

**CGE HANDS-ON TRAINING ON  
VULNERABILITY AND ADAPTATION  
ASSESSMENT**

Baseline socioeconomic scenarios



# Content

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- I. Review the history of scenario development
- II. Describe the new scenario process, including two of the key elements:  
Representative Concentration Pathway (RCP) and Shared Socioeconomic Pathways
- III. Describe a process for developing socioeconomic storylines for use in the national vulnerability process



# Objectives

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The objectives of this module are to:

- Understand the process being used to develop new scenarios for use in climate change research and assessment
- Describe a process for developing socioeconomic storylines for use in national vulnerability assessments



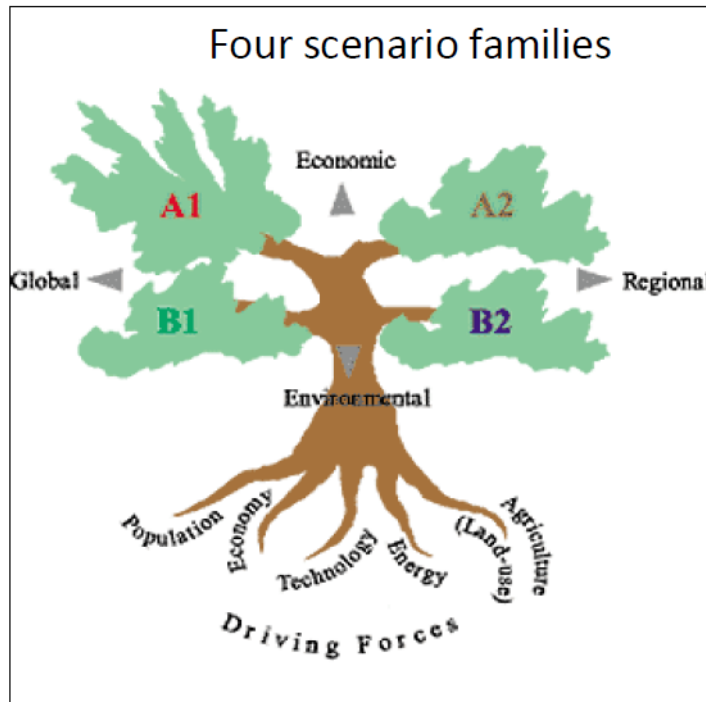
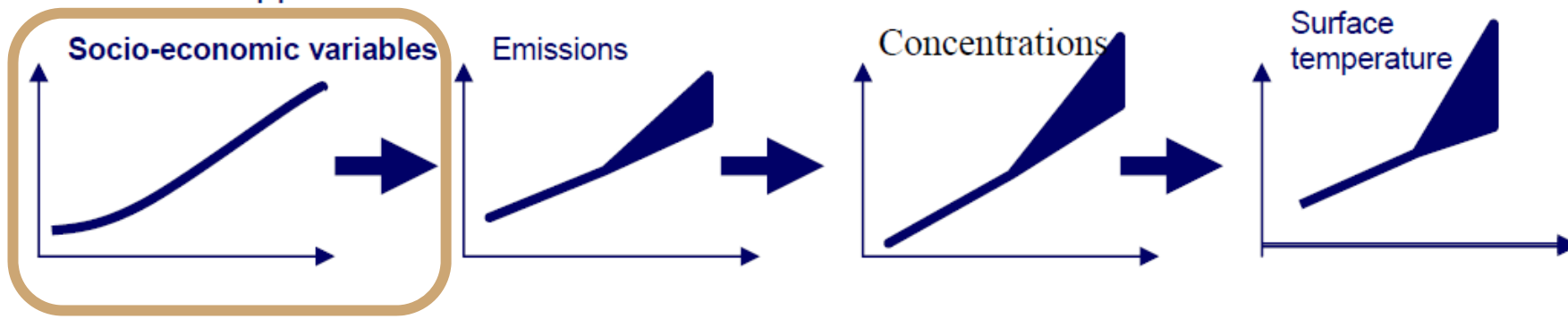
# Socioeconomic baseline scenario

