

GCAM Scenarios based on Preliminary SSP Elements

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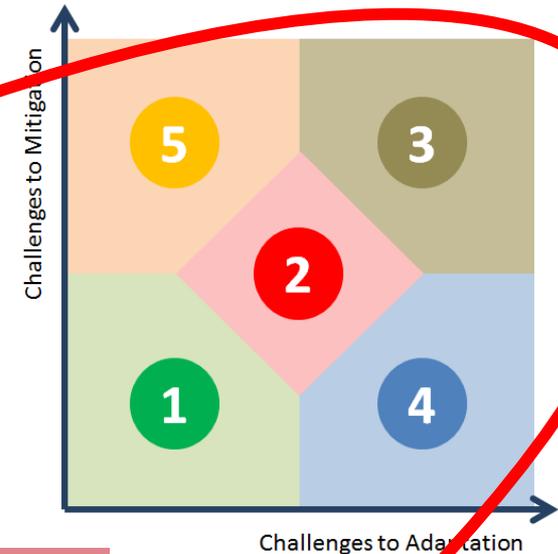


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SSPs have three elements

Storyline: The storyline is a verbal description of the state of the world. All non-quantitative aspects of the scenario are included in the storyline.



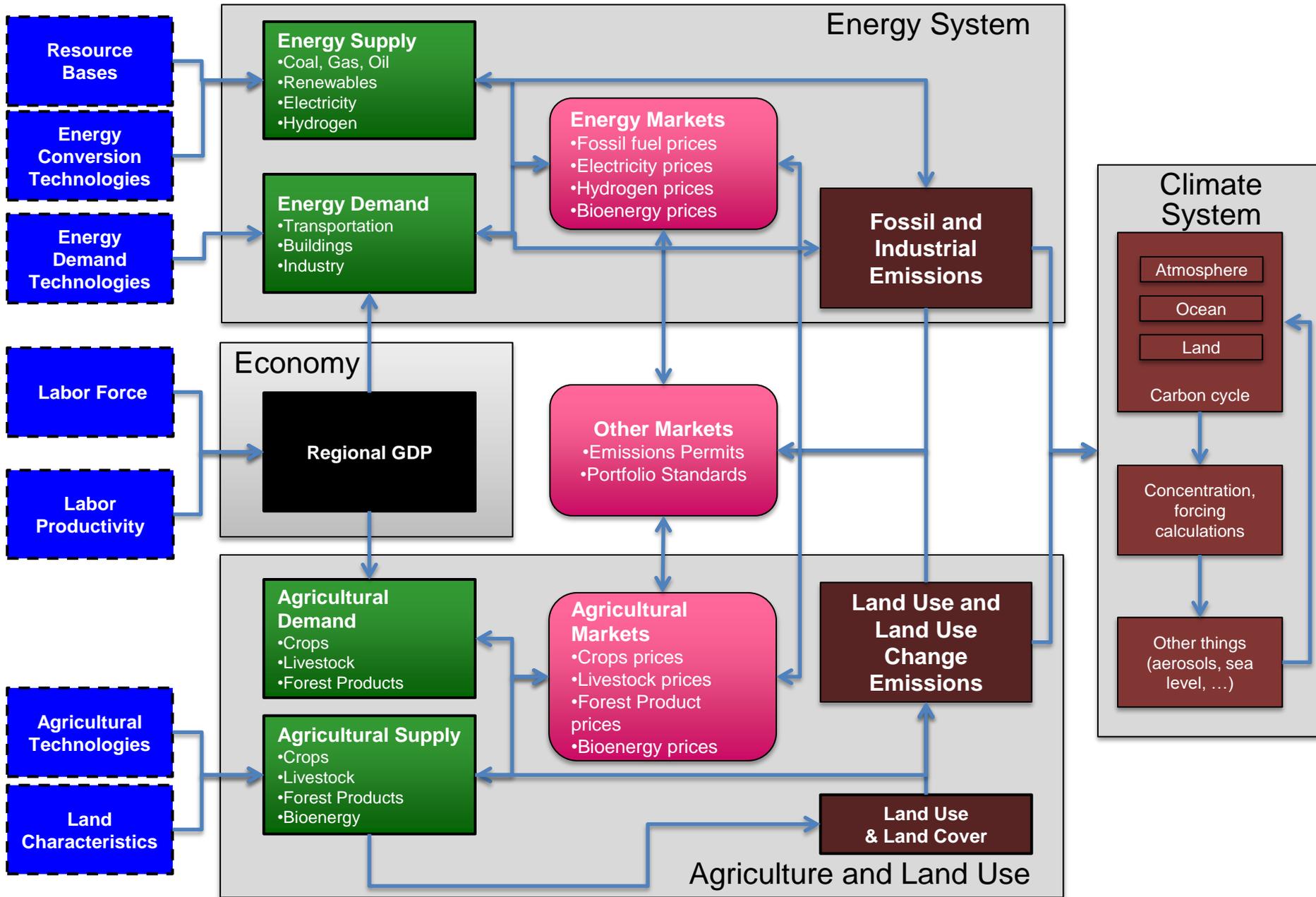
IAM Quantitative Variables that define IAM reference “no-climate-policy” scenario inputs. E.g. reference scenario population by region by year. GDP, Technology Availability.

Note: SSPs specify only pathways for quantitative input assumptions used by IAMs. They do NOT include IAM model outputs.

Non-IAM Quantitative Variables that define reference “no-climate-policy” scenario, but which are not IAM drivers. E.g. governance index or ecosystem productivity and sensitivity.

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The Global Change Assessment Model



