

Integrated Assessment Model scenarios based on SSPs

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Integrated Assessment Models & SSPs

- ▶ Five integrated assessment models will be running the SSP/RCP scenarios:

Model	Home Institution
AIM Asia Integrated Model	National Institutes for Environmental Studies, Tsukuba Japan
GCAM Global Change Assessment Model	Joint Global Change Research Institute, PNNL, College Park, MD
IMAGE The Integrated Model to Assess the Global Environment	PBL Netherlands Environmental Assessment Agency, Bilthoven, The Netherlands
MESSAGE Model for Energy Supply Strategy Alternatives and their General Environmental Impact	International Institute for Applied Systems Analysis; Laxenburg, Austria
REMIND Regionalized Model of Investments and Technological Development	Potsdam Institute for Climate Impacts Research; Potsdam, Germany

Status & Timing of the IA Scenarios

- ▶ Population & GDP marker data has been provided to the IA teams
- ▶ IA teams are currently working on implementing the scenarios
- ▶ Preliminary scenario results due June 30, 2013
- ▶ Preliminary model comparison planned for August 1-2, 2013
- ▶ IA scenarios expected to be finalized end of 2013



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PRELIMINARY ASSUMPTIONS FOR SSPS: POPULATION, GDP, AND TECHNOLOGY



SSP Narratives

SSP5: Conventional Development

- Rapid economic development
- Stabilizing population
- Consumerism
- High fossil fuel dependency
- Eradication of extreme poverty and universal access to education and basic services
- Highly engineered infrastructure and ecosystems

SSP1: Sustainability

- Good progress towards sustainable development
- Stabilizing population
- Decreasing income inequality
- Early MDG achievement
- Low resource intensity and fossil fuel dependency
- Strong int'l governance and local institutions
- Well managed urbanization
- Environmentalism

SSP2: Middle of the Road

- Current trends continue
- Moderate population growth
- Slowly converging incomes between industrialized and developing countries
- Delayed MDG achievement
- Reductions in resource and energy intensity at historic rates
- Environmental degradation

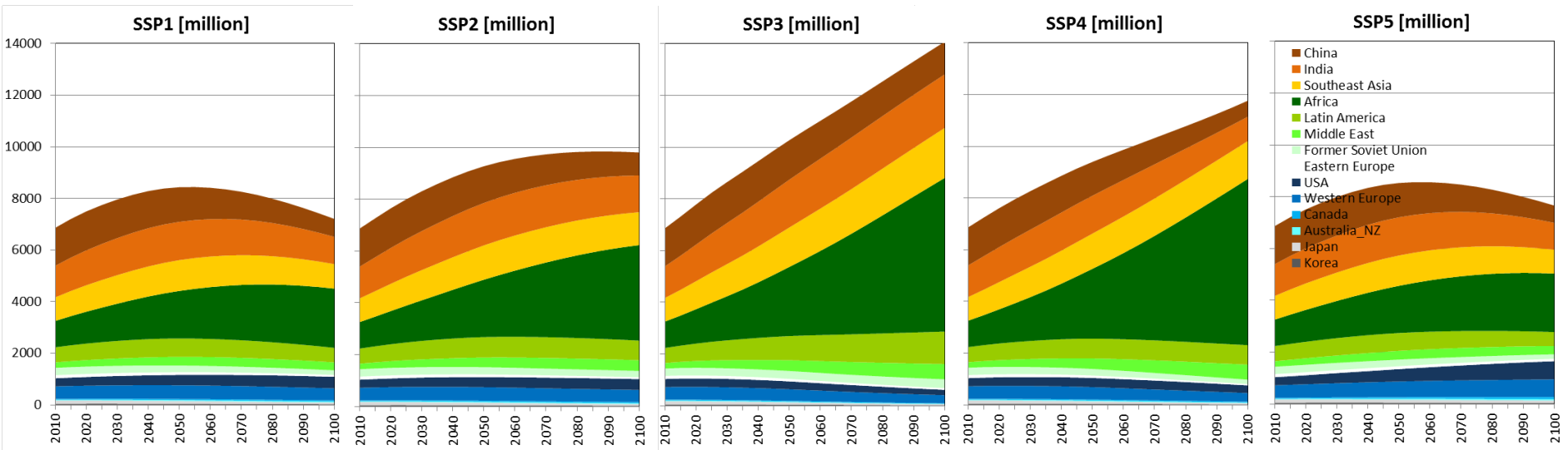
SSP3: Fragmentation

- Rapid population growth
- Slow economic growth
- Failing to achieve MDG
- High resource intensity and fossil fuel dependency
- Low investments in technology development and education
- Unplanned settlements
- Weak int'l governance and local institutions

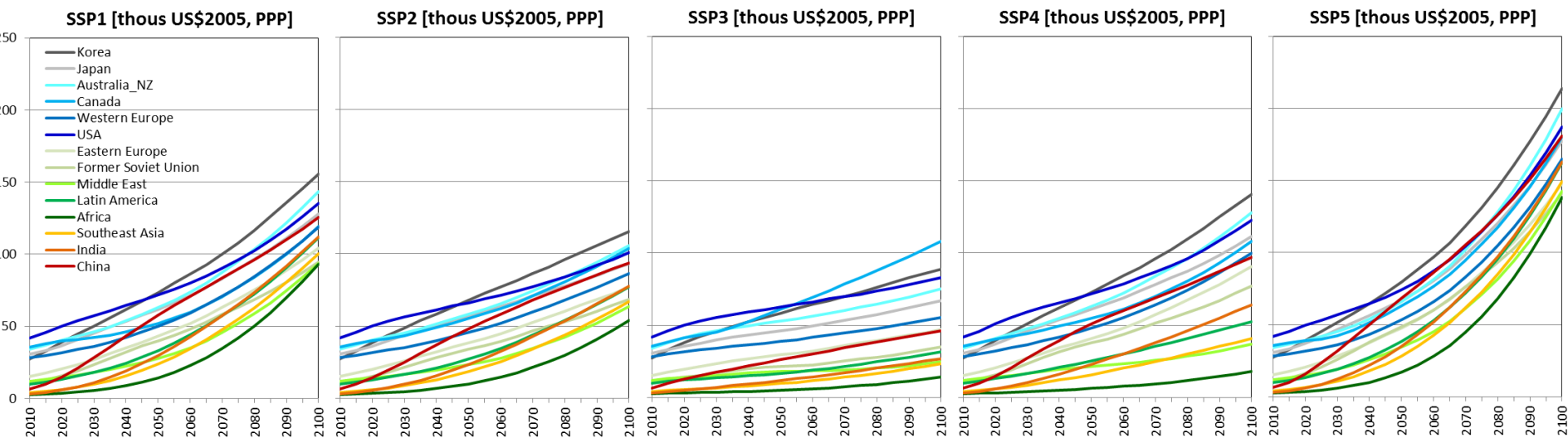
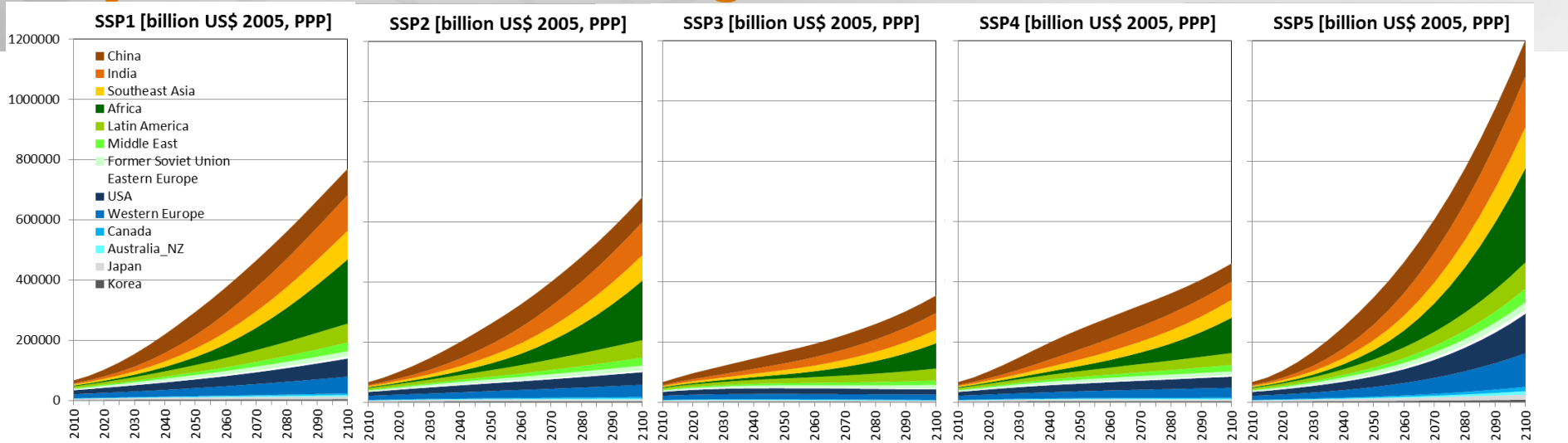
SSP4: Inequality

