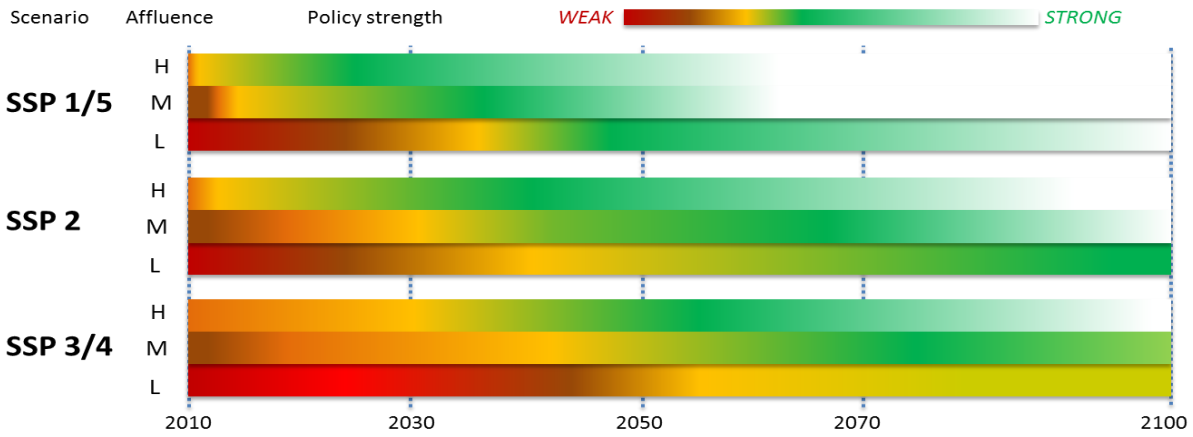


N2O Emissions, World
Reference Scenarios

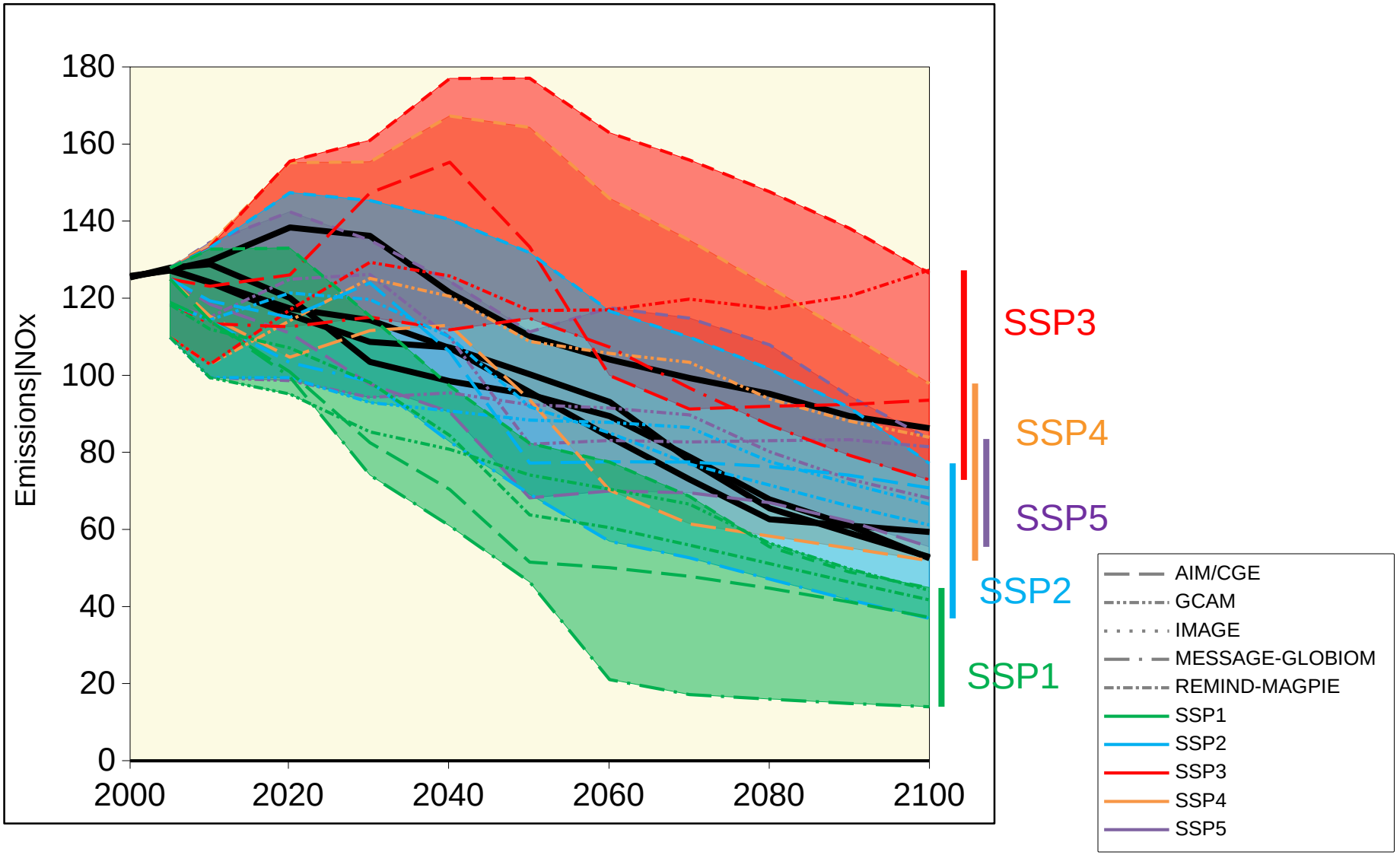


Air pollution policy assumptions (Storylines, exposure, targets)