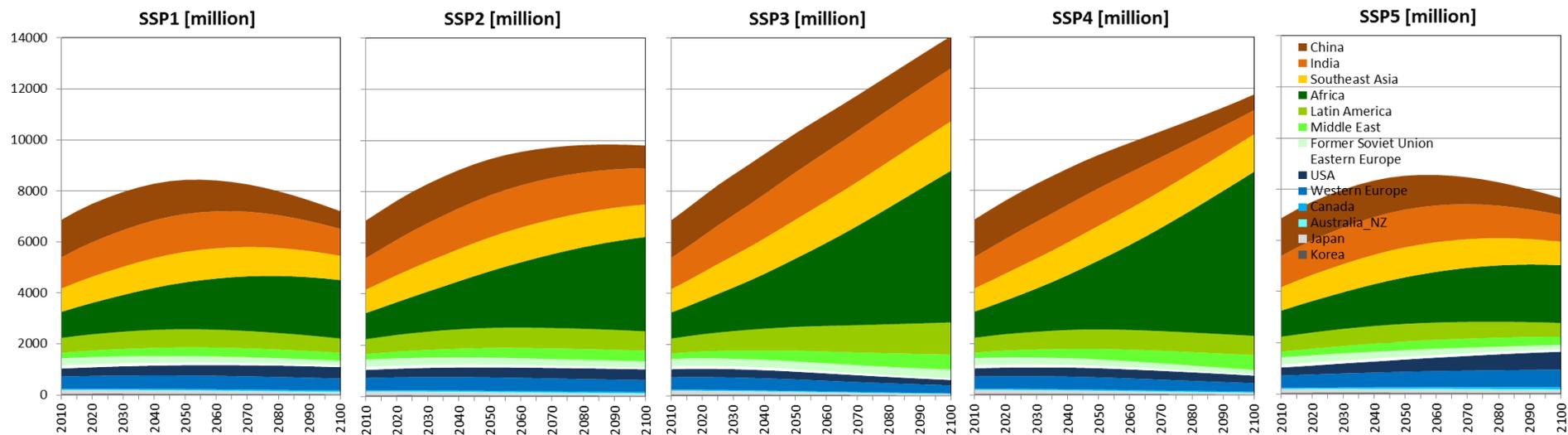
PRELIMINARY ASSUMPTIONS FOR SSPS: POPULATION & GDP



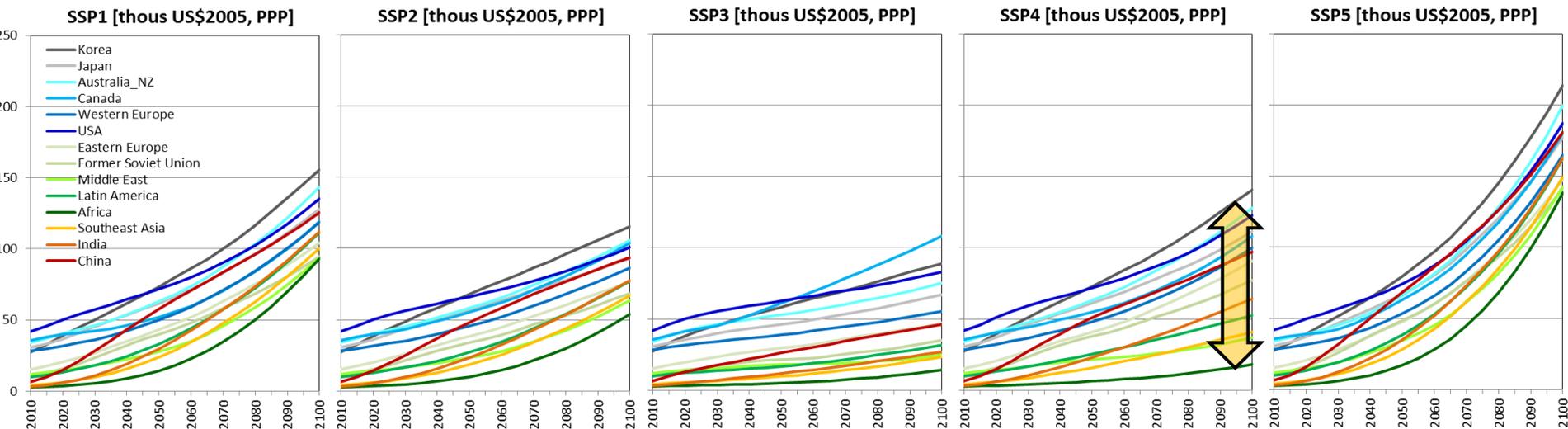
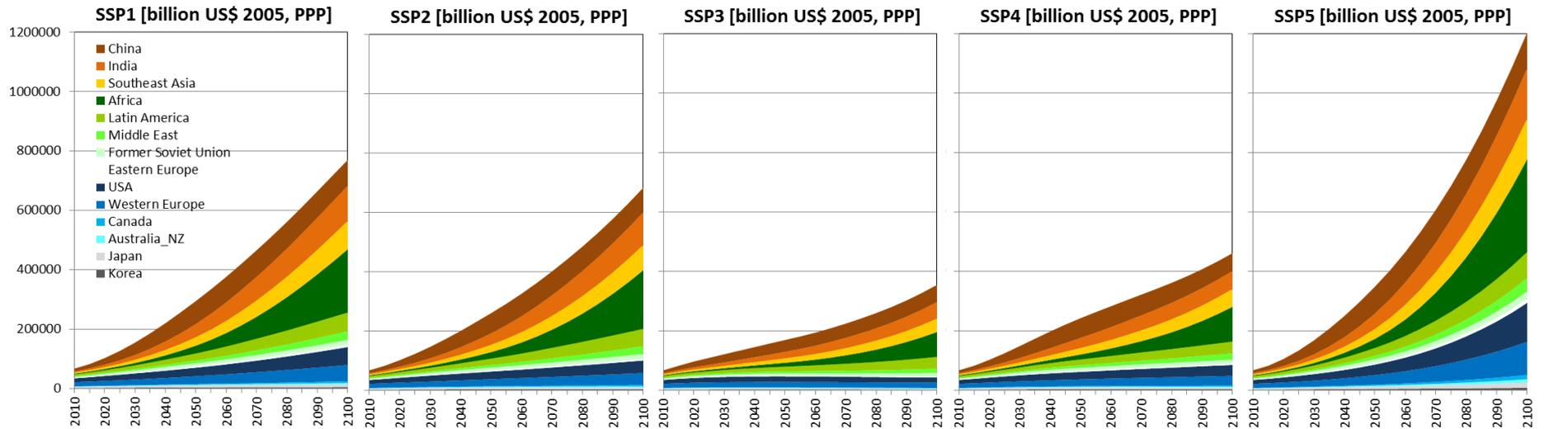
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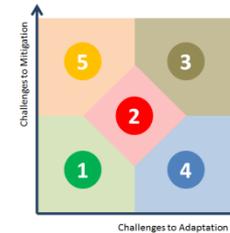
IIASA Populations by SSP and GCAM Region



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



GCAM NEW SSP Input Assumptions



	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

GCAM Technology Building Blocks

	High Tech	Med Tech	Low Tech	Lower 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	No new nuclear power plant
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	No deployment
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	NA
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	NA
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%)	NA
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	NA
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	NA
Building Tech	Faster improvements in end-use efficiencies	Base improvements in end-use efficiencies	Slower improvements in end-use efficiencies	NA
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	NA
Industry Tech	Faster improvements in end-use efficiencies	Base improvements in end-use efficiencies	Slower improvements in end-use efficiencies	NA
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	NA

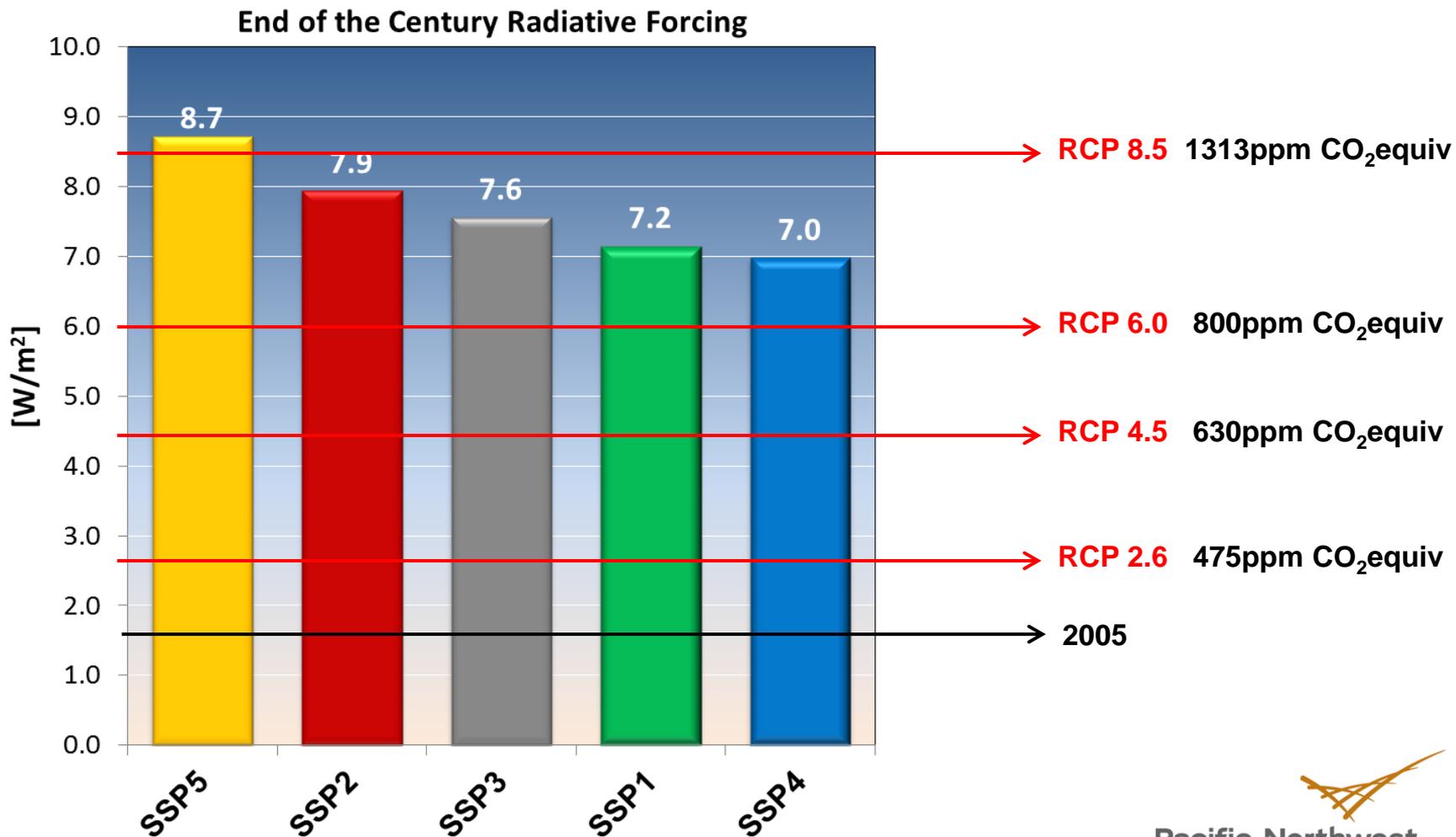
GCAM SSP SCENARIOS



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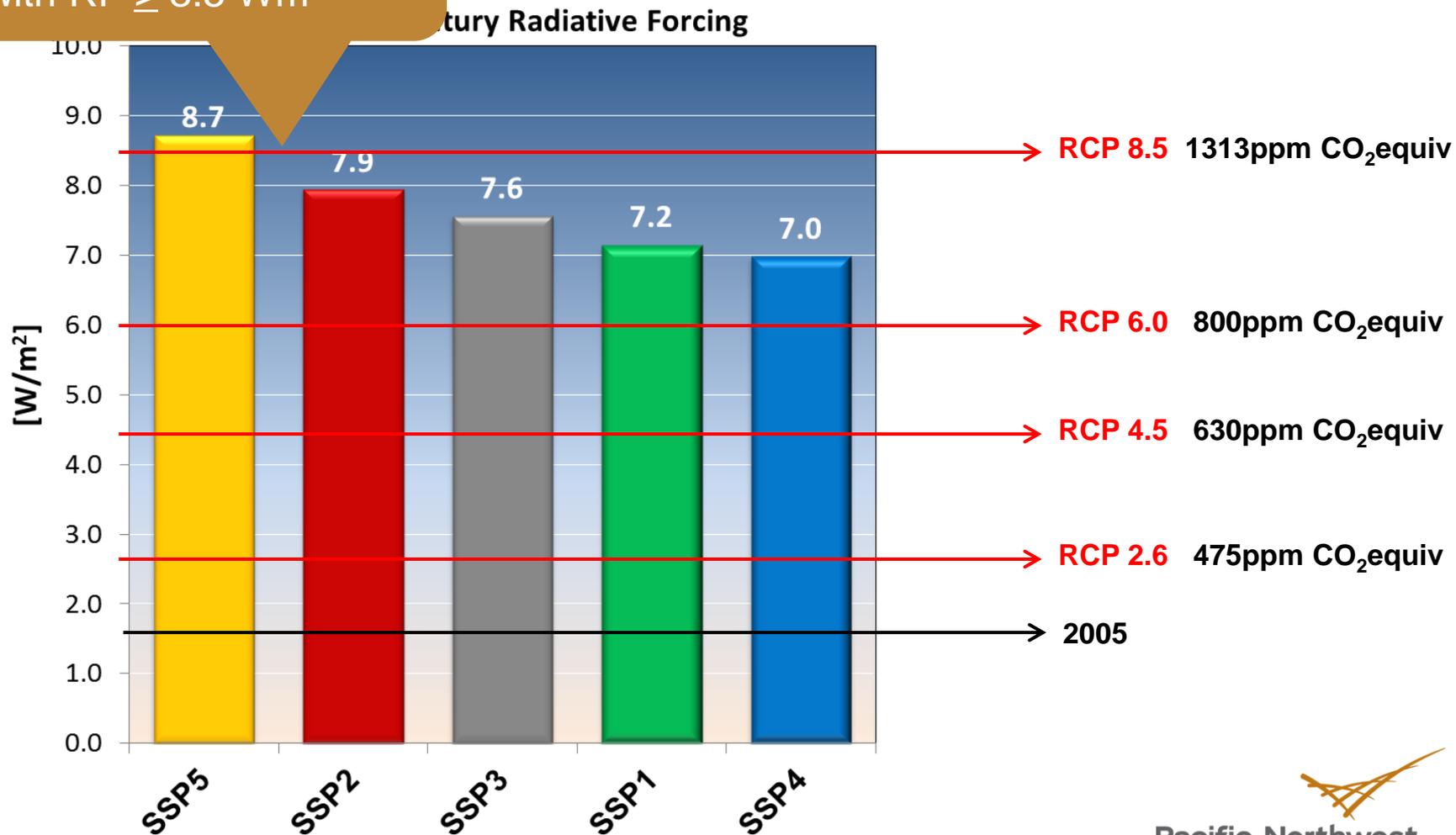
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End-of-the-Century Radiative Forcing in Reference Scenarios (relative to RCPs)