- Increasing inequality within and across countries
- Effective governance controlled by a small number of rich global elites
- Most of populations with limited access to higher education and basic services
- Energy tech R&D made by global energy corporations
- Low social cohesion

IIASA Populations by SSP and GCAM Region

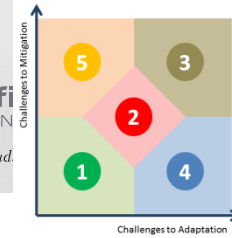


OECD's total GDP and Per Capita GDP by SSP and GCAM Region



GCAM DRAFT SSP Input Assumptions

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NEW SSP Pop & GDP

	SSP1 Sustainability	SSP2 Middle of the Road	SSP3 Fragmentation	SSP4 Inequality	SSP5 Development First
2100 Population [billion] (IIASA)	7.2 (5 th)	9.8 (3 rd)	14.1 (1 st)	11.8 (2 nd)	7.7 (4 th)
2100 GDP [trillion 2005 USD, PPP] (OECD)	770 (2 nd)	684 (3 rd)	355 (5 th)	461 (4 th)	1,205 (1 st)
Energy Service Demands	Low	Medium	High	Medium	High
End-Use Technology	High	Medium	Low	Low / High	Medium
Nuclear / CCS	Low	Medium	Medium	Mixed	Medium
Renewable Technology	High	Medium	Low	High	Medium
Fossil Fuel Extraction	Low	Medium	High	Medium	High
Crop Yield Improvement	High	Medium	Low	Low / Medium	High

Technology



GCAM Technology Building Blocks

	High Tech	Med Tech	Low Tech
Nuclear Power	Lower capital recovery factor with capital and O&M costs declining at 0.3% per year	Base capital recovery factor with capital and O&M costs declining at 0.1% per year	Higher capital recovery factor with fixed capital and O&M costs
Carbon Capture & Storage (CCS)	Lower-cost non-tradable regional land-based storage with larger capacity, expensive global-access offshore storage	Non-tradable regional land-based storage combined with expensive global-access offshore storage	Total available resource to 5% of the medium case. Cost scales up rapidly without offshore storage
Fossil Fuel Extraction	Extraction costs of coal, oil, and gas resource drop by 0.75% per year	Extraction costs of coal, oil, and gas resource drop by 0.5% per year	Extraction costs of coal, oil, and gas resource drop by 0.25% per year
Advanced Grid for Renewable Tech	1:1 backup required when renewables supply 50% of capacity	1:1 backup required when renewables (central PV, CSP, rooftop PV, wind) supply 25% of capacity	1:1 backup required when renewables supply 15% of capacity
Solar Tech	Capital and O&M costs decline at a faster rate (double)	Capital and O&M costs decline	Capital and O&M costs decline at a slower rate (50%)
Wind Tech	Capital and O&M costs drop at 0.5% per year	Capital and O&M costs drop at 0.25% per year	Capital and O&M costs do not drop
Geothermal Tech	Faster improvement in hydrothermal / EGS available with the improvement rate of 0.5% per year or more	Base improvement in hydrothermal / EGS available only after the exhaustion of hydrothermal resource / EGS improves at 0.25% per year or more	No improvement in hydrothermal / EGS not available
Building Tech	Faster improvements in end-use efficiencies	Base improvements in end-use efficiencies	Slower improvements in end-use efficiencies
Transportation Tech	Faster declines in fuel intensities in all modes	Base declines in fuel intensities in all modes	Slower declines in fuel intensities in all modes
Industry Tech	Faster improvements in end-use efficiencies	Base improvements in end-use efficiencies	Slower improvements in end-use efficiencies
Crop Production	Crop yield improvements converging to 0.5% per year by 2050	Crop yield improvements converging to 0.25% per year by 2050	Crop yield improvements converging to 0% per year by 2050