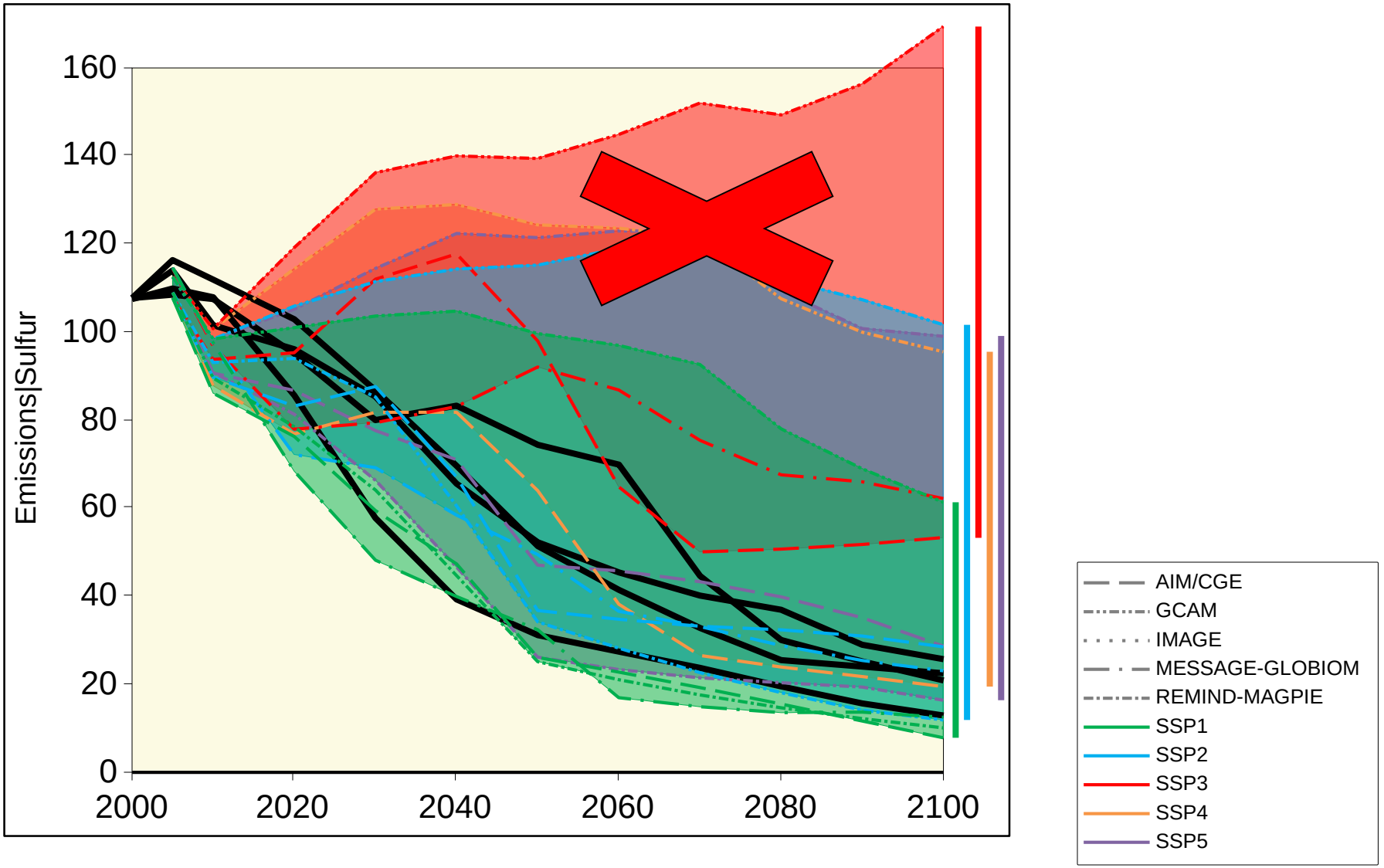
	Policy Targets (exposure/concentrations)		Technological Innovation
Policy Strength	***High Income* Countries**	***Medium and Low Income***	
Strong	Much lower than current targets in order to minimize adverse effects on both general population, vulnerable groups, and ecosystems.	Comparatively quick catch-up with the developed world (relative to income)	Pollution control technology costs drop substantially with control performance increasing.
Central	Lower than current targets	Catch-up with the developed world at income levels lower than when OECD countries began controls (but not as quick as in the strong control case).	Continued modest technology advances.
Weak	Regionally varied policies.	High emissions levels and/or institutional limitations substantially slower progress in pollution control.	Lower levels of technological advance overall.



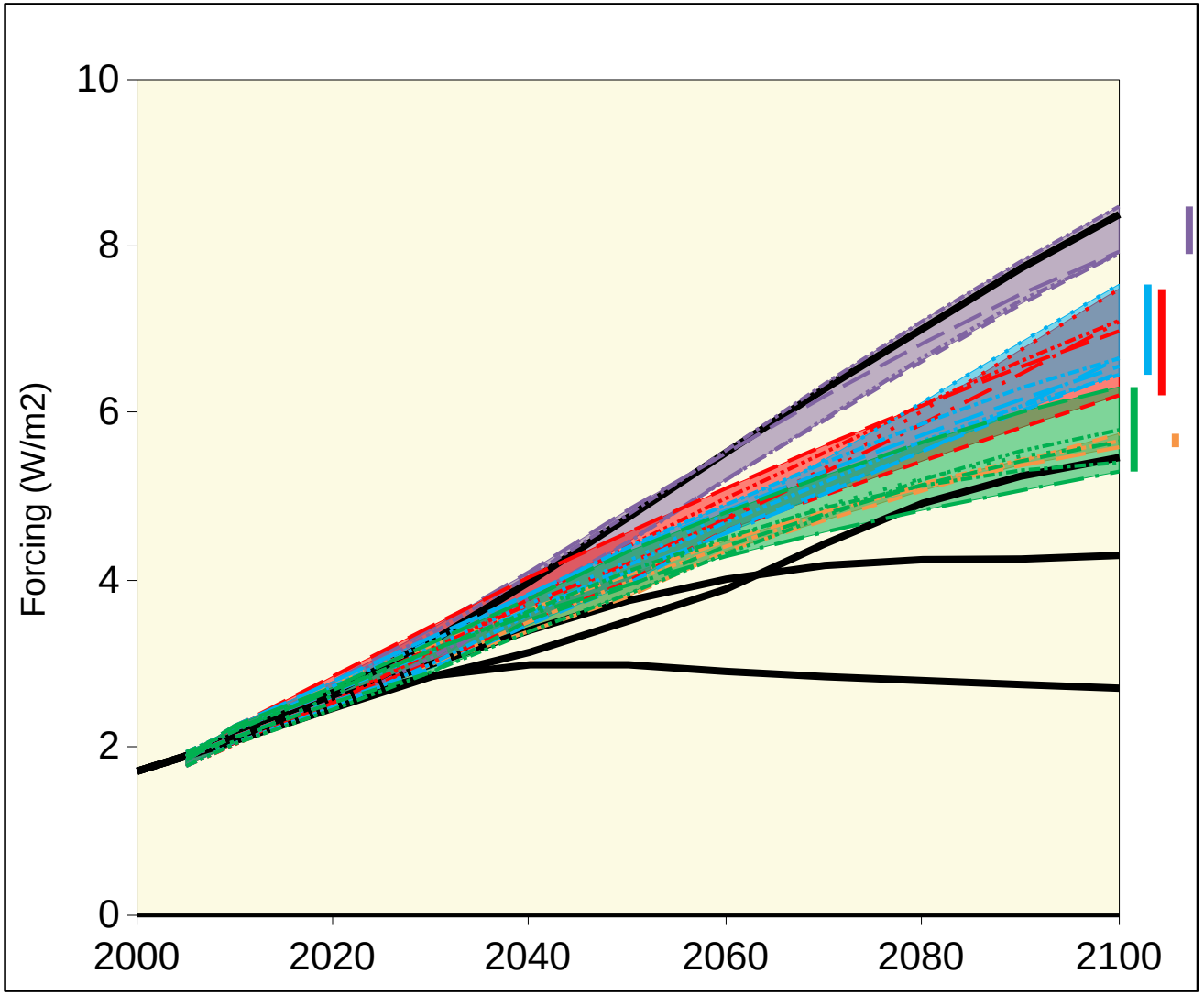
World Emissions|NOx
SSP reference scenarios