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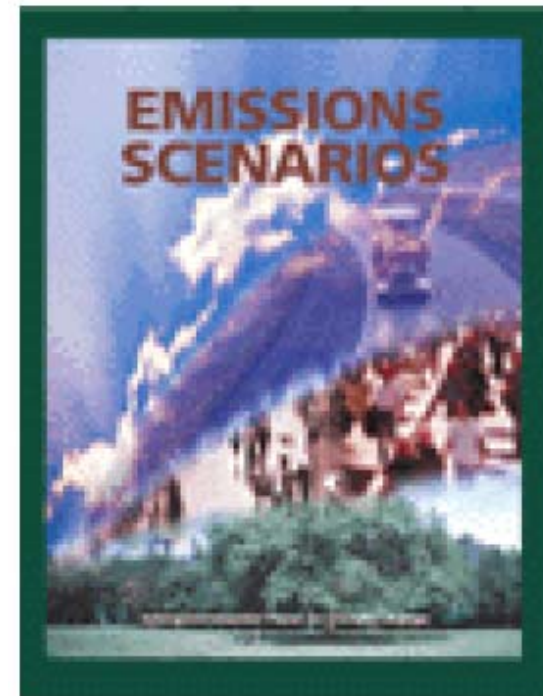
- Definition of *socioeconomic scenarios*: a comprehensive and plausible description of the future of the human-environment system, including a narrative with qualitative trends and quantitative projections about development patterns
- Understanding the range and character of possible futures is critical to furthering assessment of climate change, including
  - a) The potential risks to physical, natural, and human systems in the context of different development pathways, and
  - b) Mitigation and adaptation options to avoid, prepare for, and manage those risks
- Not considering how pathways for how socioeconomic and natural systems could evolve over coming decades could under- or over-estimate future risks



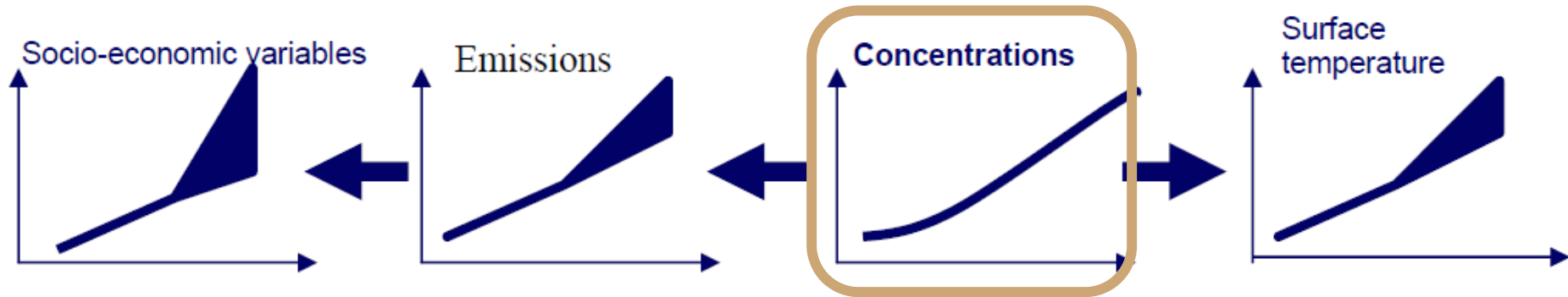
# Traditional/linear/forward scenario process