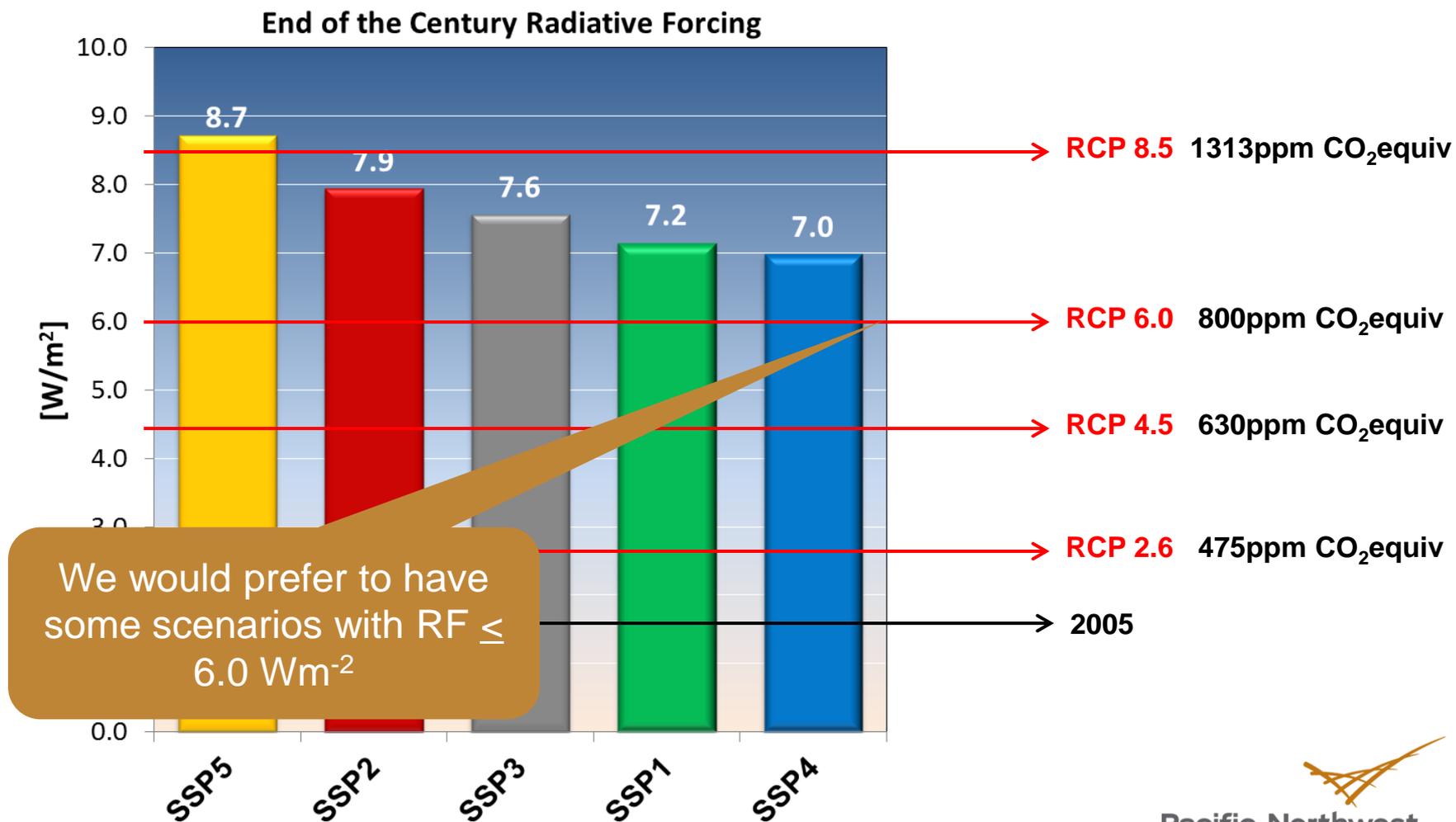


End-of-the-Century Radiative Forcing in SSP Scenarios (relative to RCPs)

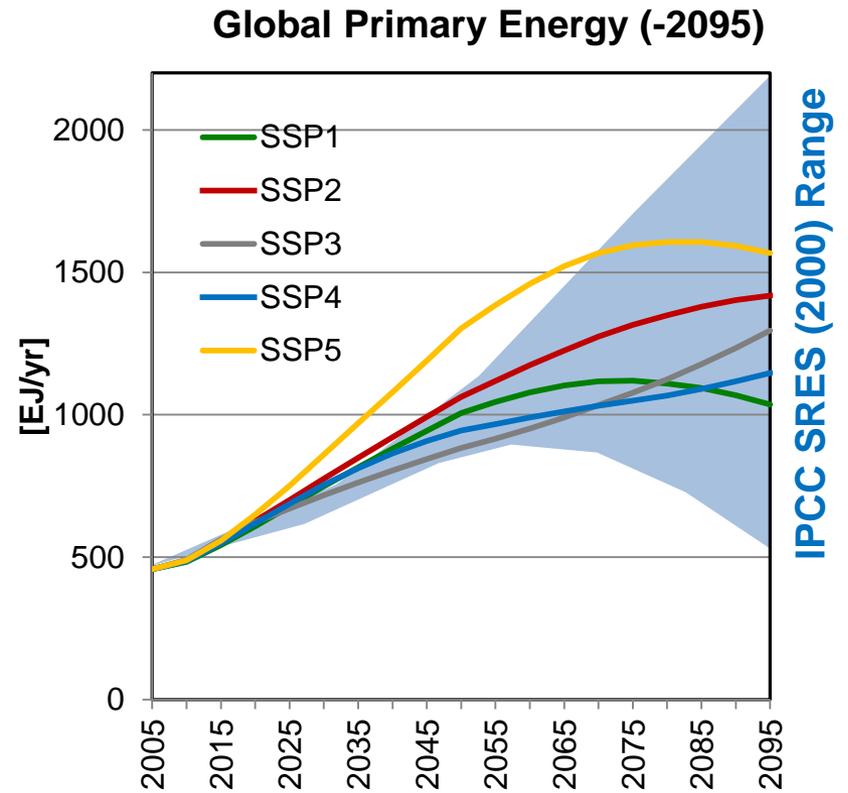
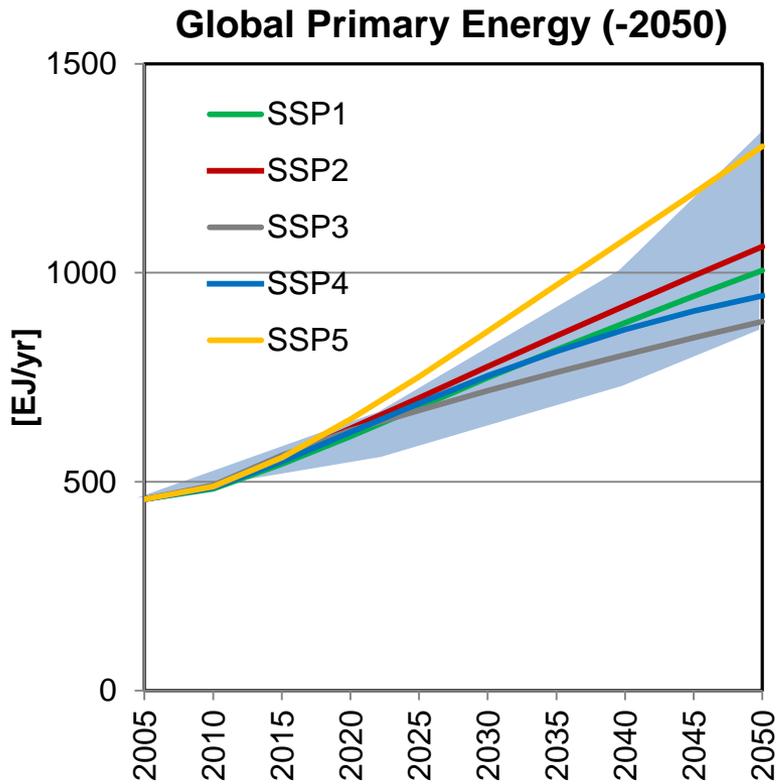
We feel that it is important to have at least one scenario with $RF \geq 8.5 \text{ Wm}^{-2}$