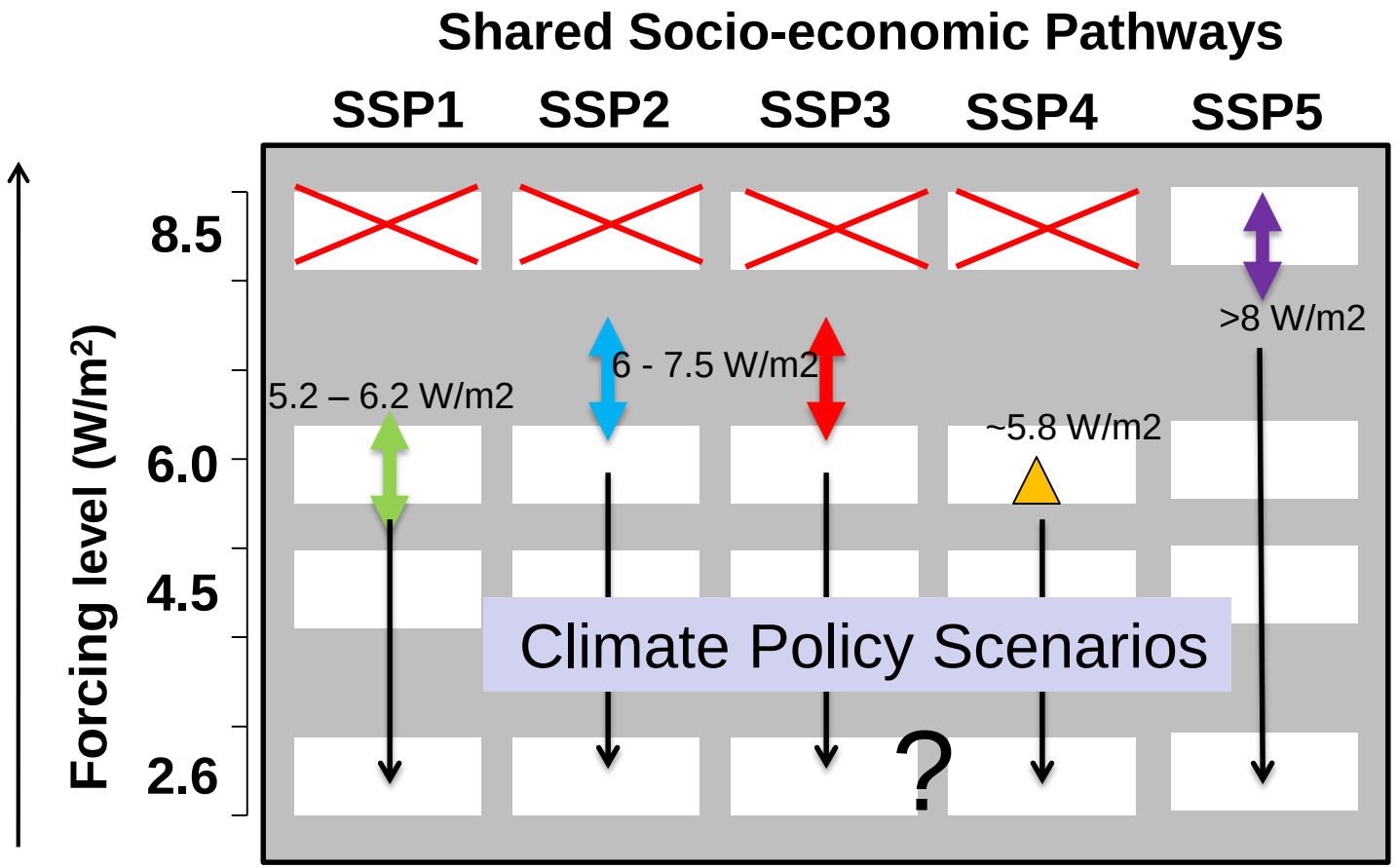
World Emissions|Sulfur
SSP Reference Scenarios