## SRES Scenarios



# New parallel/reverse scenario process



Shared socio-economic pathways

- Small number
- Shared across RCPs

RCPs

CMIP5



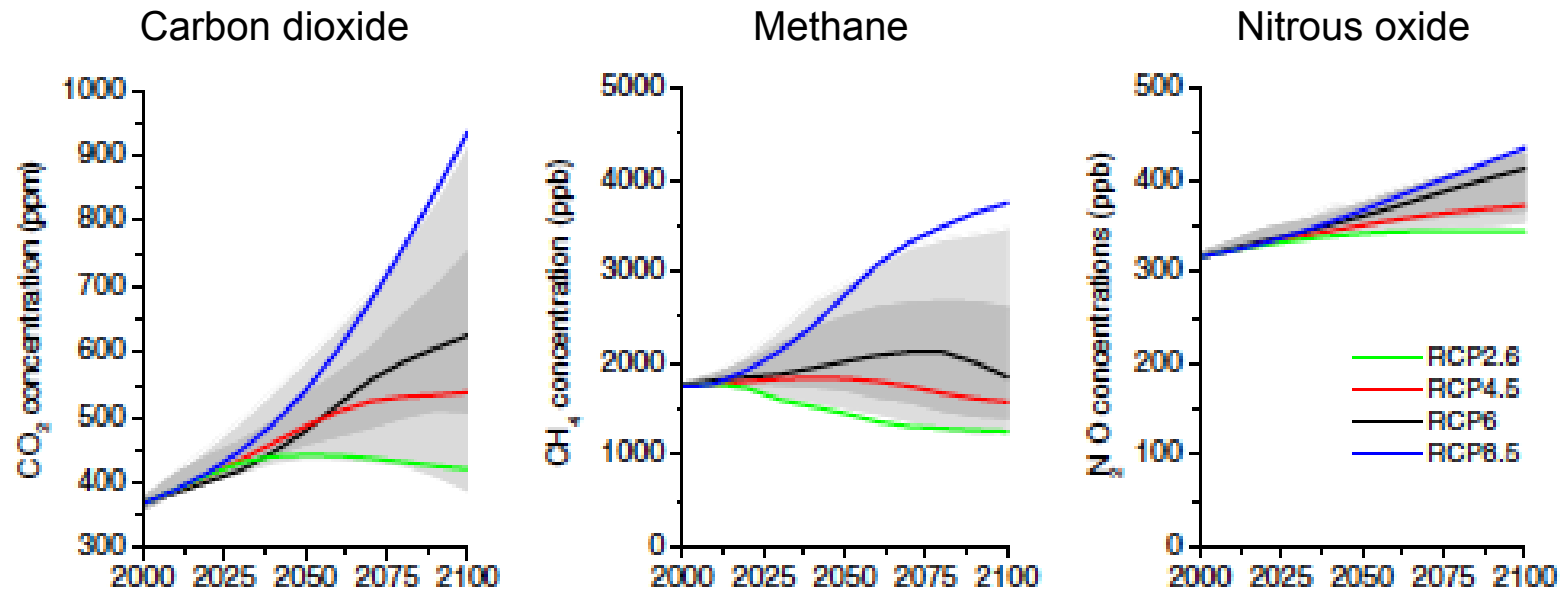
# RCPs

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- RCP8.5
  - a) Rising radiative forcing pathway leading to 8.5 W/m<sup>2</sup> (~ 1,370 ppm CO<sub>2</sub> eq) by 2100
- RCP6.0
  - a) Stabilization without overshoot pathway to 6 W/m<sup>2</sup> (~ 850 ppm CO<sub>2</sub> eq) at stabilization after 2100
- RCP4.5
  - a) Stabilization without overshoot pathway to 4.5 W/m<sup>2</sup> (~ 650 ppm CO<sub>2</sub> eq) at stabilization after 2100
- RCP2.6
  - a) Peak in radiative forcing at ~ 3 W/m<sup>2</sup> (~ 490 ppm CO<sub>2</sub> eq) before 2100 and then decline (the selected pathway declines to 2.6 W/m<sup>2</sup> by 2100)