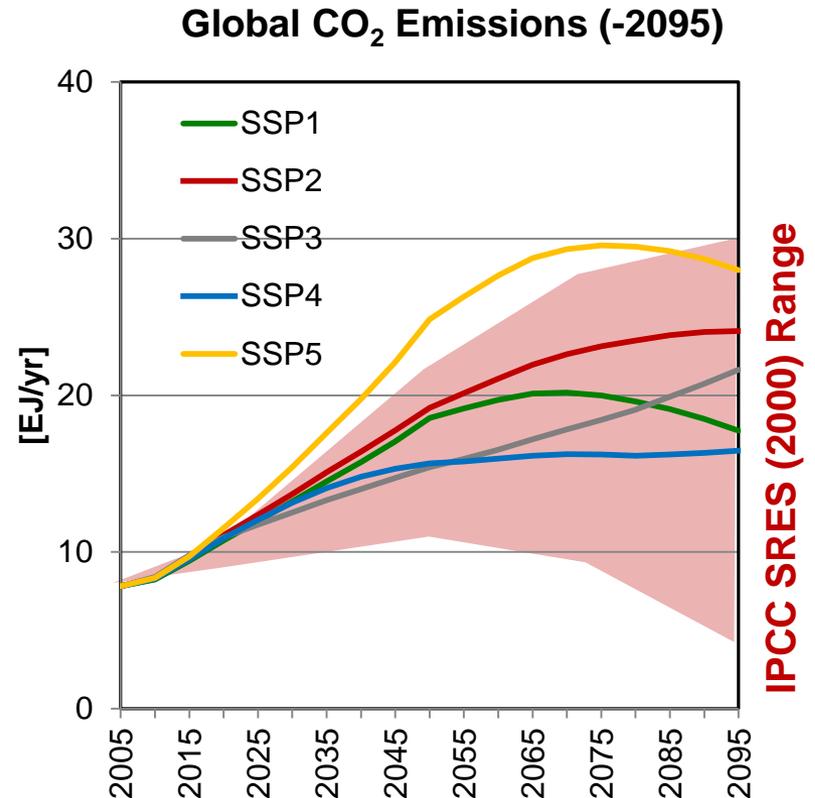
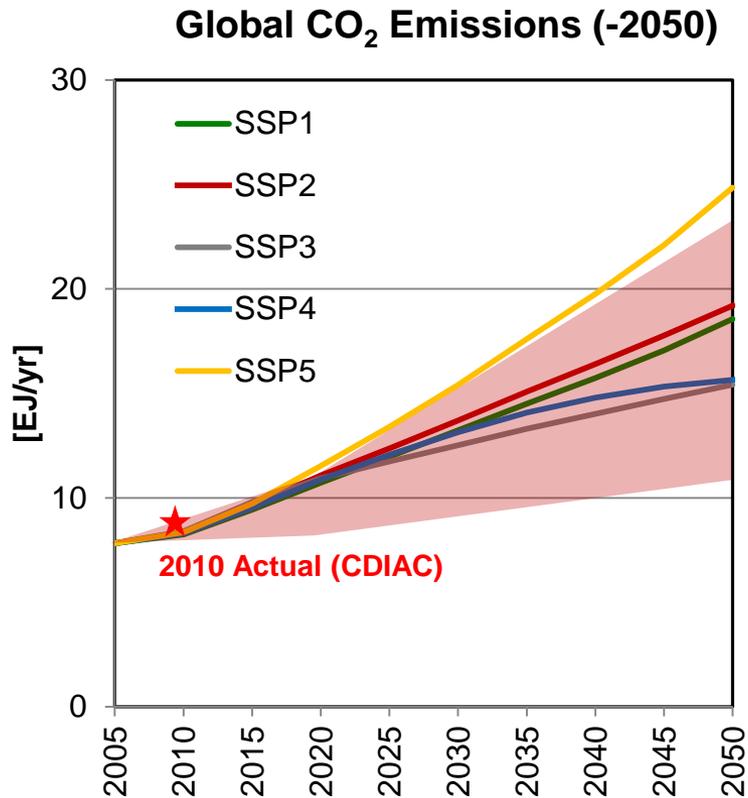
End-of-the-Century Radiative Forcing in Reference Scenarios (relative to RCPs)



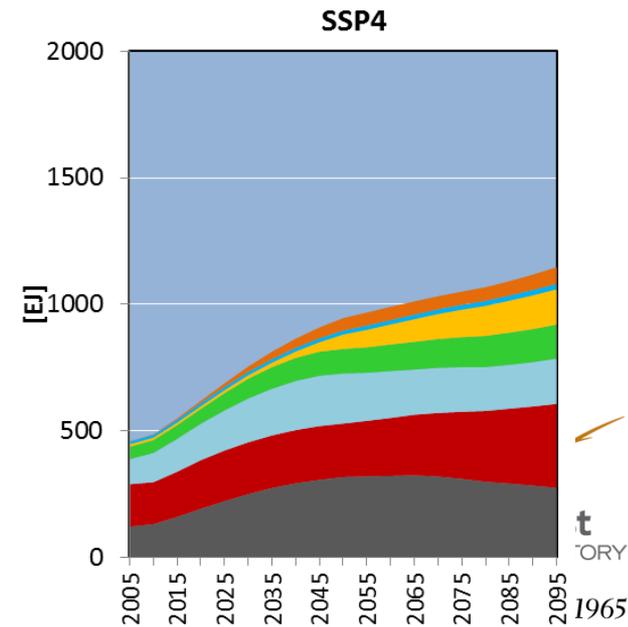
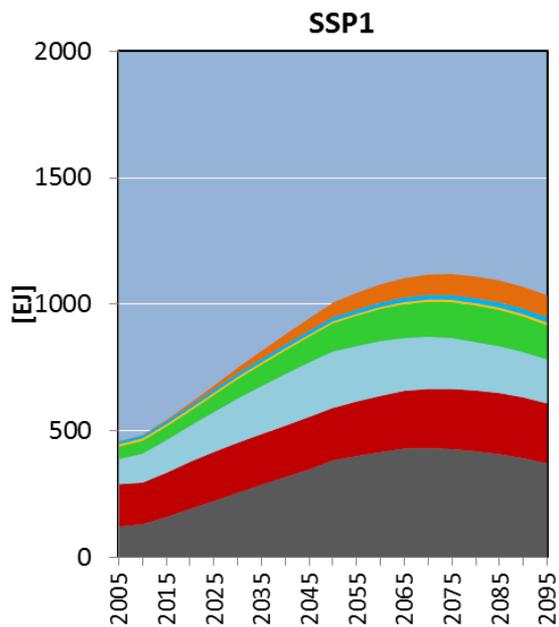
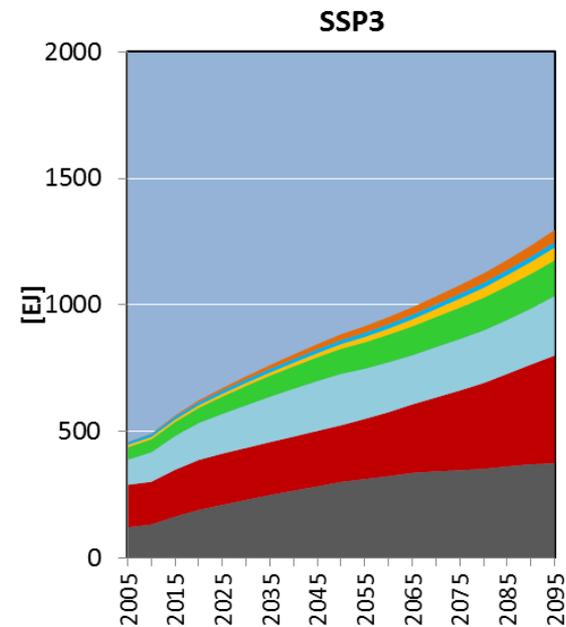
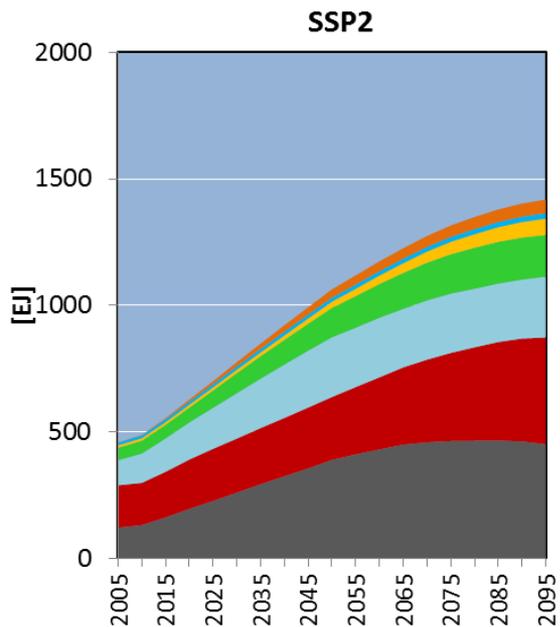
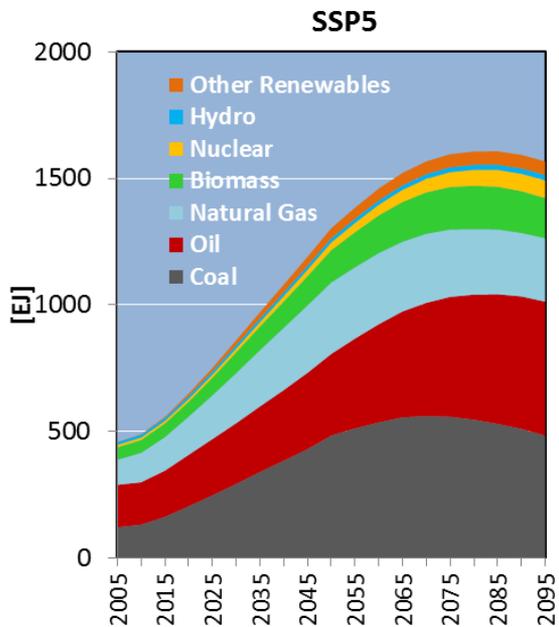
Global Total Primary Energy