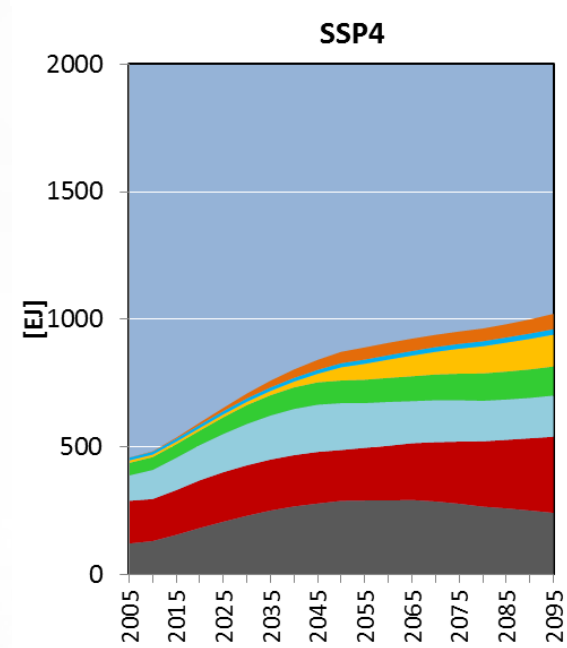
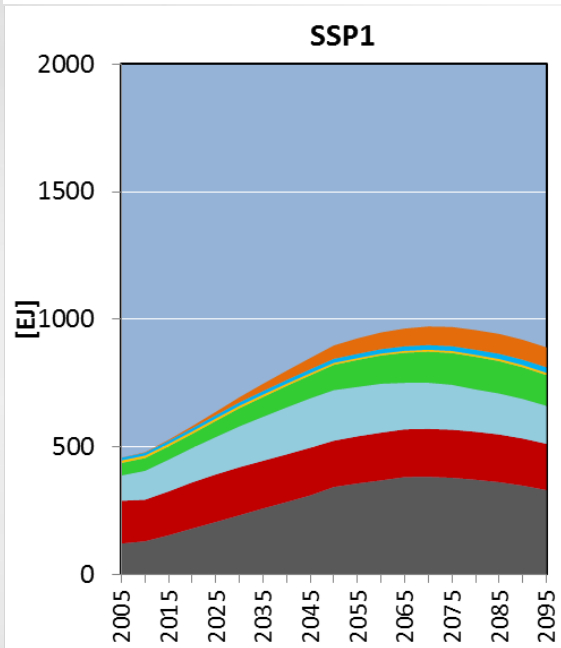
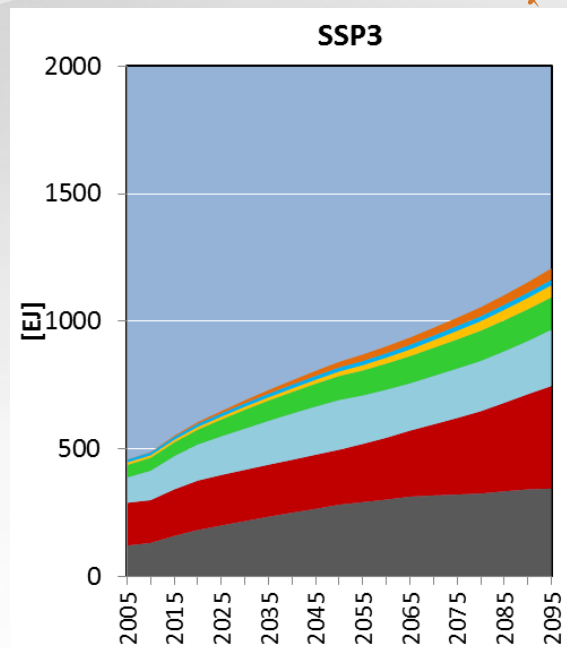
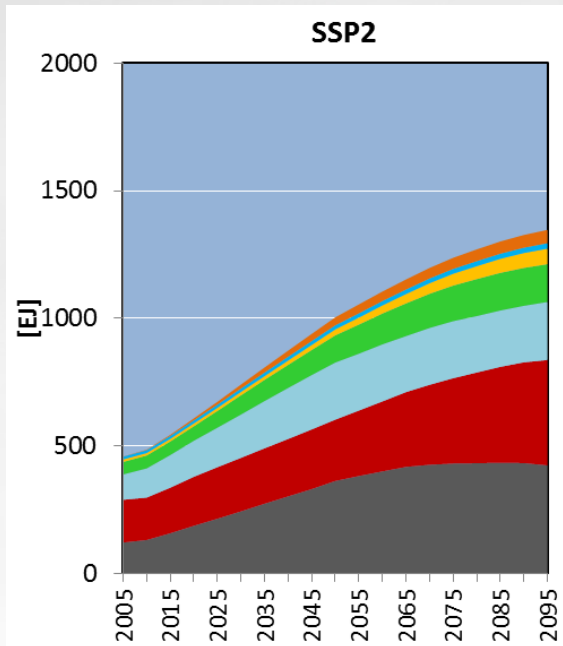
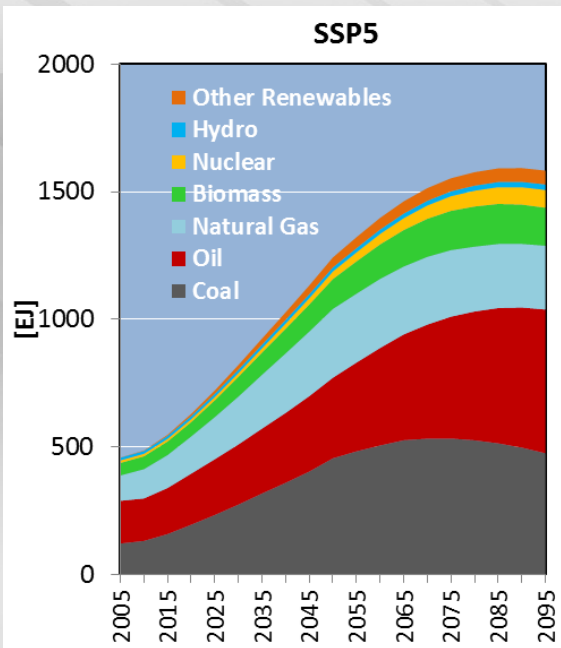


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GCAM PRELIMINARY SSP SCENARIOS

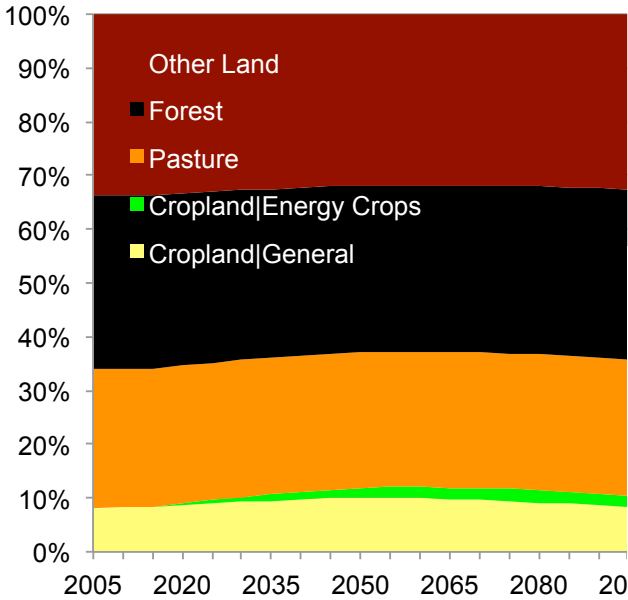
Global Primary Energy by Fuel: Reference Scenarios