World Radiative Forcing
Reference Scenarios



SSP/RCP combinations based on reference IAM scenarios



CLIMATE POLICY SCENARIOS

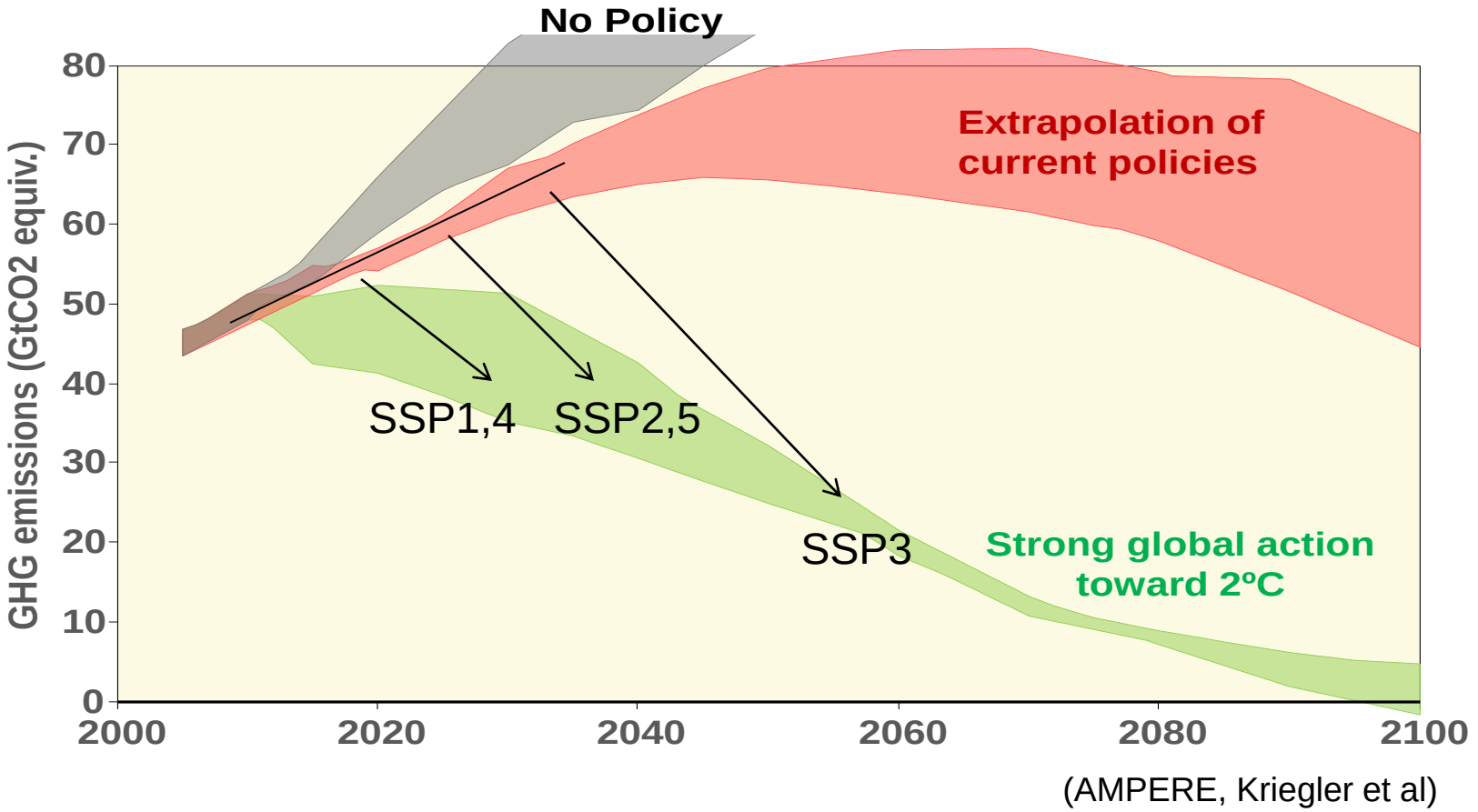
Shared Policy Assumptions SPAs

SSPs describe worlds with widely different challenges to mitigation due to eg fragmentation, lack of institutions, inequity, lack of technology, etc..

SPAs reflect these differences

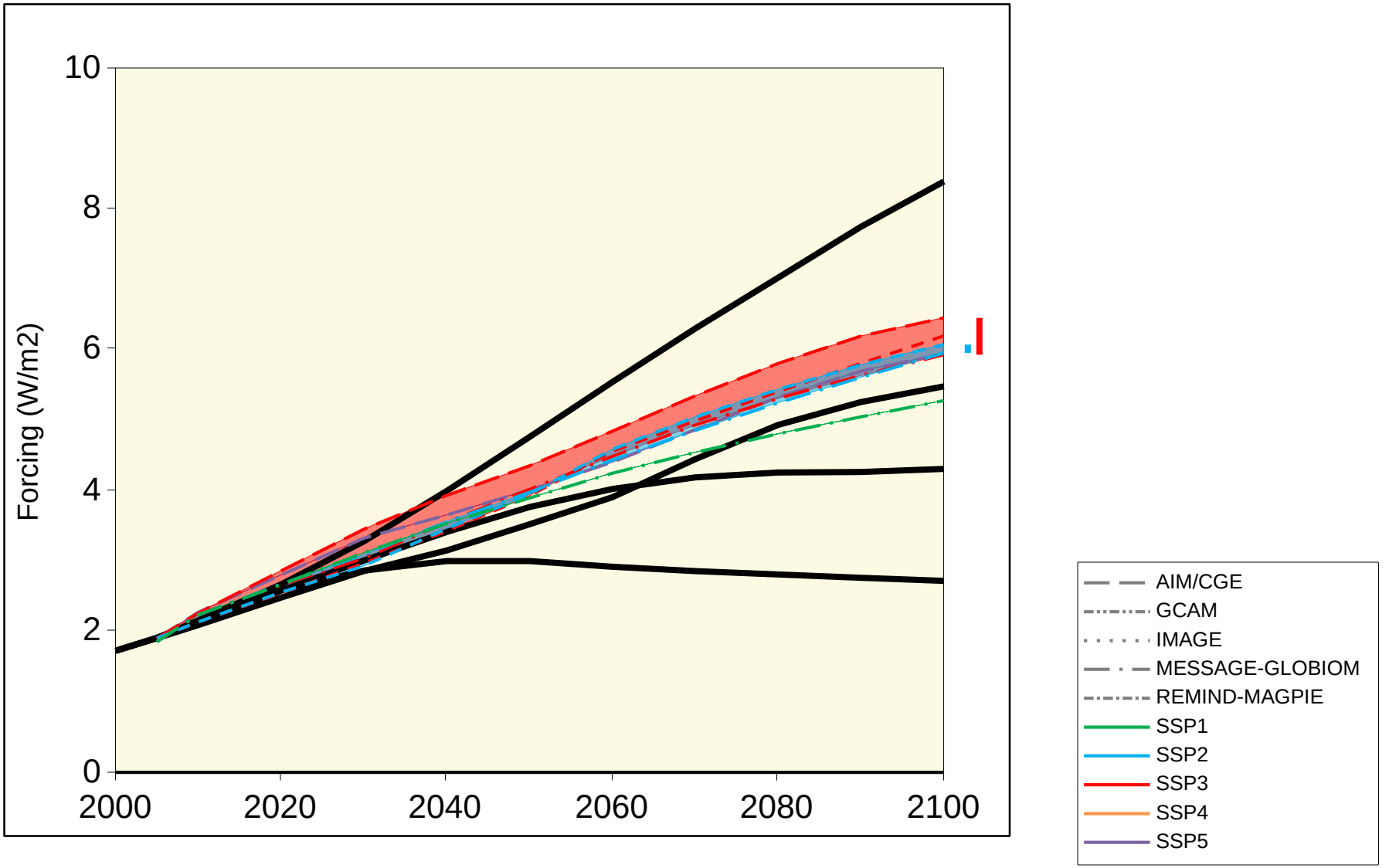
Accession/ Regional Participation	Effectiveness of land policies
F1: Early Accession, Global collaboration as of 2020 SSP1, SSP4	L1 highly effective SSP1
F2: Some delays, poor regions join in 2030 SSP2,5	L2 Intermediately effective (limited REDD) SSP2,4
F3: Late Accession, poor regions join in 2040 SSP3	L3 Low effectiveness (implementation failures, high transaction costs) SSP3