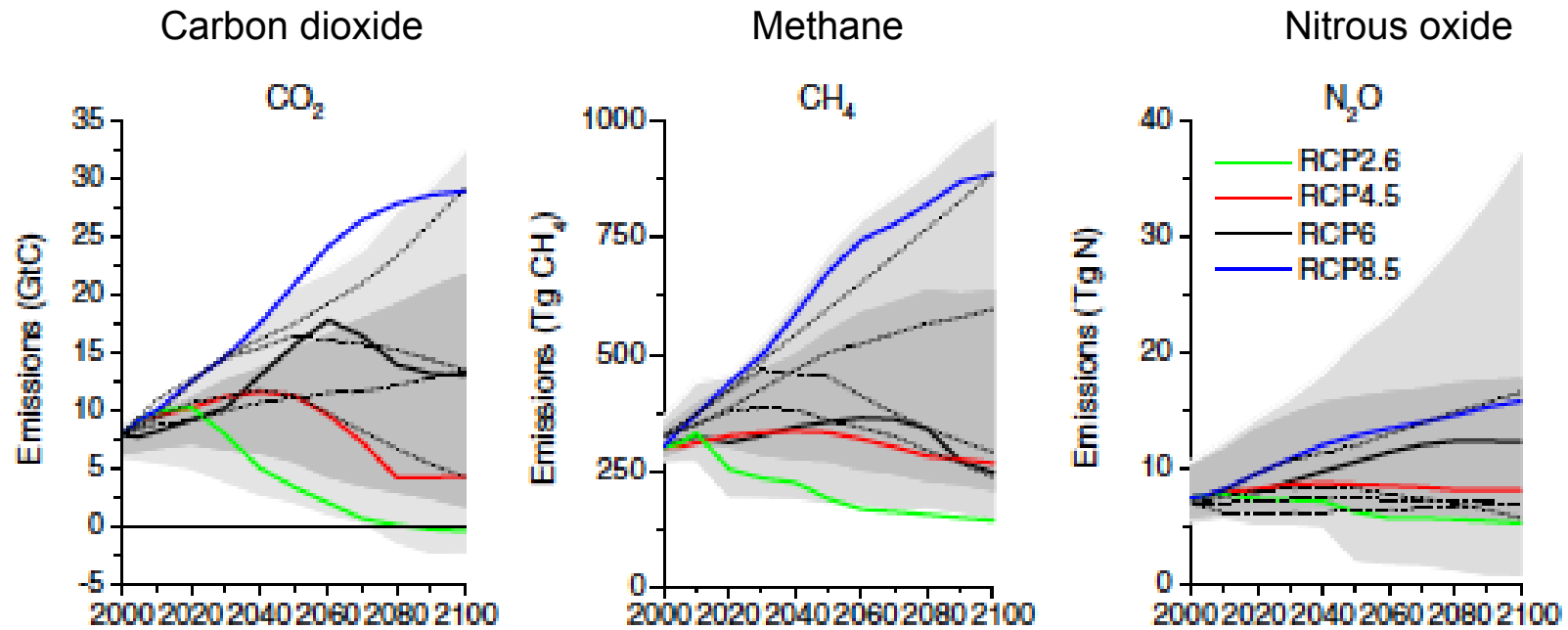


# Trends in concentrations of greenhouse gases in the RCPs





# Trends in concentrations of greenhouse gases in the RCPs (cont.)



# What's different from the SRES scenarios?

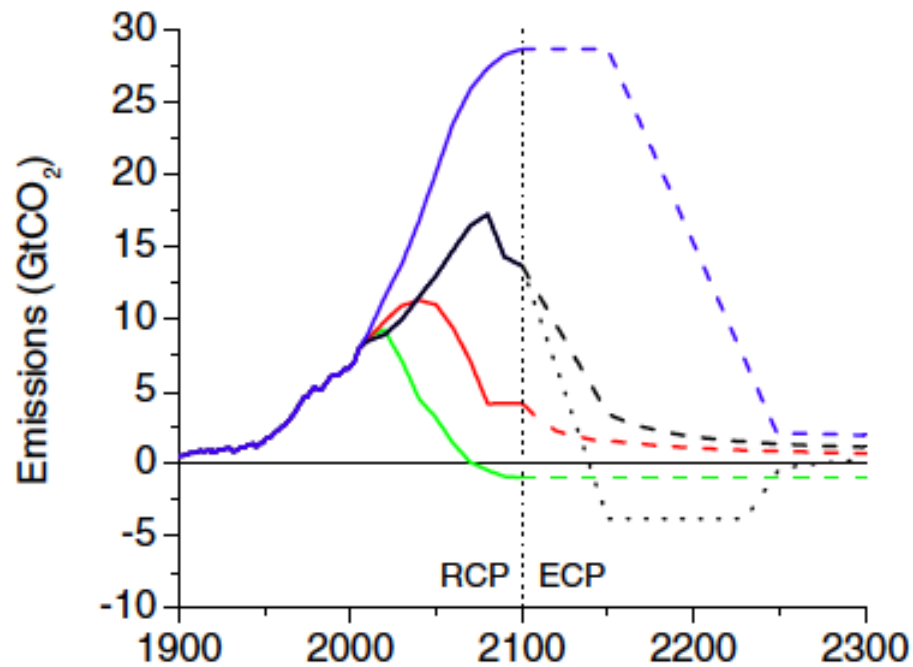
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- RCPs were developed by the IAM community and not the IPCC
- RCPs provide land-use and land cover information as  $1/2^\circ \times 1/2^\circ$  gridded data
- RCPs provide short-lived species emissions as  $1/2^\circ \times 1/2^\circ$  gridded data
- RCPs include climate stabilization scenarios
  - a) RCP 4.5 and RCP 2.6 assume climate policy intervention to transform associated reference scenarios
  - b) RCP 8.5 does not include climate policy interventions
  - c) RCP 6.0 assumes climate policy intervention late in the century
- RCPs provide very long-term radiative forcing trajectories – to the year 2300
- RCPs include limited socioeconomic information (population and GDP)