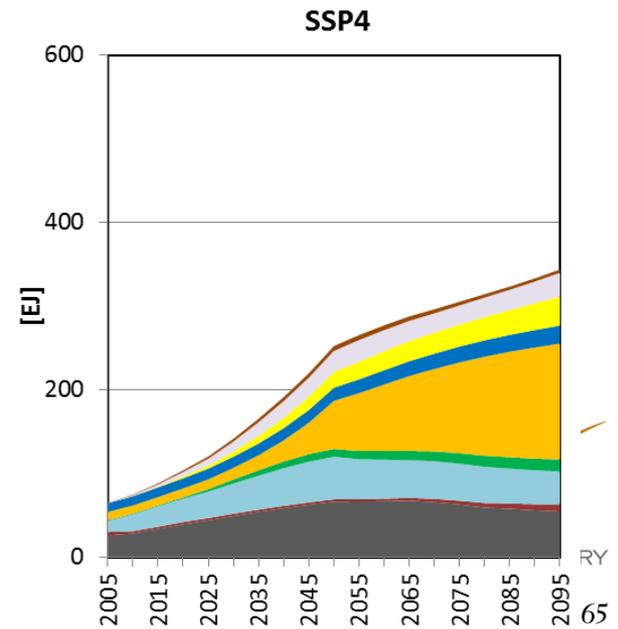
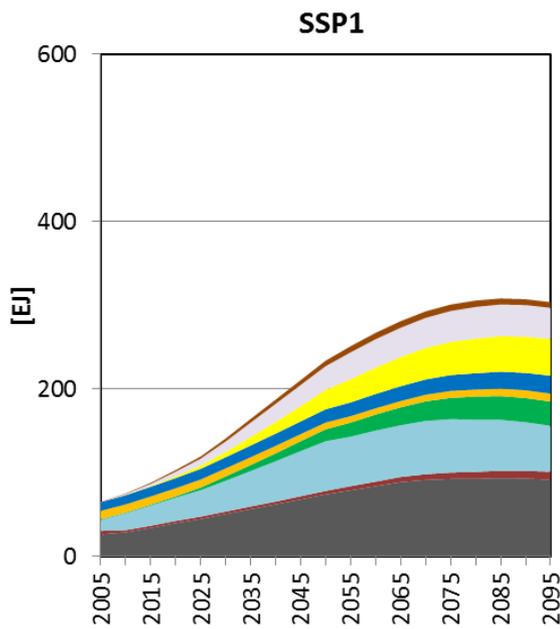
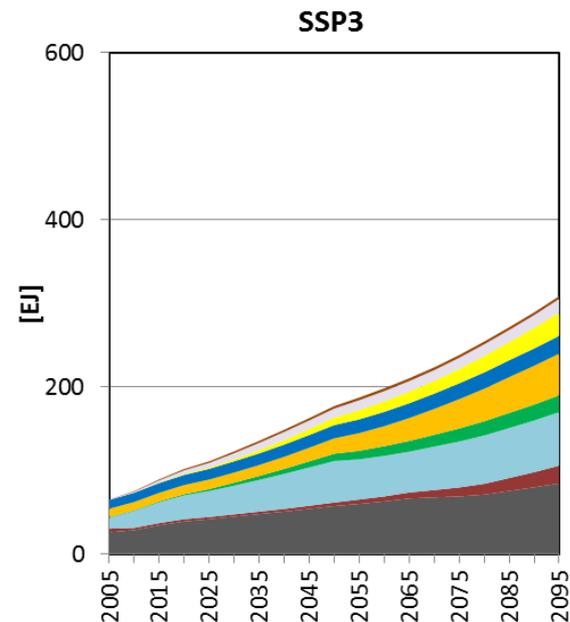
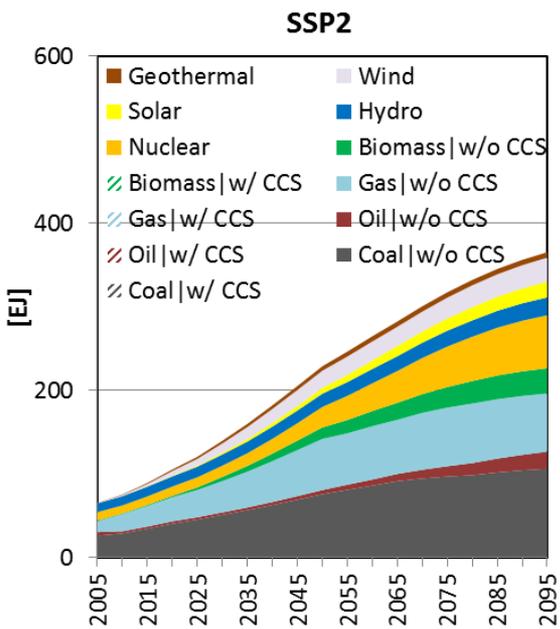
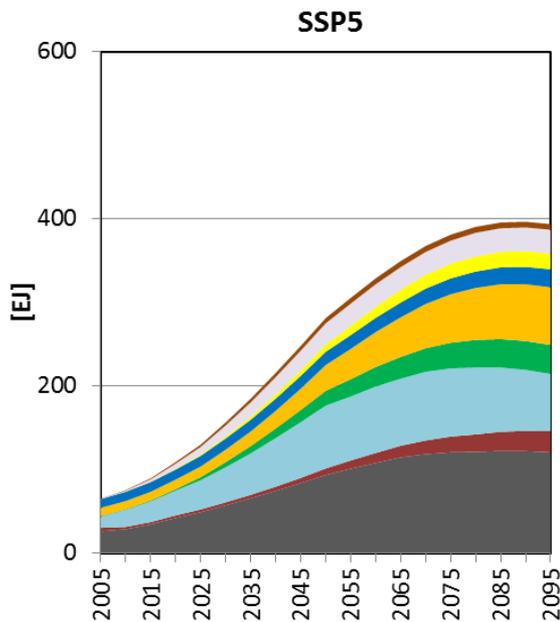
Global Total CO₂ Emissions



Global Primary Energy by Fuel: Reference Scenarios

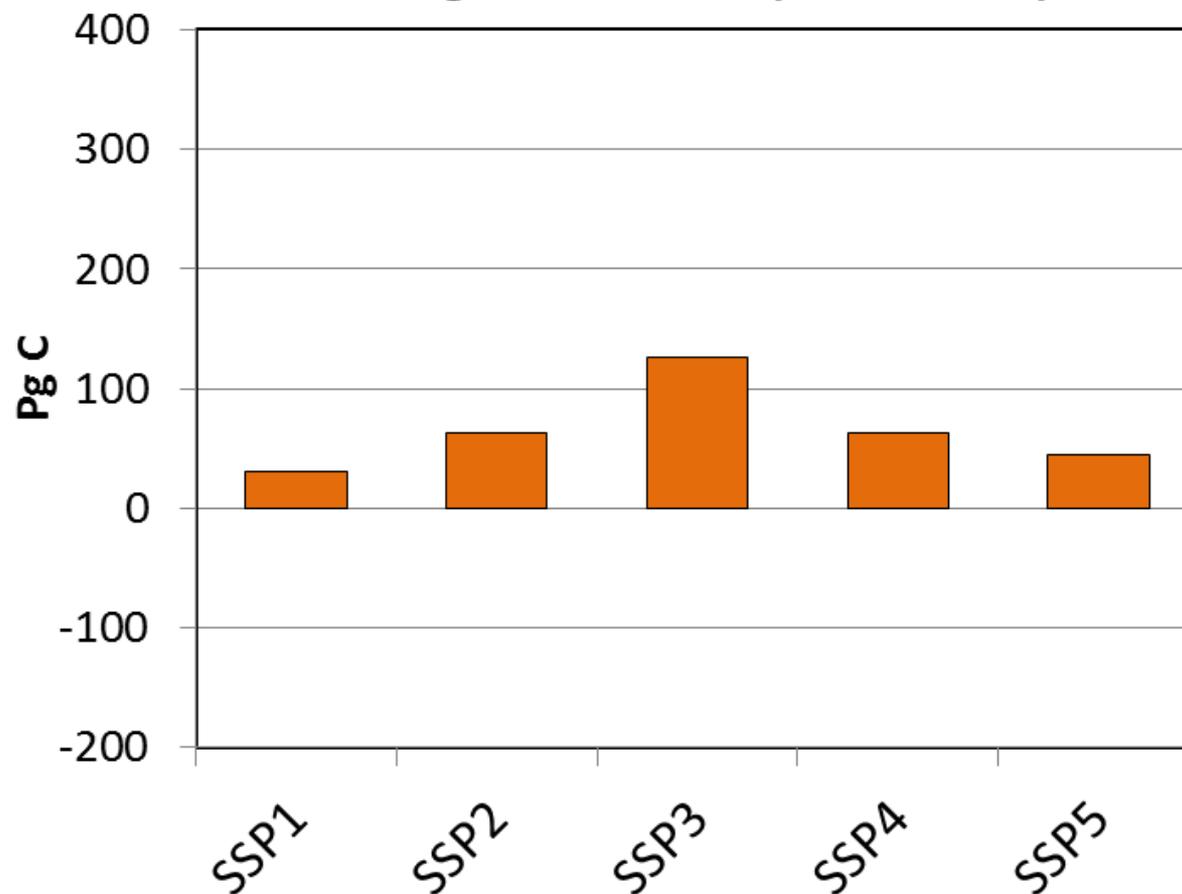


Global Power Generation by Fuel: Reference Scenarios



Land Use Change Emissions

2005-2095 Cummulative Land Use Change Emissions (Reference)



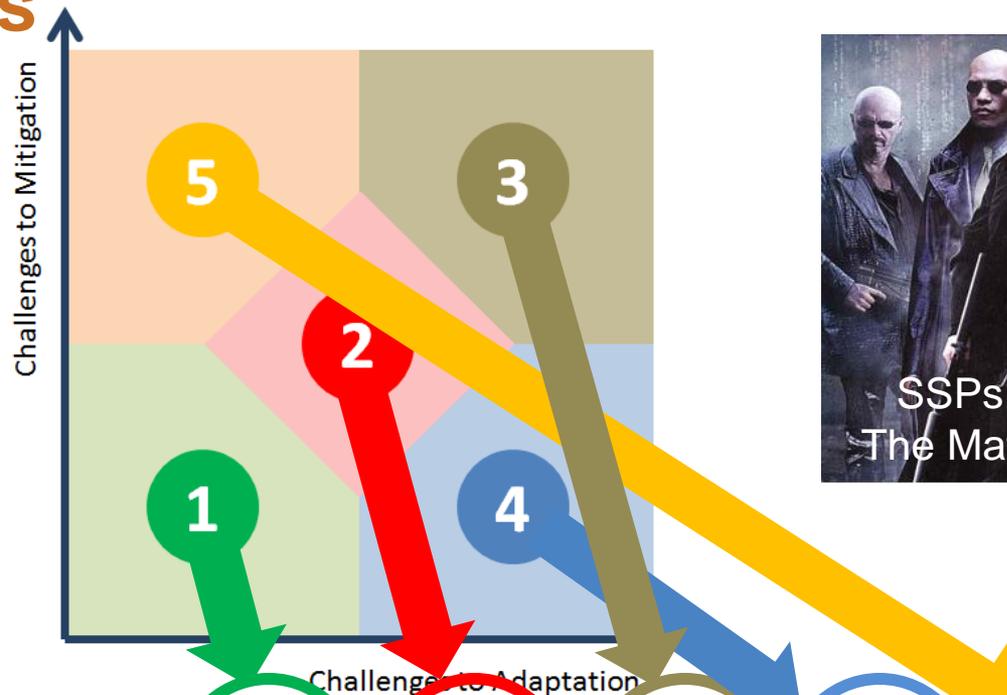
THE MATRIX



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Into the Matrix where SSPs spawn RCP Replications