Shared Policy Assumptions Accession

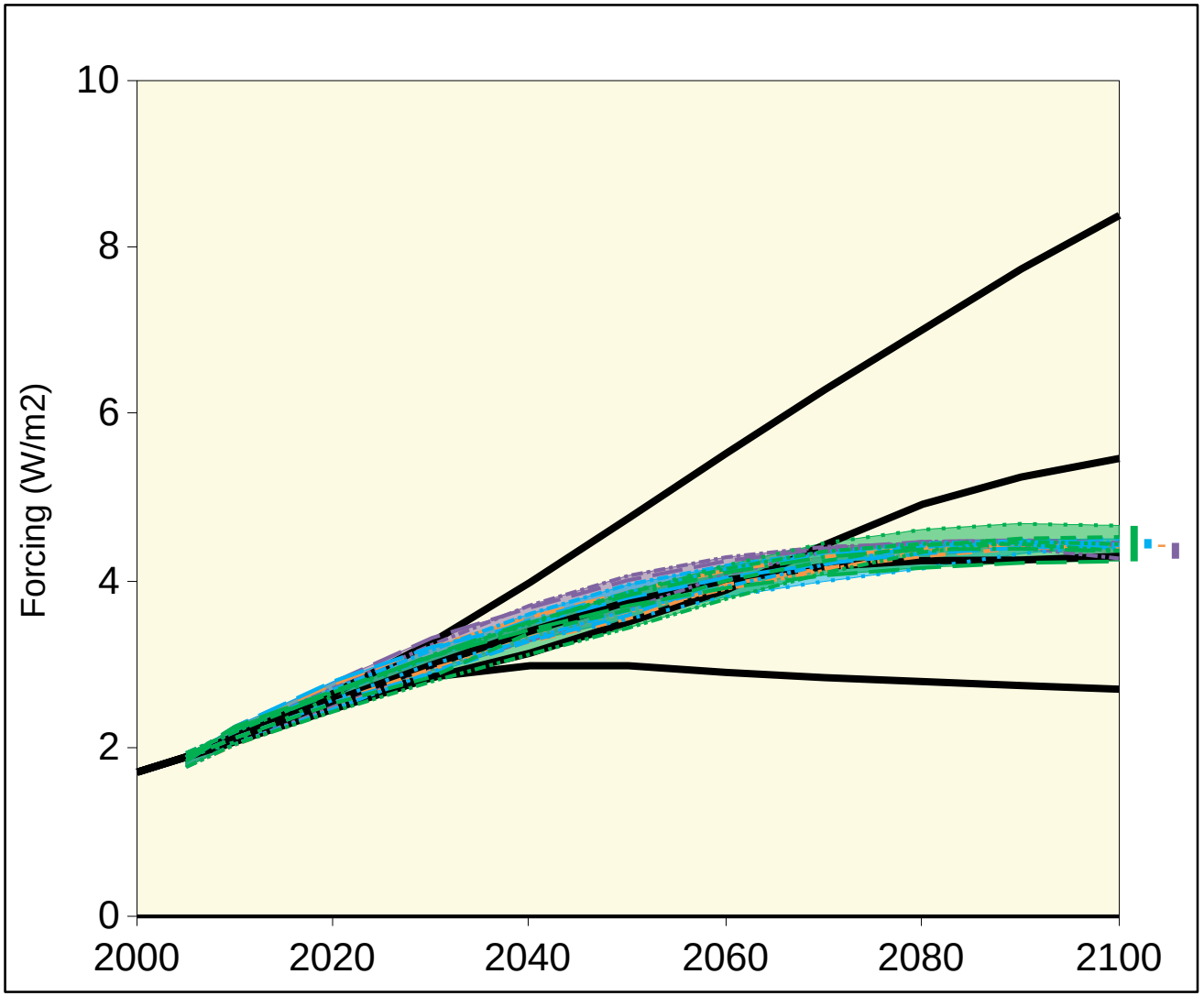


(AMPERE, Kriegler et al)