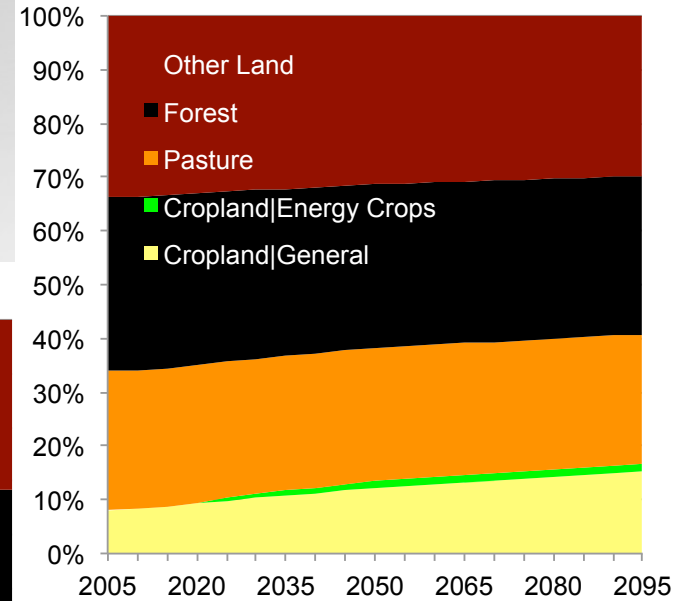
Global Land Cover: Reference Scenarios



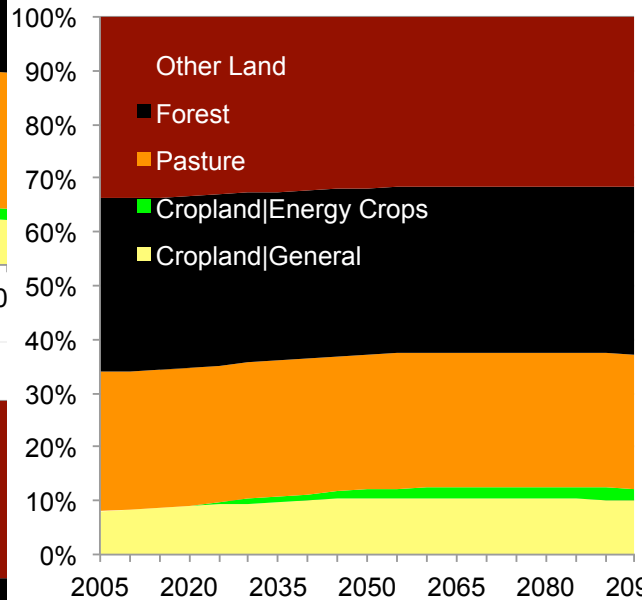
SSP5



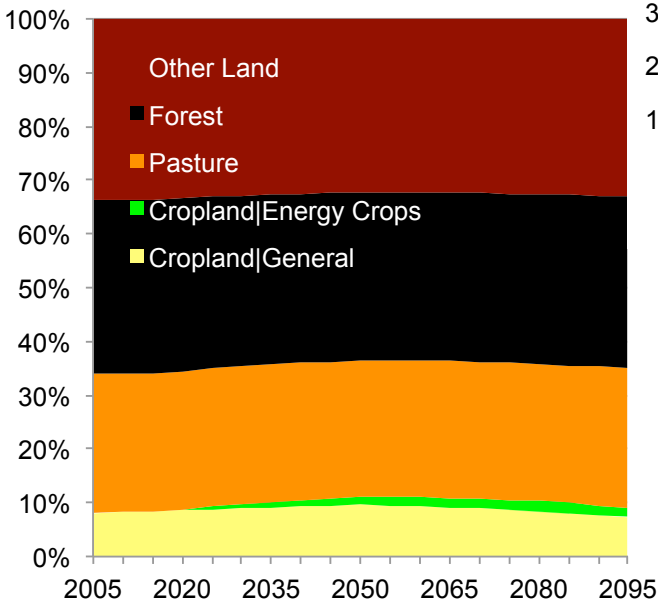
SSP3



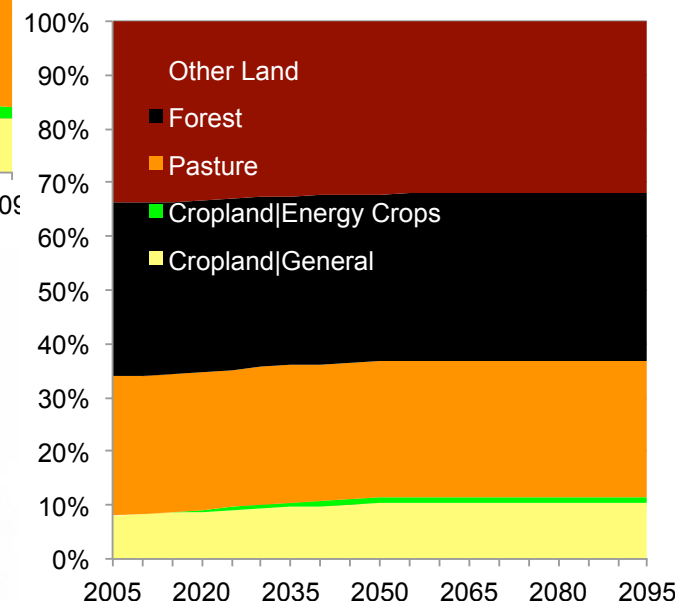
SSP2



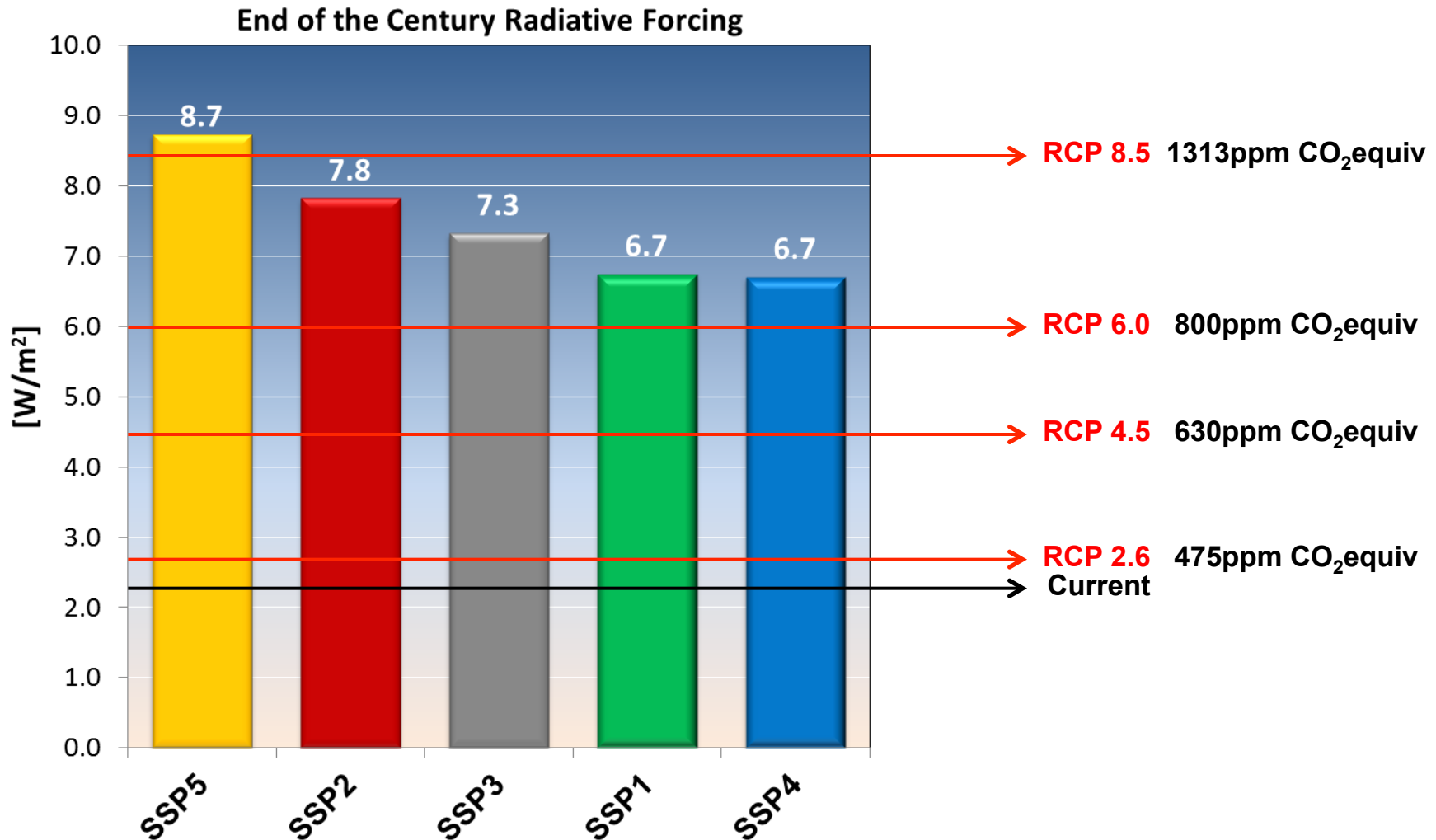
SSP1



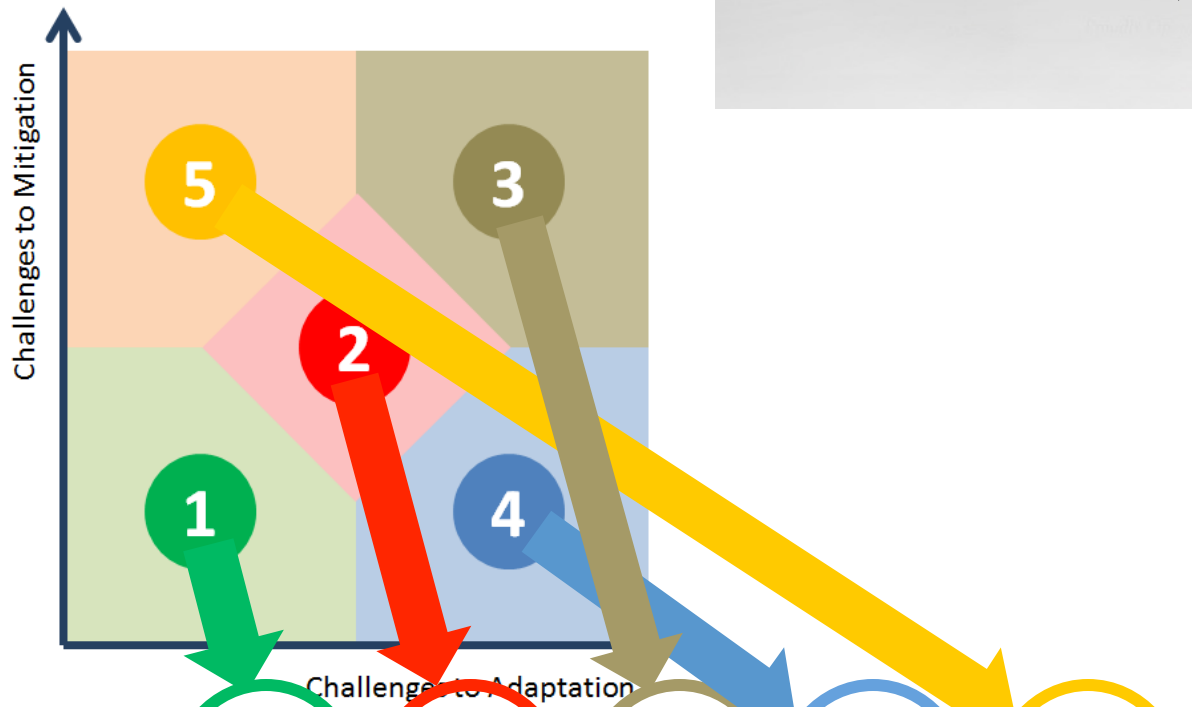
SSP4



End-of-the-Century Radiative Forcing in Reference Scenarios (relative to RCPs)



From SSPs to RCP Replications

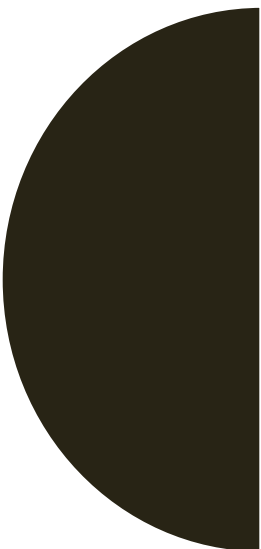


		SSP 1	SSP 2	SSP 3	SSP 4	SSP 5
	Reference	X	X	X	X	X
Replication	8.5 Wm ⁻²					X
	6.0 Wm ⁻²	X	X	X	X	X
	4.5 Wm ⁻²	X	X	X	X	X
	2.6 Wm ⁻²	X	X			X