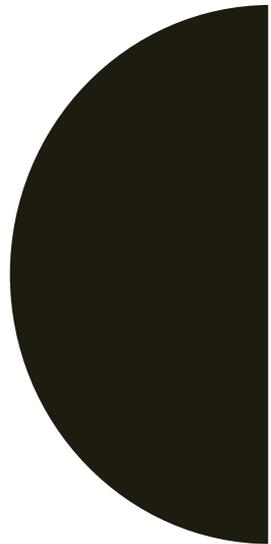


		SSP 1	SSP 2	SSP 3	SSP 4	SSP 5
	Reference	X	X	X	X	X
Replication	8.5 Wm ⁻²					X
	6.0 Wm ⁻²	X	X	X	X	X
	4.5 Wm ⁻²	X	X	X	X	X
	2.6 Wm ⁻²	X	X			X

SPAs

GCAM SPAs: Accession to Global Carbon Market

Instantaneous Accession Scenario



**Global Carbon Tax
from 2015:**
All global regions

Delayed Accession Scenario



Joins in 2070:
global price by 2085

Joins in 2050:
global price by 2065

Joins in 2030:
global price by 2045

**Global Carbon
Tax from 2015**

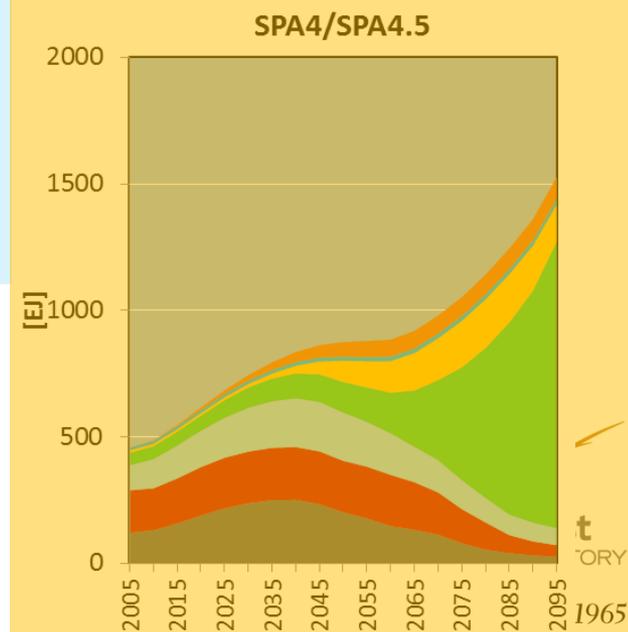
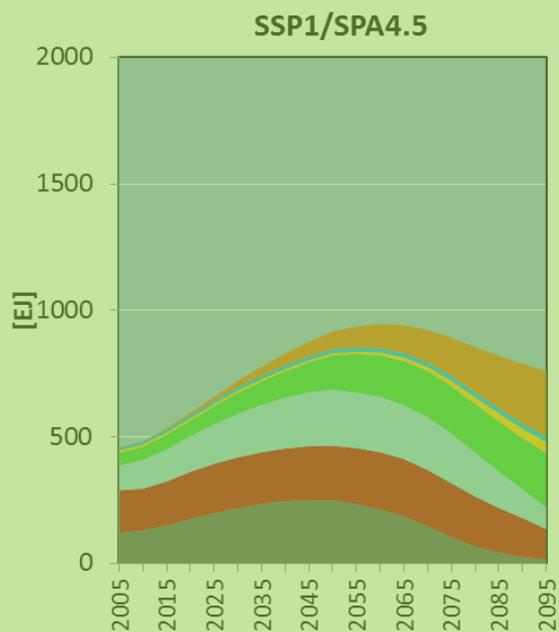
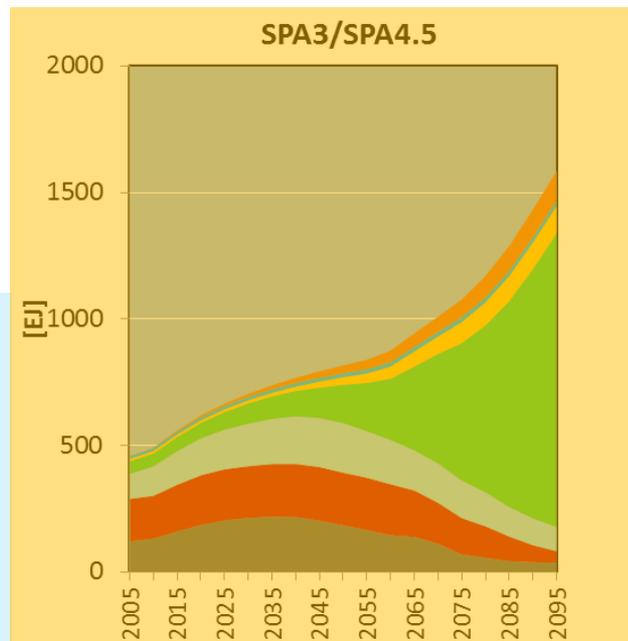
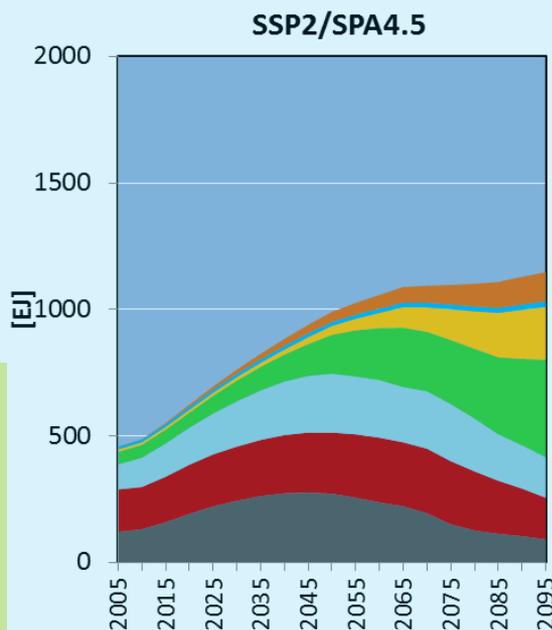
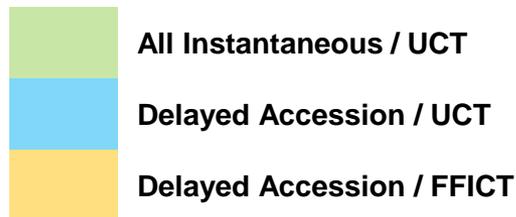
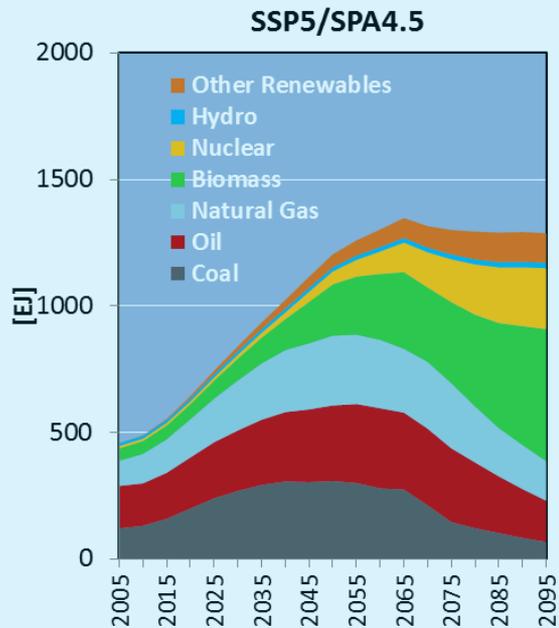
- Africa
- India / Latin America / Southeast Asia
- USA / China / Canada / Australia / NZ / Korea
- Western Europe / Eastern Europe / Japan