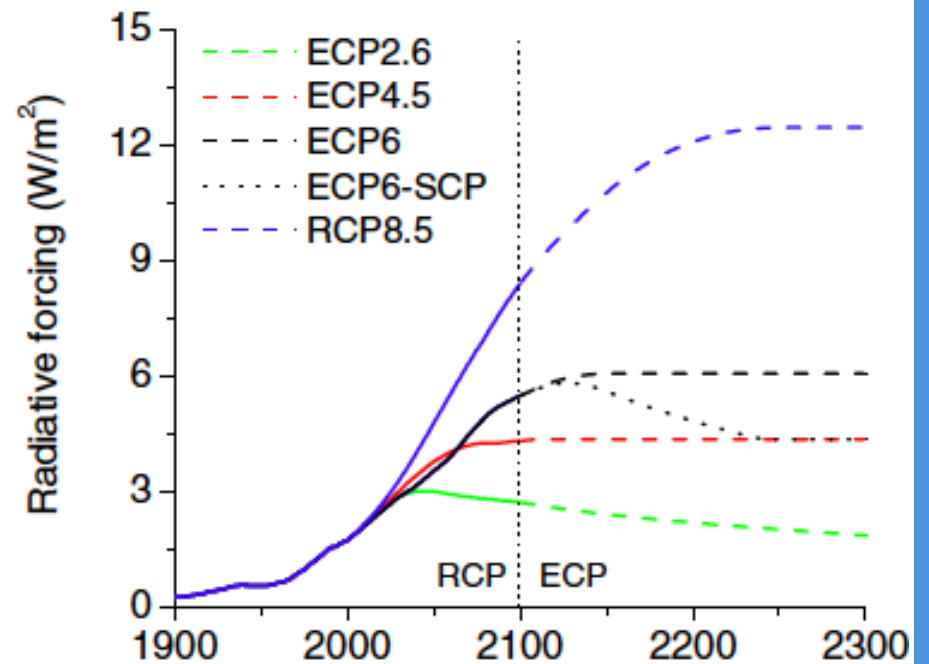


# Emissions and radiative forcing in the RCPs

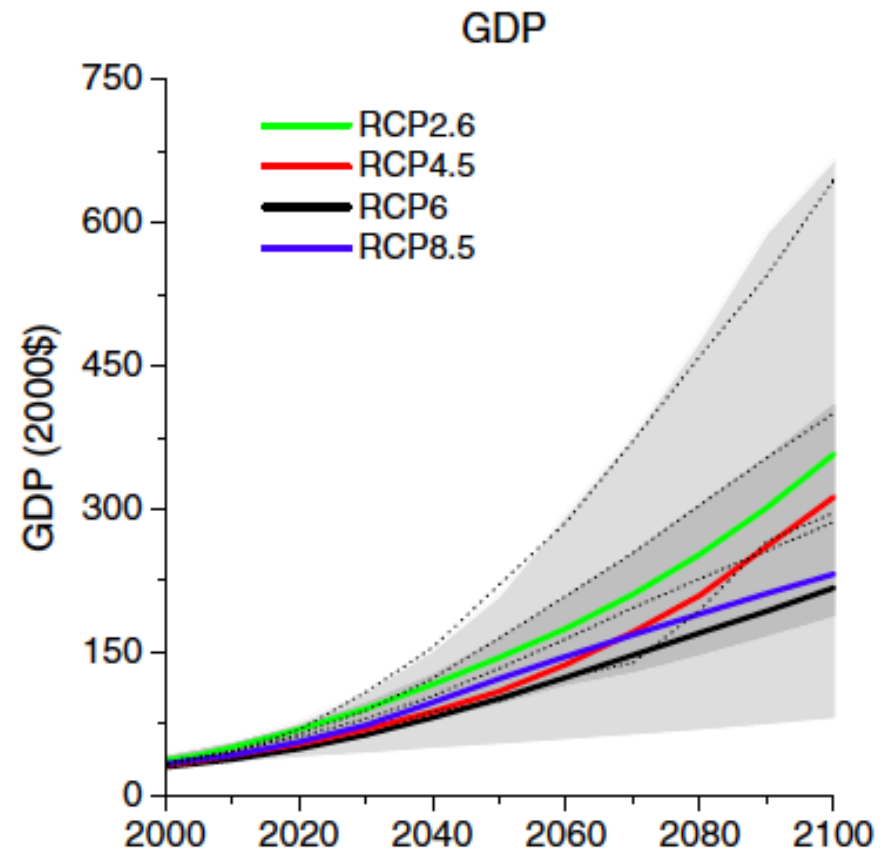
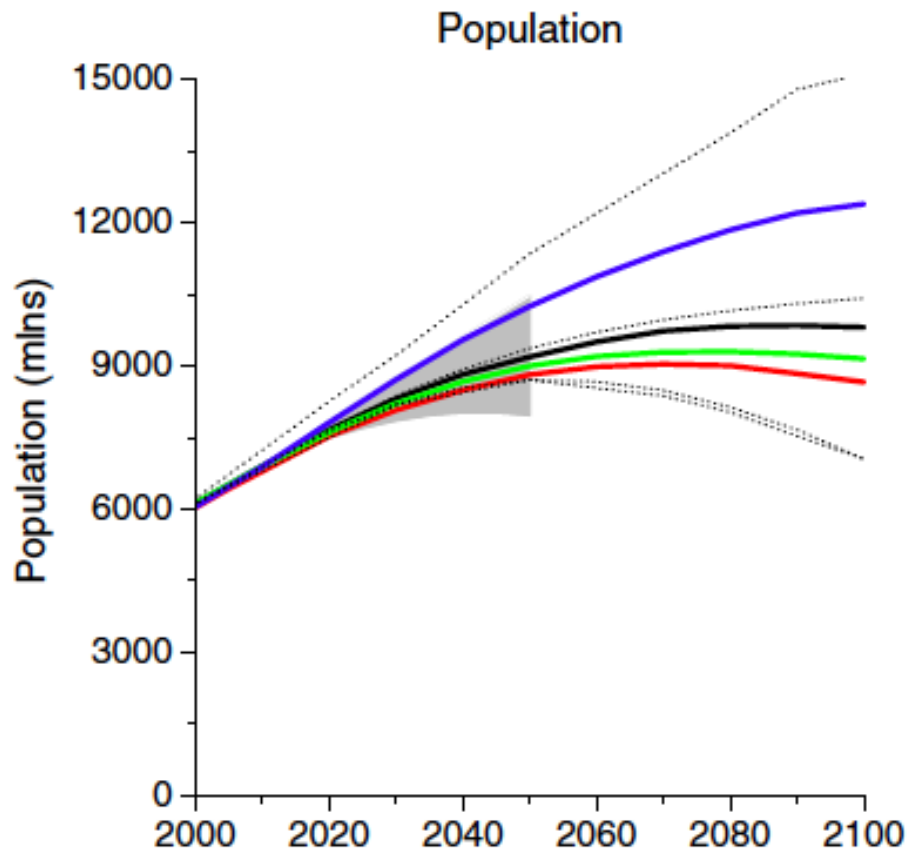
## Emissions GtCO<sub>2</sub>