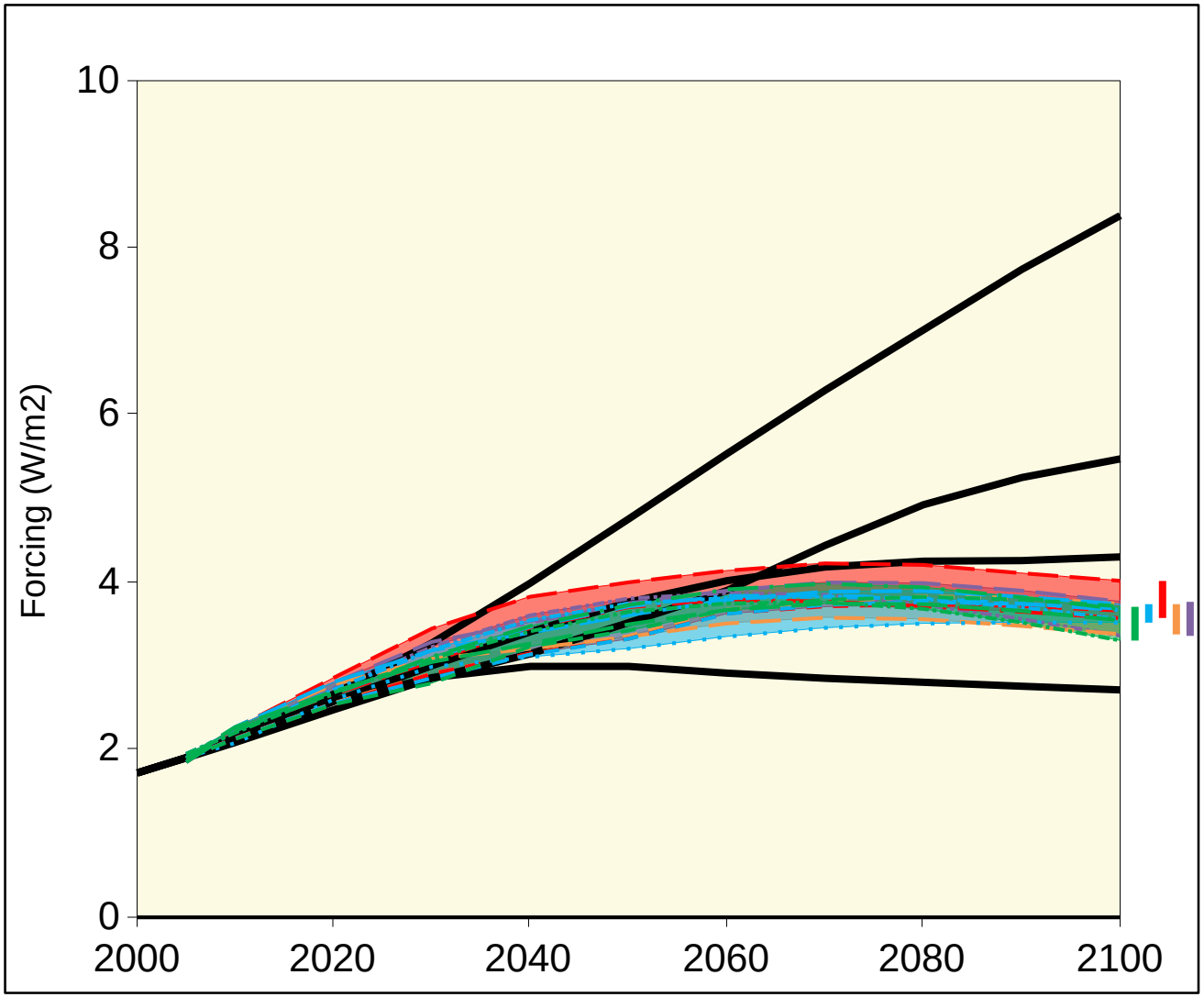
World Forcing
6.0



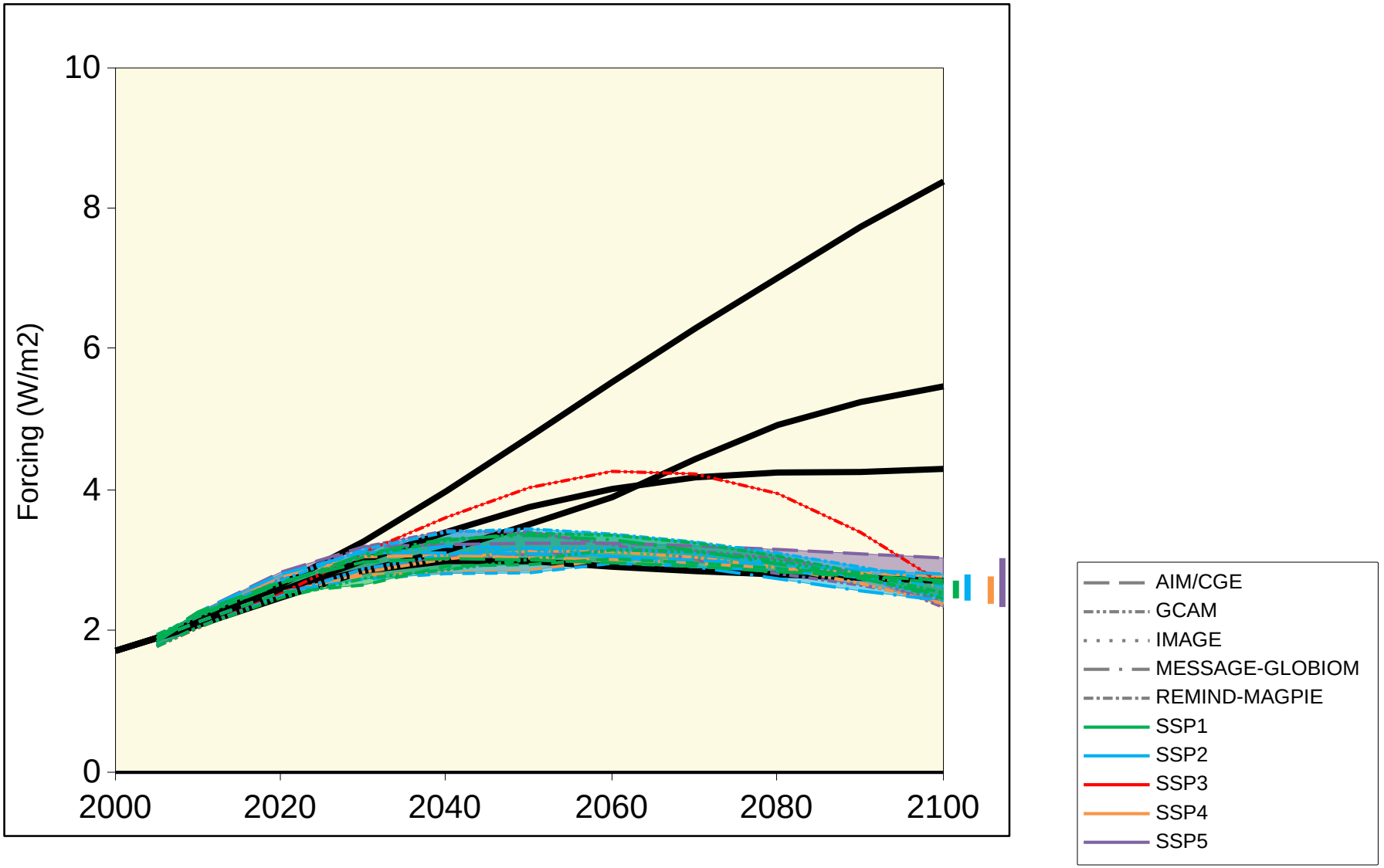
World Forcing
4.5



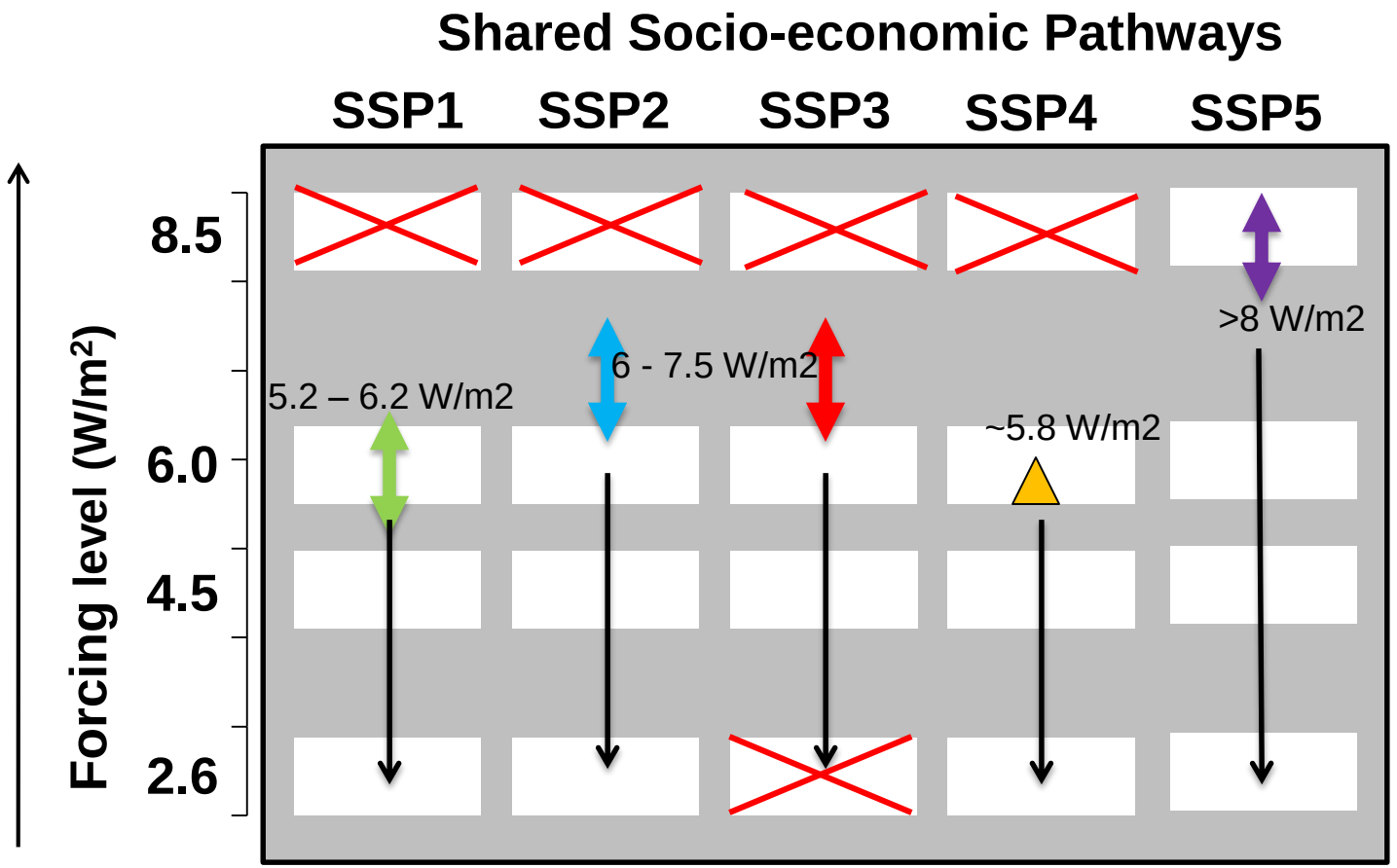
World Forcing
3.7



World Forcing
2.6



SSP/RCP combinations based on reference IAM scenarios



Special Issue in GEC
SSPs + IAM Scenarios

- Narratives: O'Neill et al (submitted)
- Population: KC & Lutz (accepted)
- GDP: (1) Leimbach et al, (2) Dellink et al, (3) Crepo (submitted)
- Urbanization: Jiang & O'Neill (submitted)
- 5 x IAM marker papers
- Crosscut papers:
  - Energy
  - Land-use
  - Air Pollution/Aerosols