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



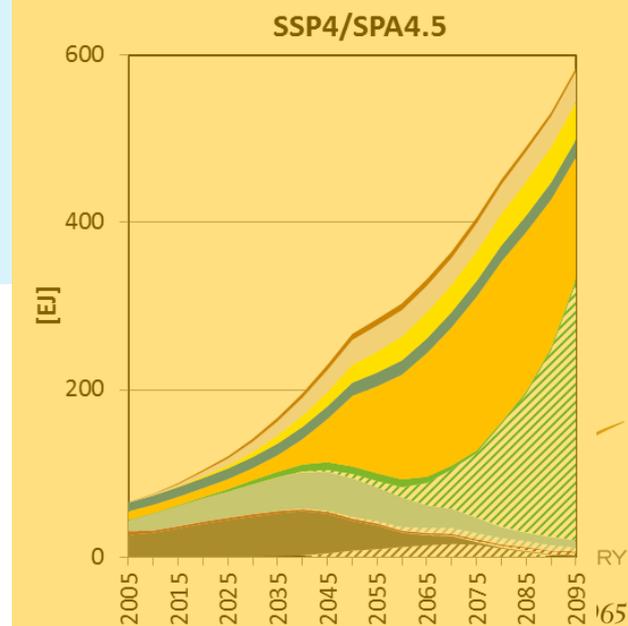
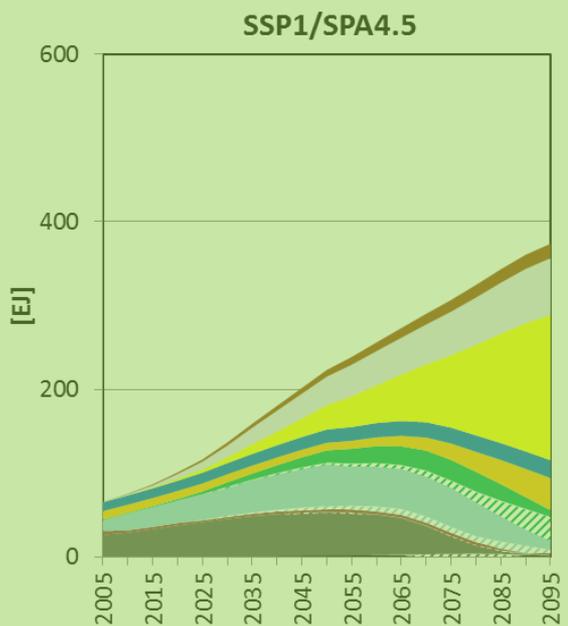
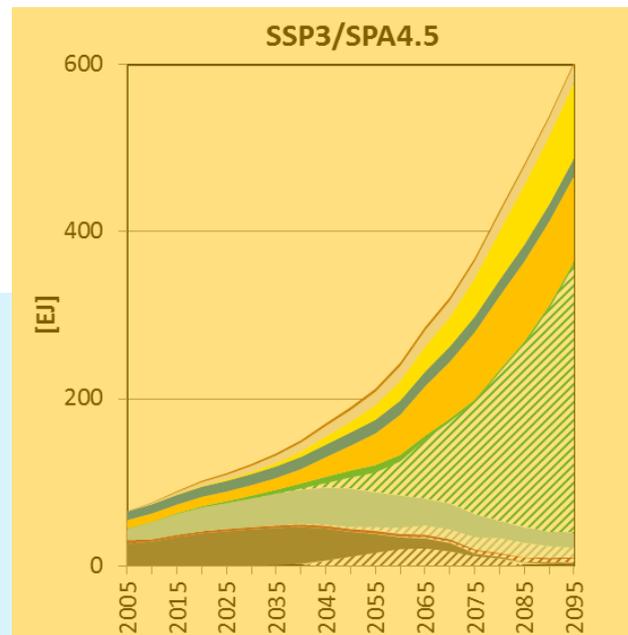
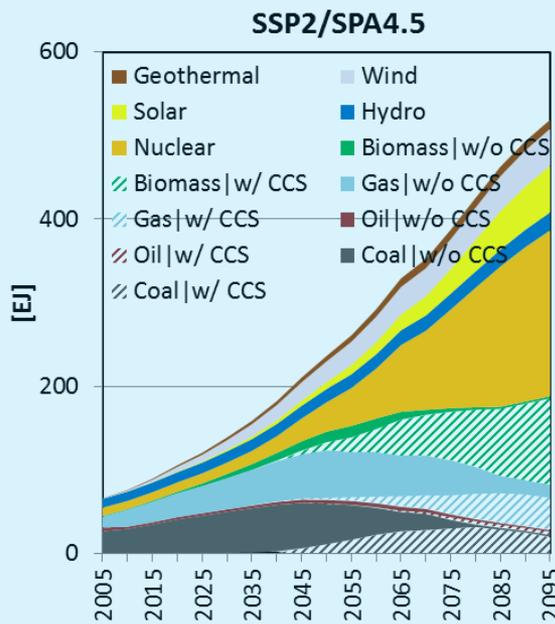
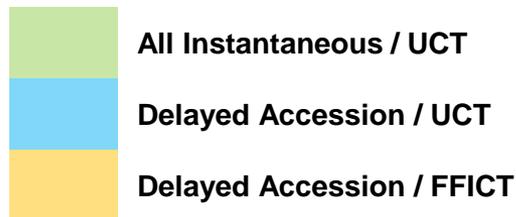
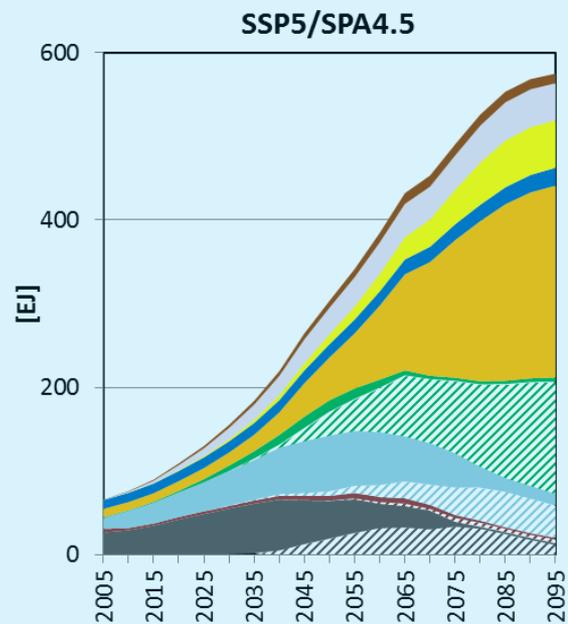
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Global Primary Energy by Fuel: SPA 4.5 Scenarios

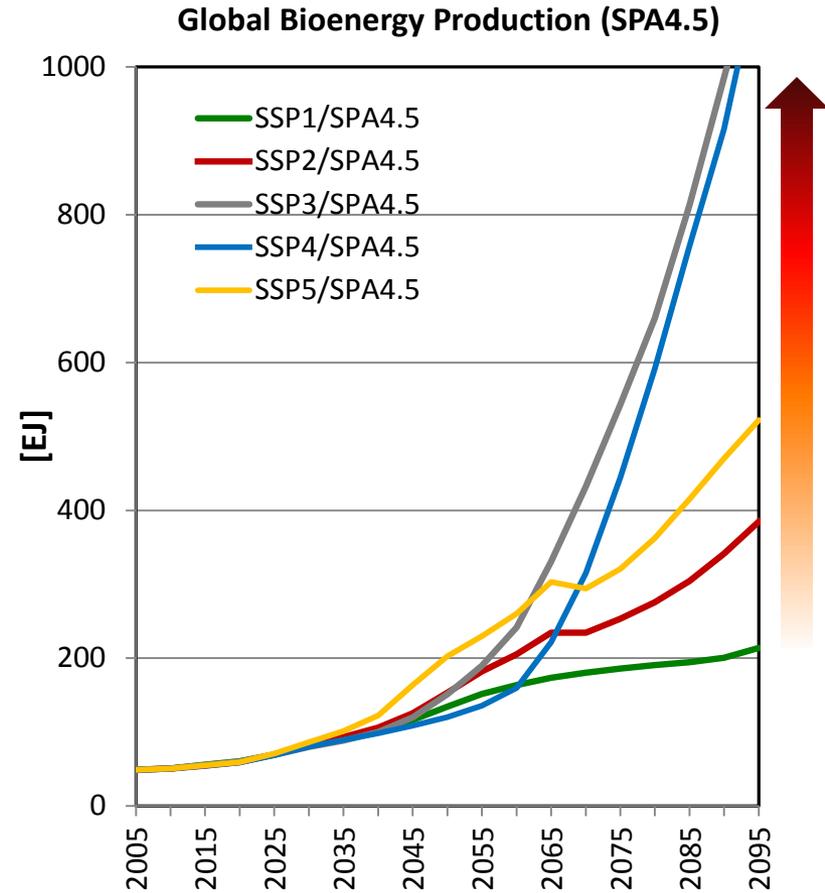
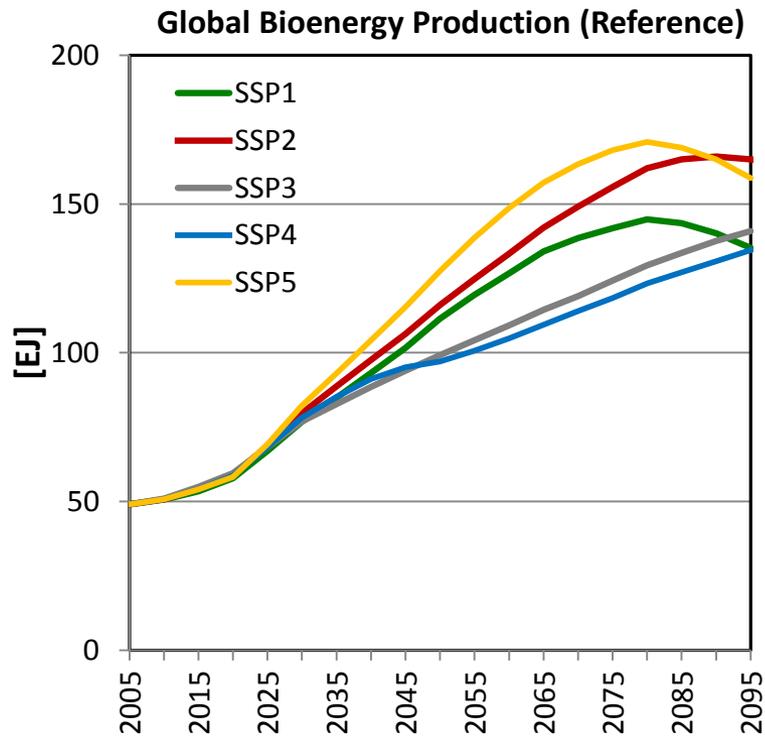