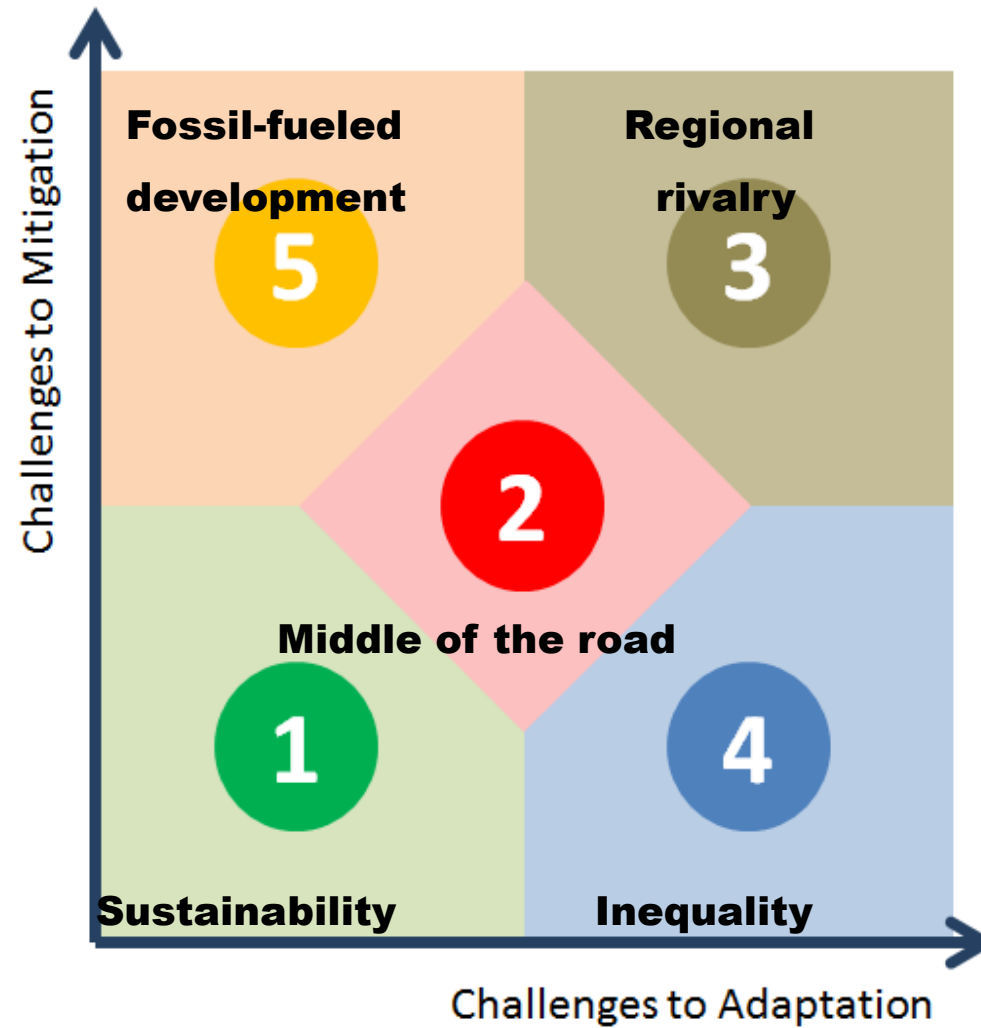
## Radiative Forcing



# Population and GDPs in the RCPs



# Shared socio-economic pathways



# SSP1: Sustainability – Taking the Green Road

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- The world shifts gradually, but pervasively, toward a more sustainable path, emphasizing more inclusive development that respects perceived environmental boundaries. Increasing evidence of and accounting for the social, cultural, and economic costs of environmental degradation and inequality drive this shift.
- Educational and health investments accelerate the demographic transition, leading to a relatively low population.
- Broader emphasis on human well-being, even at the expense of somewhat slower economic growth over the longer term.
- Inequality is reduced both across and within countries.
- Investment in environmental technology and changes in tax structures lead to improved resource efficiency,
- Consumption is oriented toward low material growth and lower resource and energy intensity.
- Results in relatively low challenges to mitigation and low challenges to adaptation.