SPAS

Accession to Global Carbon Market

Instantaneous Accession Scenario



**Global CO₂-equivalent Tax
from 2015:**
All global regions

Delayed Accession Scenario

- 
- Joins in 2070:**
global price by 2085
 - Africa
 - Joins in 2050:**
global price by 2065
 - India / Latin America / Southeast Asia
 - Joins in 2030:**
global price by 2045
 - USA / China / Canada / Australia / NZ / Korea
 - Global Carbon Tax from 2015**
 - Western Europe / Eastern Europe / Japan

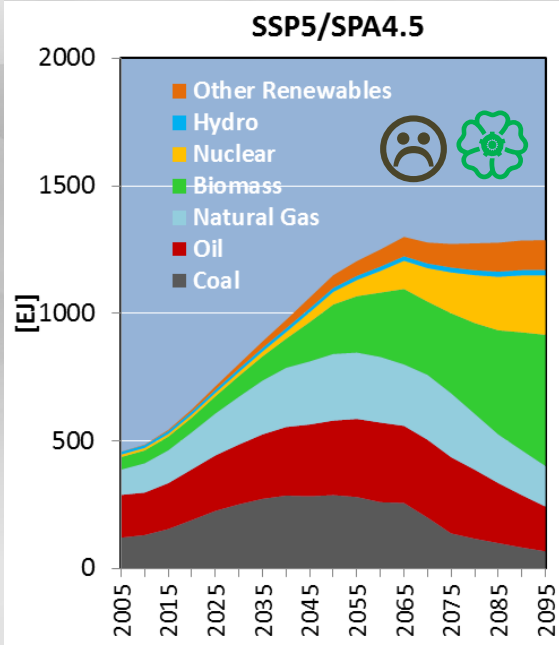
- ▶ In delayed accession scenario, Former Soviet Union and Middle East Never Join the global carbon market.