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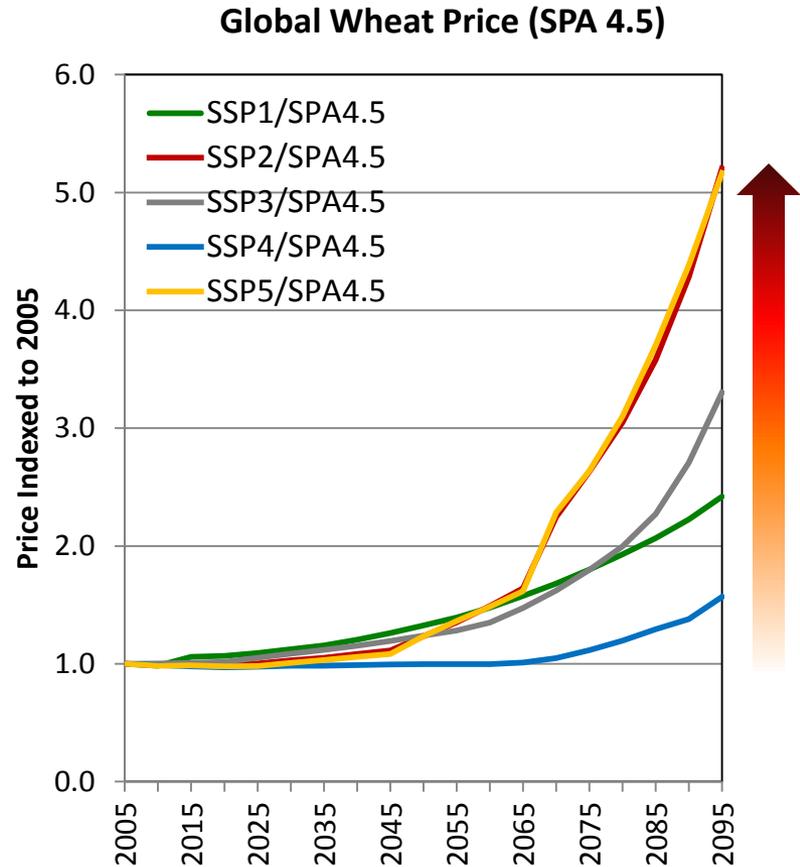
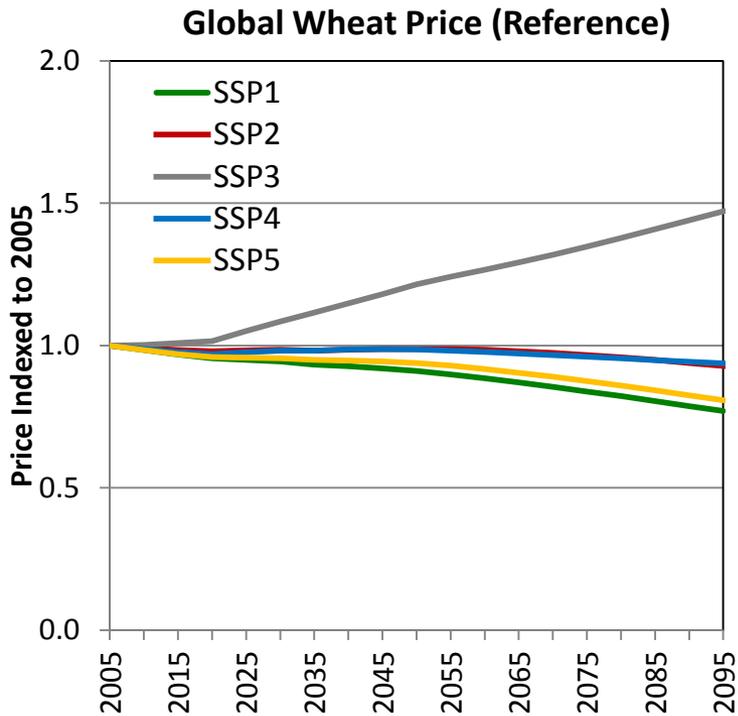
Global Power Generation by Fuel: SPA 4.5 Scenarios



Global Bioenergy Production

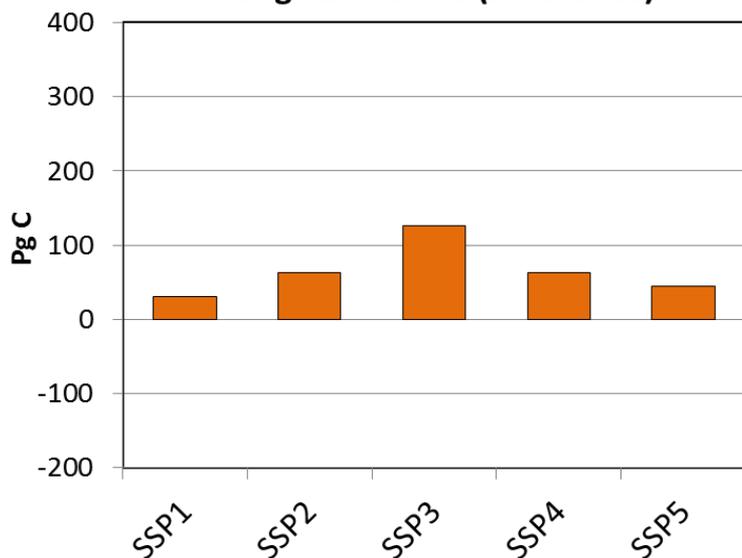


Global Wheat Prices

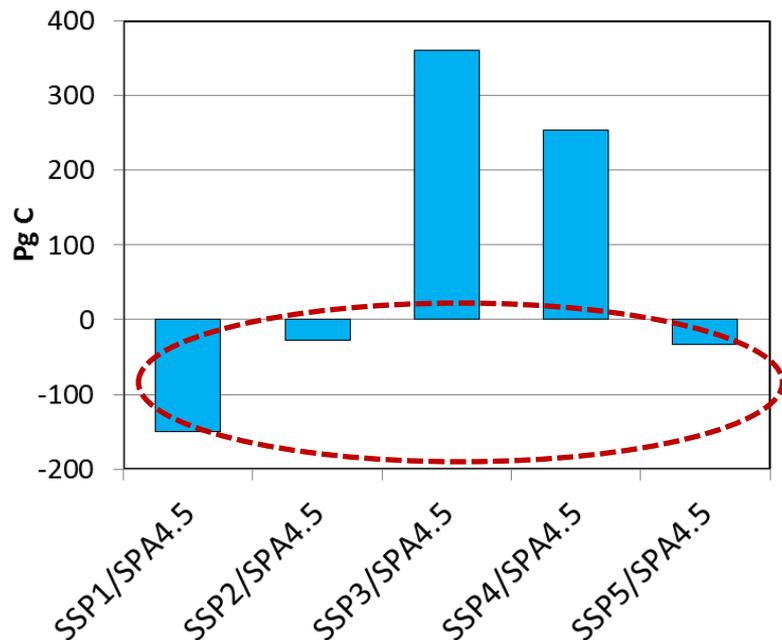


Land Use Change Emissions

2005-2095 Cumulative Land Use Change Emissions (Reference)



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



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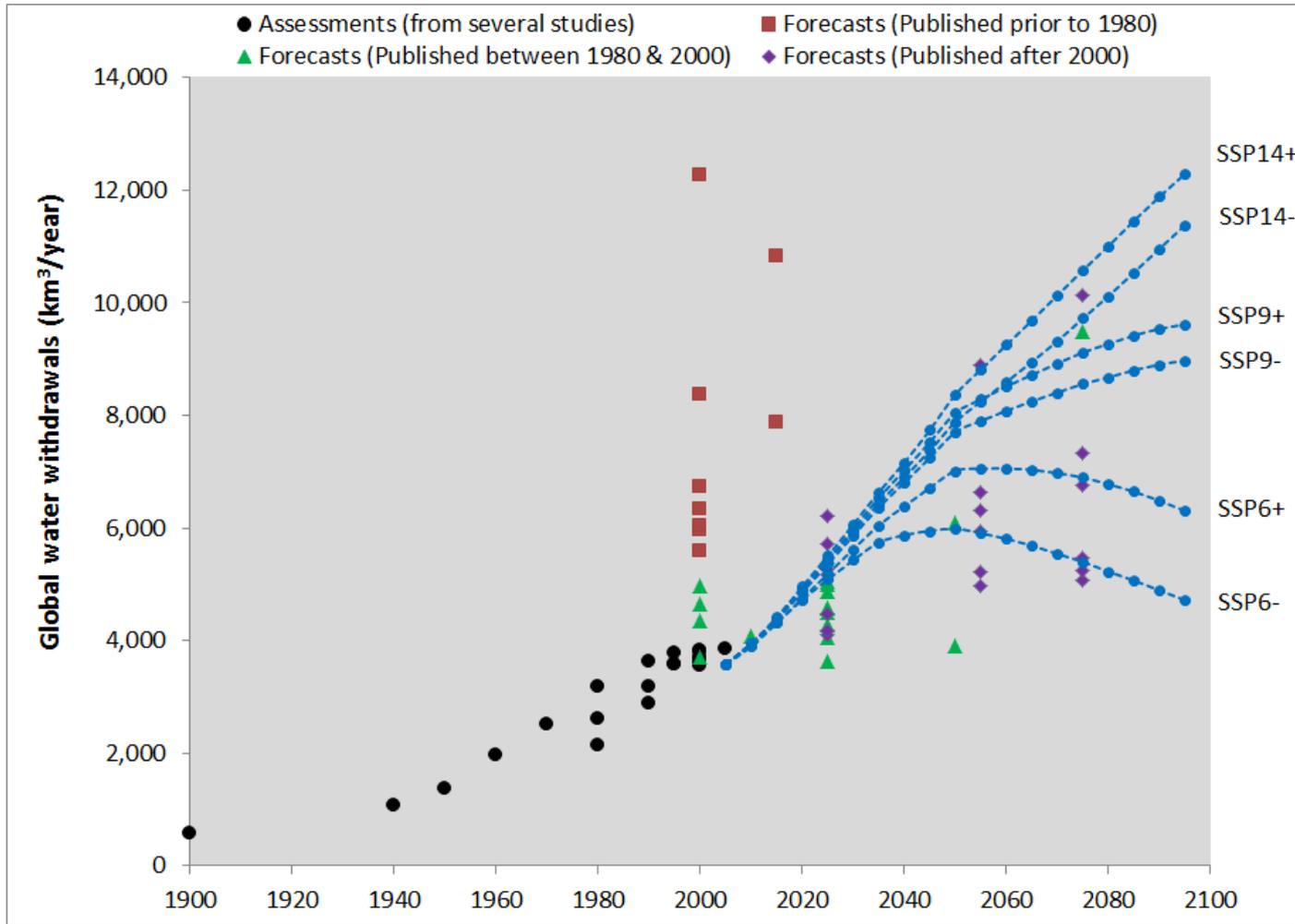
OTHER GCAM EXPERIMENTS: WATER



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Global water withdrawals vs. literature estimates of water use



Sources: Gleick 2003 (and references therein), Falkenmark & Rockström, 2000, Alcamo et al. 2003a, Alcamo et al. 2003b, Shiklomanov & Rodda, 2003, Alcamo et al., 2007, Shen et al. 2008, Wada et al., 2011, and AQUASTAT 2011

DISCUSSION



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