Data availability and resolution

All data will be publicly available at the SSP database

Already available (national data)

GDP

Population (structure, education, tot)

Urbanization

IAM scenario data by end of the year

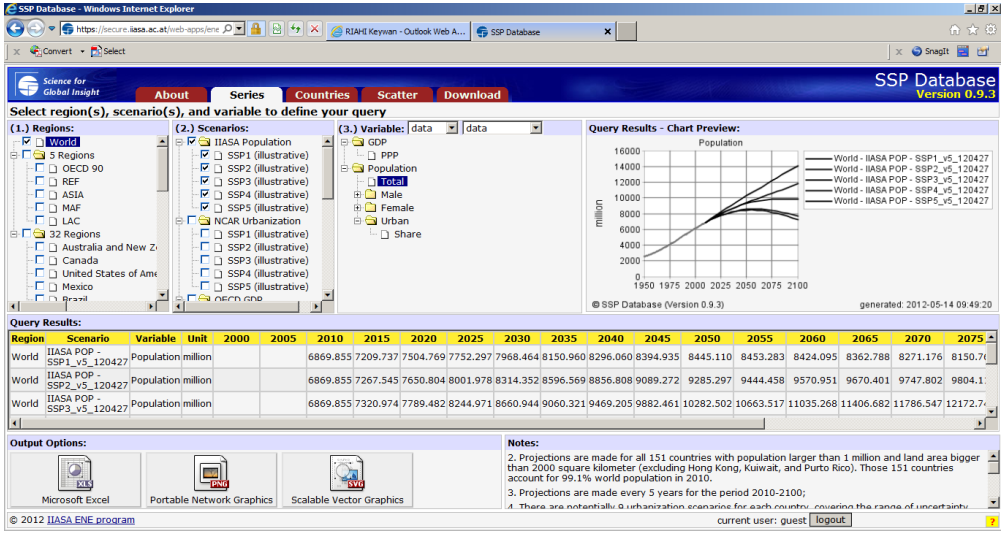
Energy

Land-use

Emissions

Forcing & Temperature

Other relevant indicators (energy/carbon price, economic feedbacks, etc..)



https://secure.iiasa.ac.at/web-apps/ene/SspDb

Resolution: 5 World Regions (more details available from IAM teams 10-26 regions)

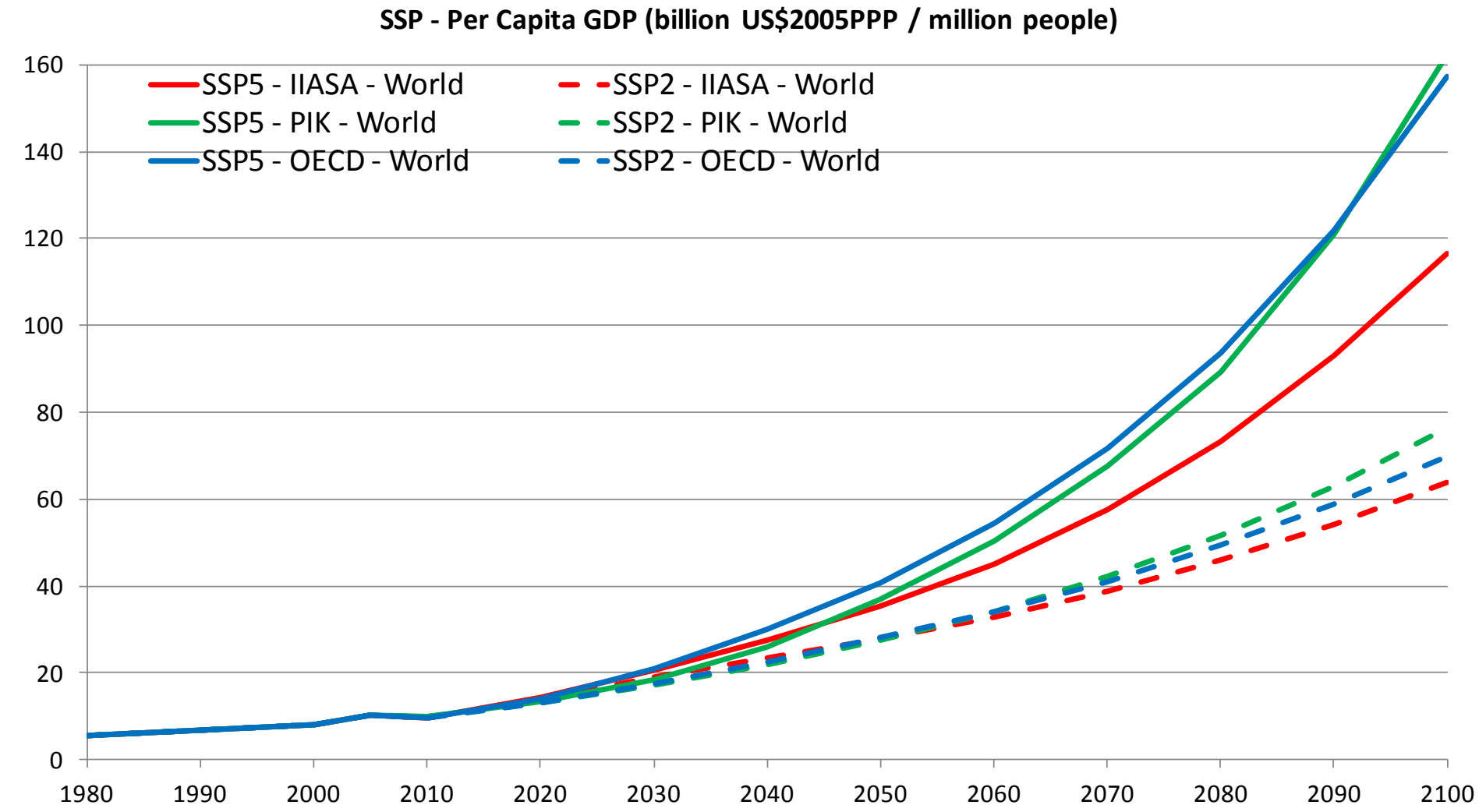
At the moment there are no concrete plans for spatial downscaling (assess on user needs) (individual efforts for downscaling: NCAR, IMPRESSIONs, IIASA, and other projects)

Timeline

- Beta-version of IAM scenarios will become available for comments by end of 2014
- Submission of selected papers (eg overview paper) around the same
- Parallel community/paper review
- Present beta-SSP scenarios at the IPCC Scenarios Meeting in February (not fixed yet!)
- Finalization of scenarios and SI mid 2015