(O'Neill et al., 2015)



## *SSP3: Regional Rivalry – A Rocky Road*

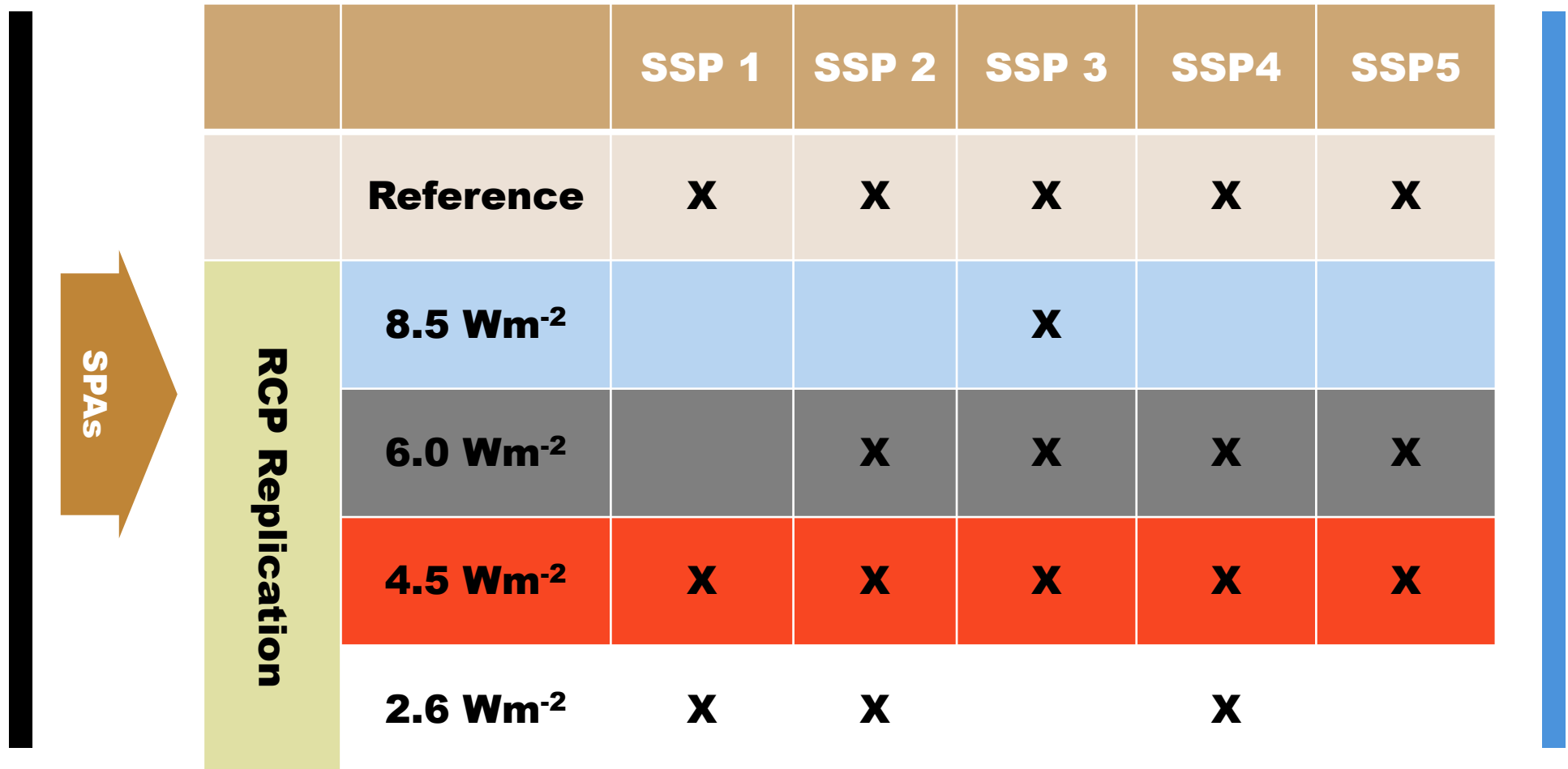
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- A resurgent nationalism, concerns about competitiveness and security, and regional conflicts push countries to increasingly focus on domestic or, at most, regional issues.
- Weak global institutions
- Policies shift over time to become increasingly oriented toward national and regional security issues, including barriers to trade, particularly in the energy resource and agricultural markets.
- Countries focus on achieving energy and food security goals within their own regions at the expense of broader-based development
- Several regions move toward more authoritarian forms of government with highly regulated economies.
- Investments in education and technological development decline.
- Economic development is slow, consumption is material-intensive, and inequalities persist or worsen over time, especially in developing countries.
- A low international priority for addressing environmental concerns leads to strong environmental degradation in some regions.