Land Use Policy

Land-use change emissions taxed 

NO land-use change policy 

Global Primary Energy by Fuel: SPA 4.5 Scenarios



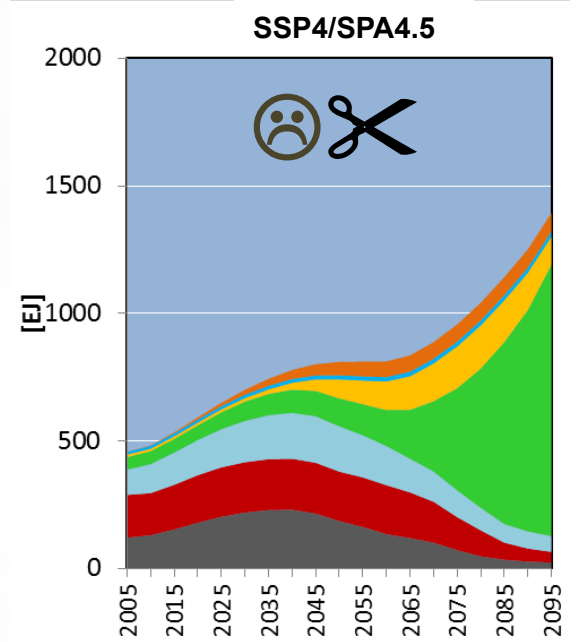
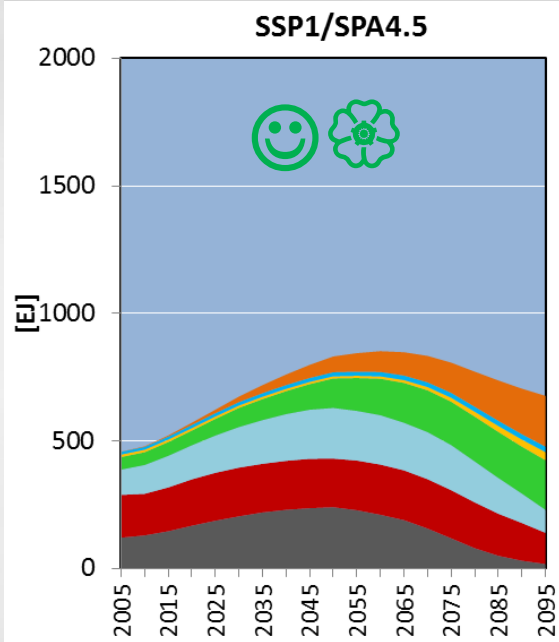
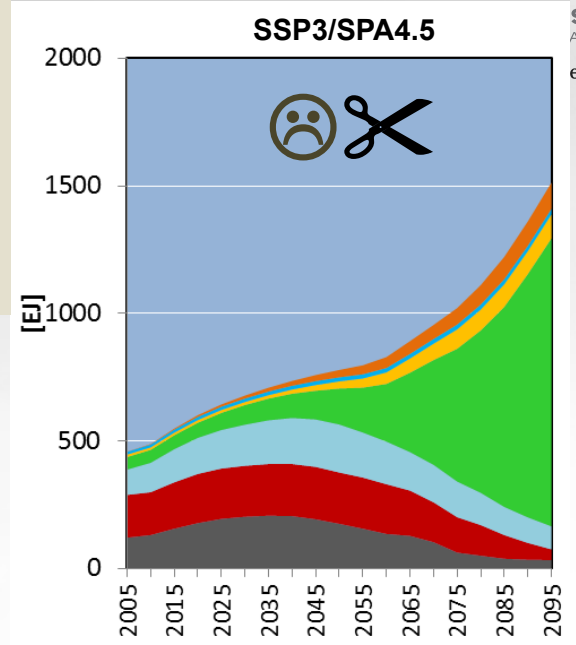
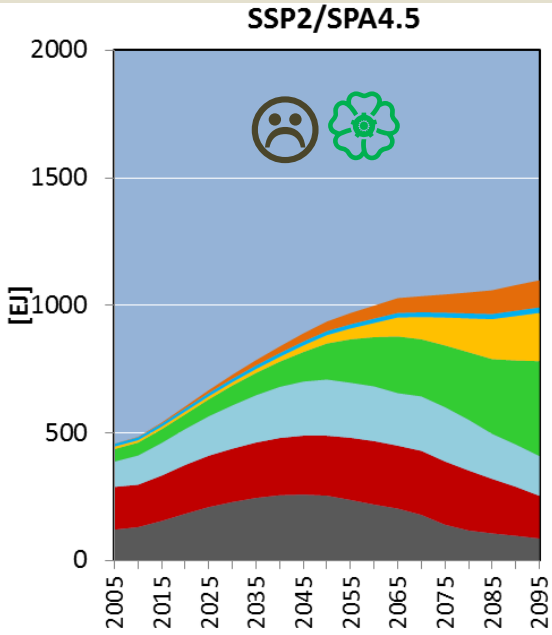
SPAs