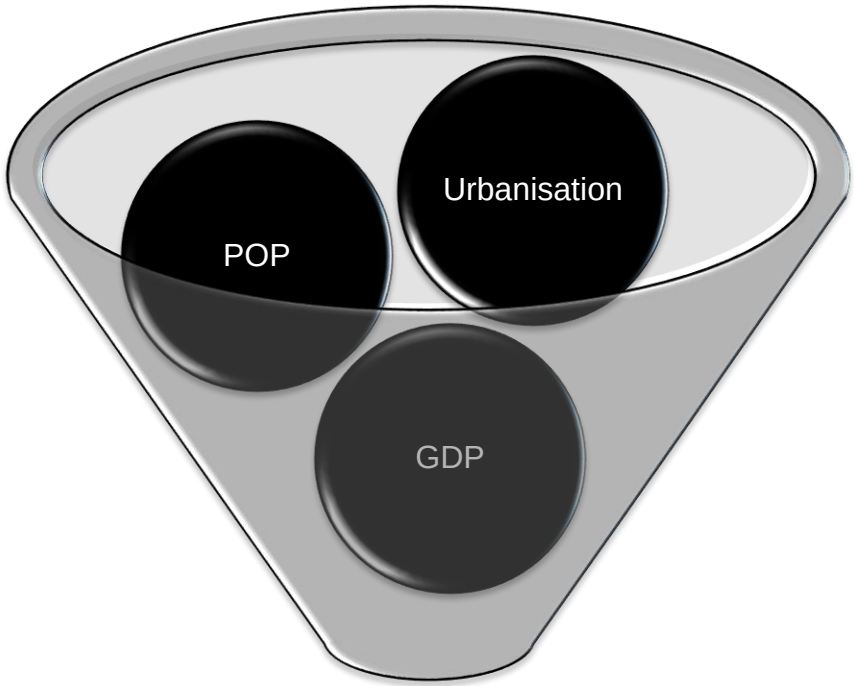
Additional Slides

Global GDP levels by scenario



Source: preliminary SSP database

The SSP Kitchen



IAM Models

(Narratives)

SSP1 SSP2 SSP3 SSP4 SSP5

Population assumptions consistent with SSP Storylines

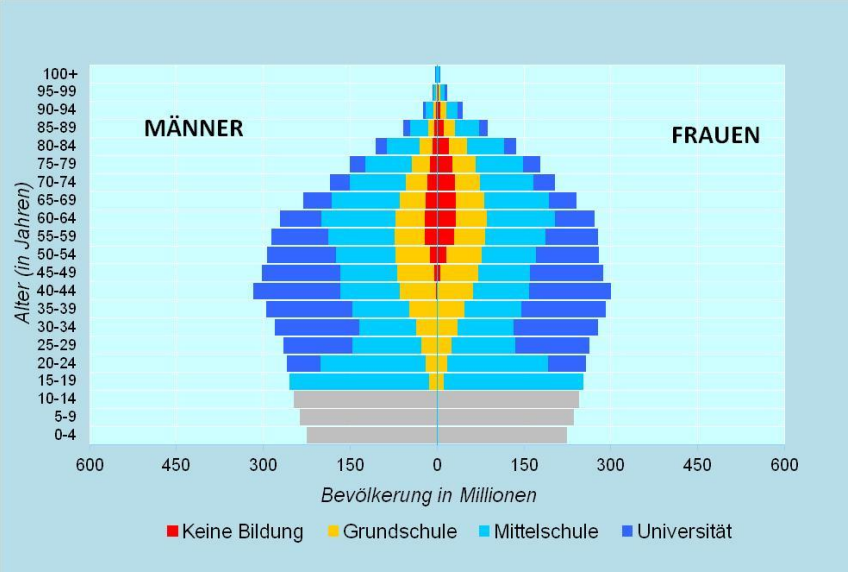
	SSP 1			SSP 2			SSP 3			SSP 4			SSP 5		
							Country Groupings								
SSP Element	*HiFert*	*LoFert*	*Rich-OECD*	*HiFert*	*LoFert*	*Rich-OECD*	*HiFert*	*LoFert*	*Rich-OECD*	*HiFert*	*LoFert*	*Rich-OECD*	*HiFert*	*LoFert*	*Rich-OECD*
Demographics															
Population															
Fertility	Low	Low	Med	Med	Med	Med	High	High	Low	High	Low	Low	Low	Low	High
Mortality	Low	Low	Low	Med	Med	Med	High	High	High	High	Med	Med	Low	Low	Low
Migration	Med	Med	Med	Med	Med	Med	Low	Low	Low	Med	Med	Med	High	High	High
Education	High (FT)	High (FT)	High (FT)	Med (GET)	Med (GET)	Med (GET)	Low (CER)	Low (CER)	Low (CER)	V.Low (CEN)	Low (CER)	Med (GET)	High (FT)	High (FT)	High (FT)

High challenges for adaptation

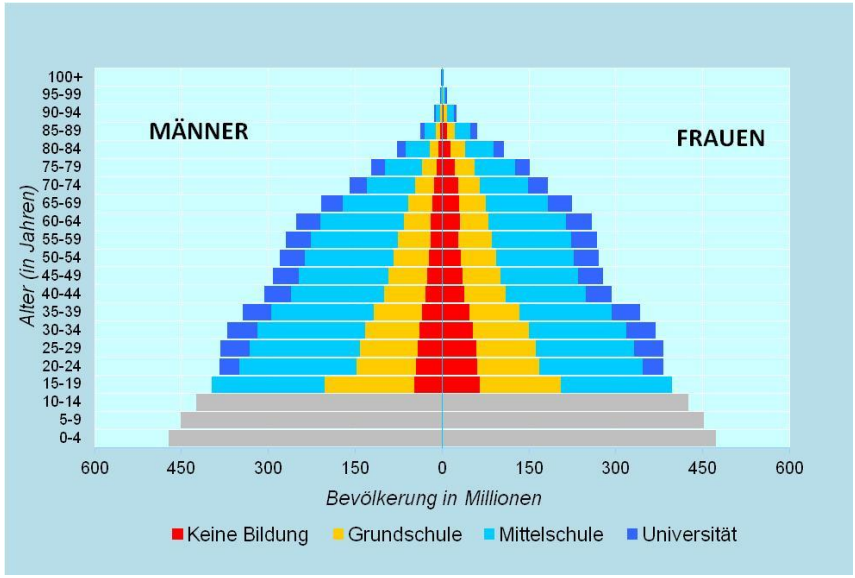
Low challenges for adaptation

World 2050

SSP1 Pop=8673 Mio



SSP3 Pop=10603 Mio



Lutz & KC

Common interpretation of the SSPs OECD – IIASA - PIK

	Frontier TFP growth	Speed of convergence
SSP1: Sustainability	Medium high	High
SSP2: Middle of the road	Medium	Medium
SSP3: Fragmentation	Low	Low
SSP4: Inequality	Medium	Low Income: Low Middle Income: Medium High Income: Medium
SSP5: Conventional development	High	High

N.B. Quantitative interpretations and methodology differ between models, illustrating the uncertainties in making economic projections

Key SSP elements
(three main products + IAV variables)