Run as idealized = 😊 or

Run as DELAYED participation = 😞

Run WITH land-use change taxed = 🌸 or

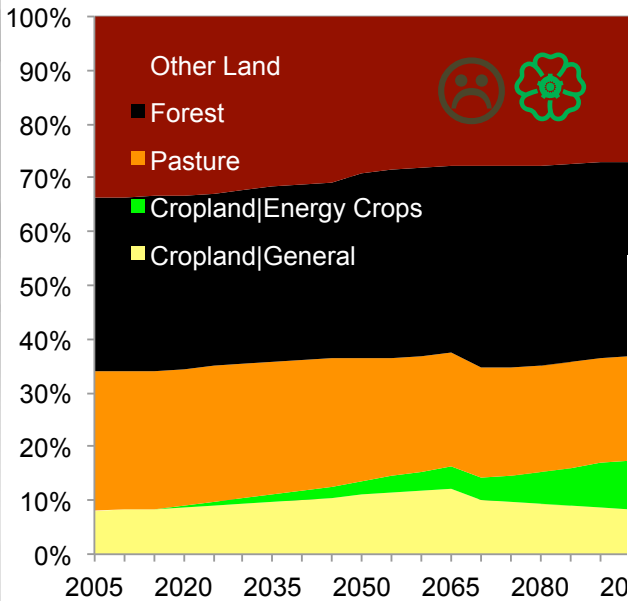
Run NO land policy = ✂️



Global Land Cover: SPA 4.5 Scenarios



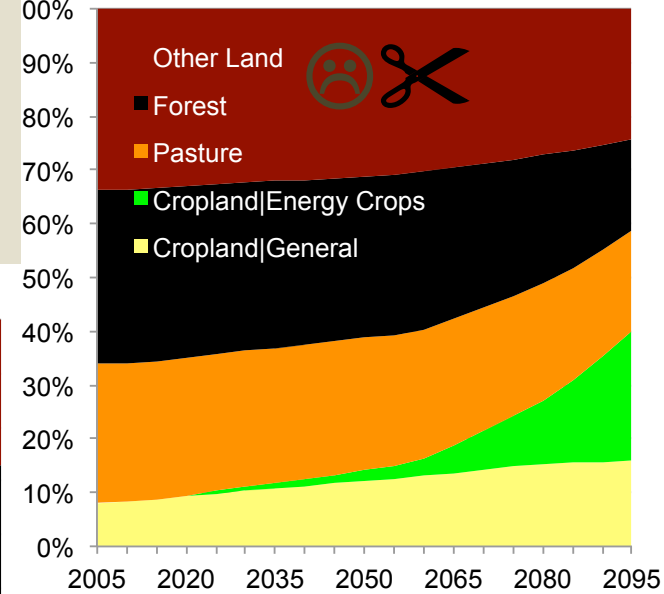
SSP5/SPA4.5



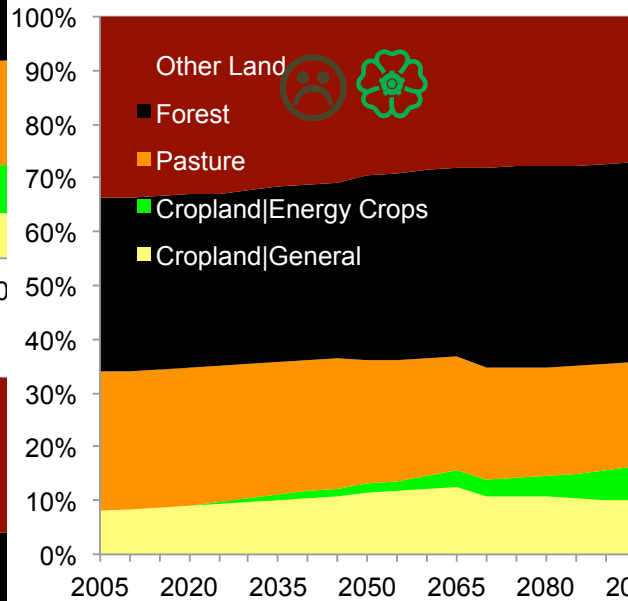
SPAs

Run as idealized=😊 or
 Run as DELAYED participation=☹️
 Run WITH land-use change taxed=🌸 or
 Run NO land policy=✂️

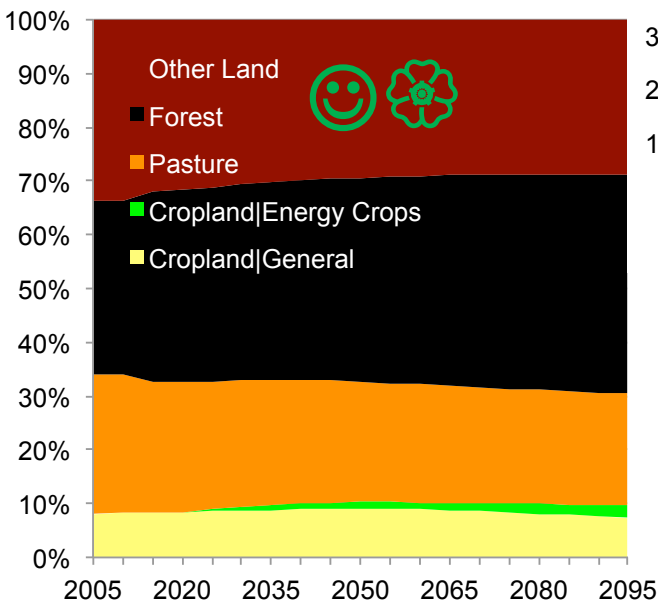
SSP3/SPA4.5



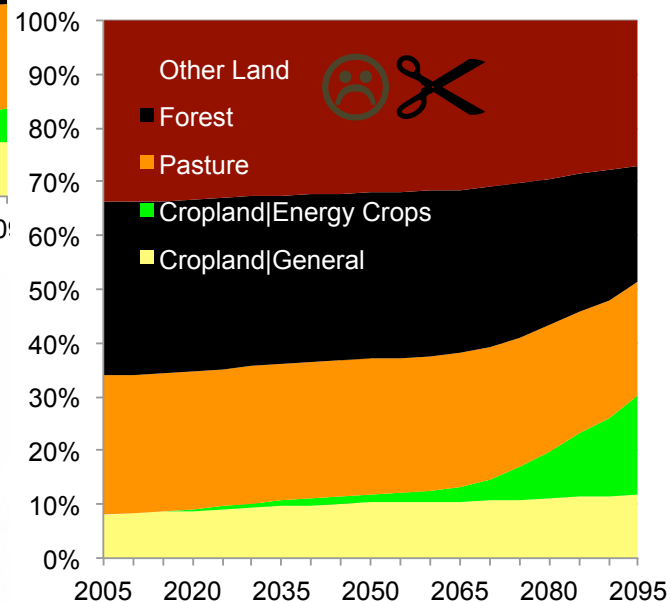
SSP2/SPA4.5



SSP1/SPA4.5

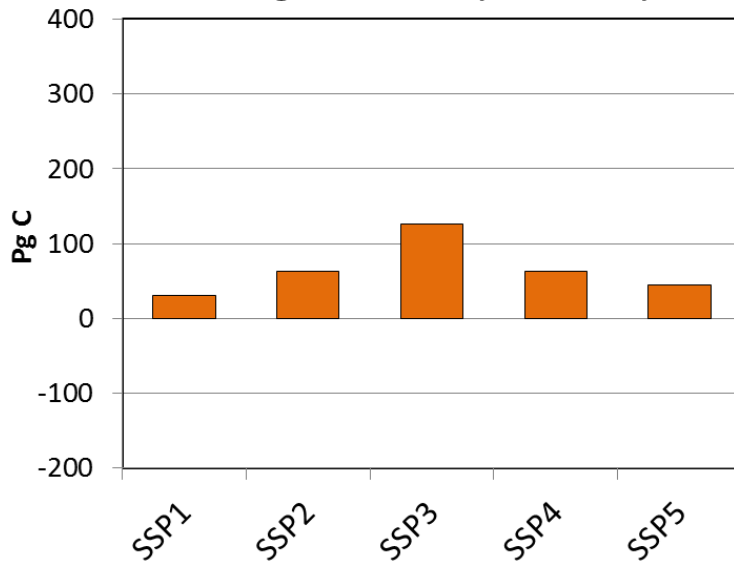


SSP4/SPA4.5

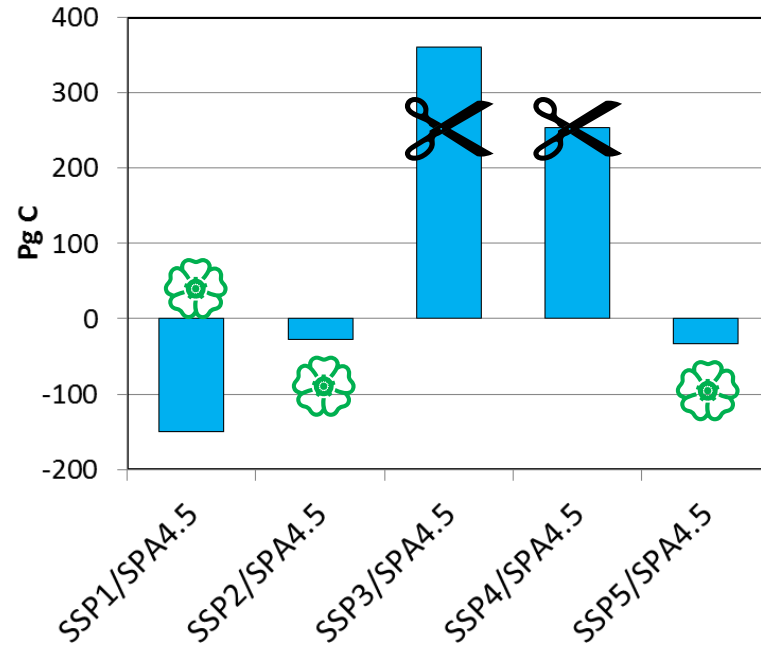


Land Use Change Emissions

2005-2095 Cumulative Land Use Change Emissions (Reference)



2005-2095 Cumulative Land Use Change Emissions (SPA4.5)



- ▶ The IA models are in the process of running the SSPs now, and hope to finish by the end of 2013.

- ▶ The new scenario process will generate as many as 20 new scenarios (5 SSPs x 4 RCPs).
 - However, some SSPs may not achieve RCP8.5 and others may not achieve RCP2.6.

- ▶ For a given RCP, results for energy use, land cover, and emissions may vary both globally and regionally. Whether the difference is enough to result in a different climate is not known.



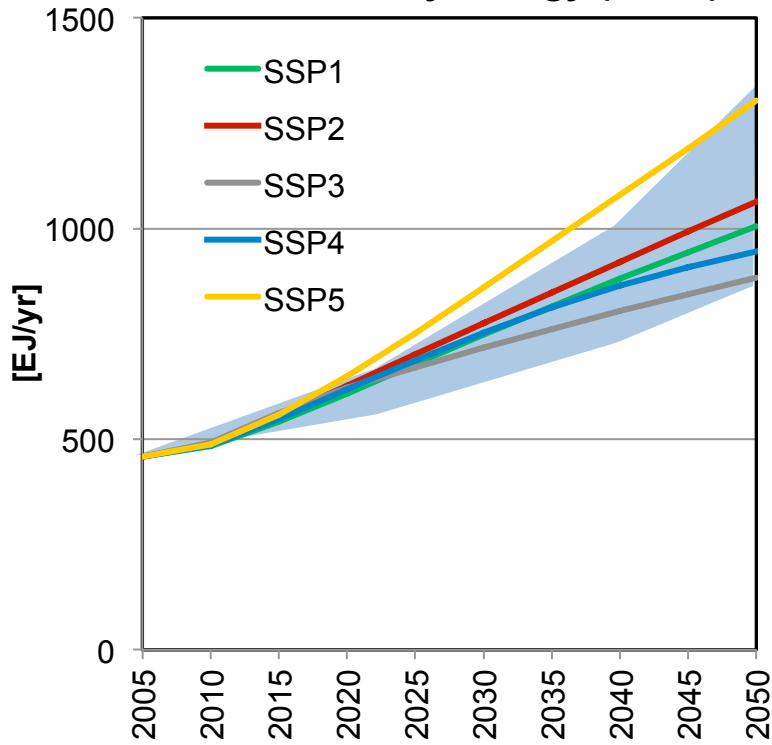
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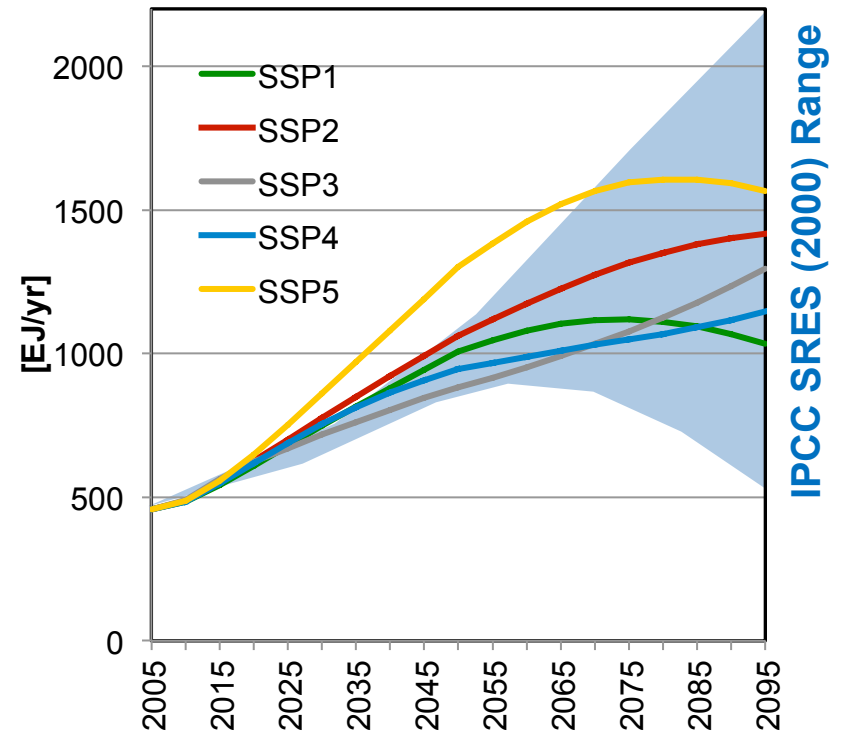
DISCUSSION

Global Total Primary Energy

Global Primary Energy (-2050)



Global Primary Energy (-2095)



Global Total CO₂ Emissions