(O'Neill et al., 2015)



# Scenario matrix architecture



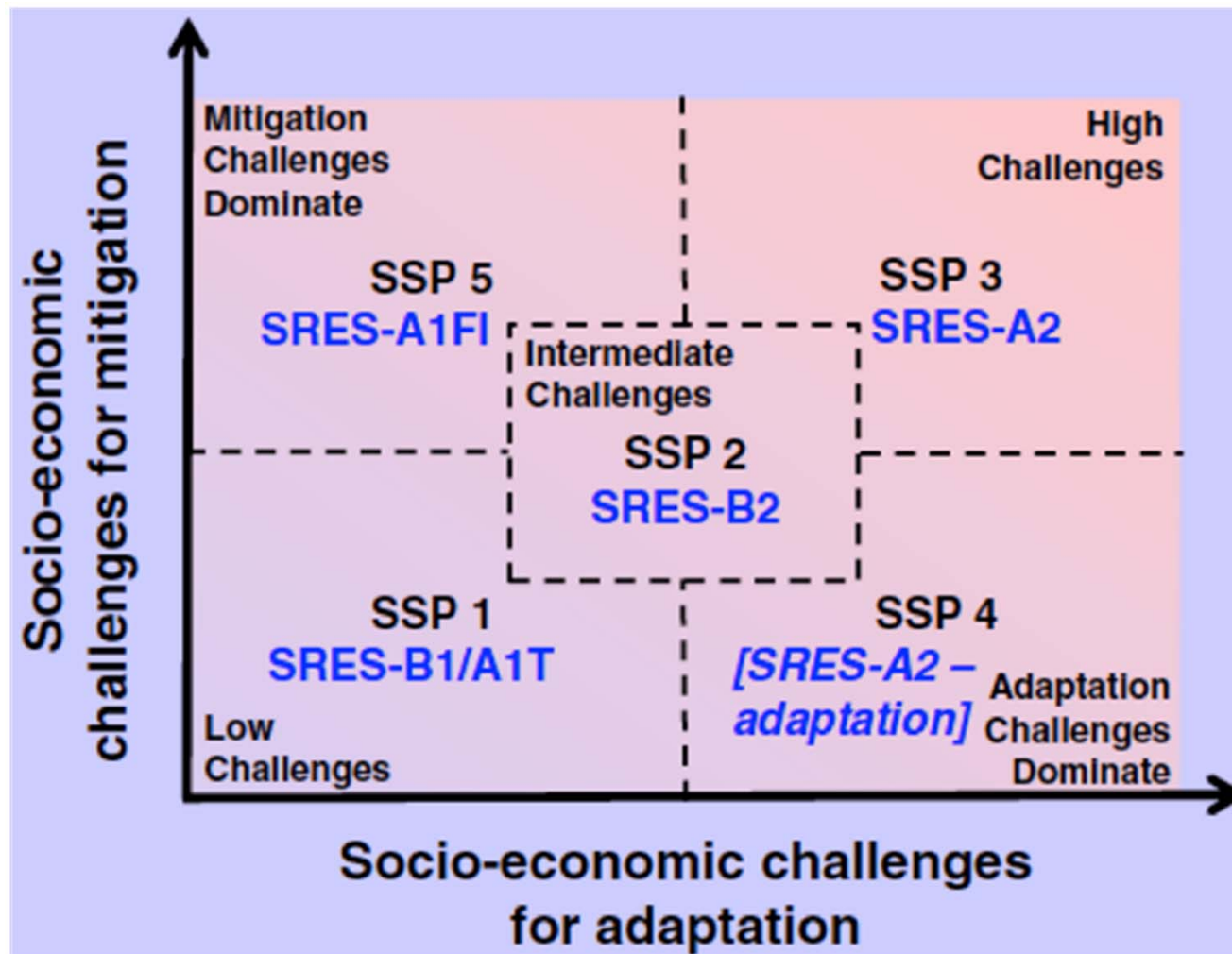
The diagram illustrates the scenario matrix architecture. It features a central grid with columns for SSP 1, SSP 2, SSP 3, SSP 4, and SSP 5. The rows represent different scenarios: Reference, 8.5 Wm<sup>-2</sup>, 6.0 Wm<sup>-2</sup>, 4.5 Wm<sup>-2</sup>, and 2.6 Wm<sup>-2</sup>. An arrow labeled 'SPAs' points to the grid, and a vertical bar labeled 'RCP Replication' is positioned to the left of the grid. The grid cells contain 'X' marks indicating the presence of a scenario in a specific row and column.

		SSP 1	SSP 2	SSP 3	SSP 4	SSP 5
	Reference	X	X	X	X	X
RCP Replication	8.5 Wm <sup>-2</sup>			X		
	6.0 Wm <sup>-2</sup>		X	X	X	X
	4.5 Wm <sup>-2</sup>	X	X	X	X	X
	2.6 Wm <sup>-2</sup>	X	X		X	





# Mapping of the SRES onto the five SSP domains



(van Vuuren and Carter, 2014)

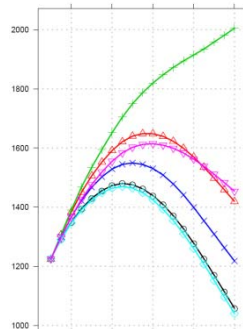


# SSP elements

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Narrative



Quantitative elements including:

- Population
- Urbanization
- Rates of technological change
- Income
- Human Development Index
- Income distribution

Does not include:

- Typical model output such as emissions, land use, climate change
- Climate policy (mitigation or adaptation)



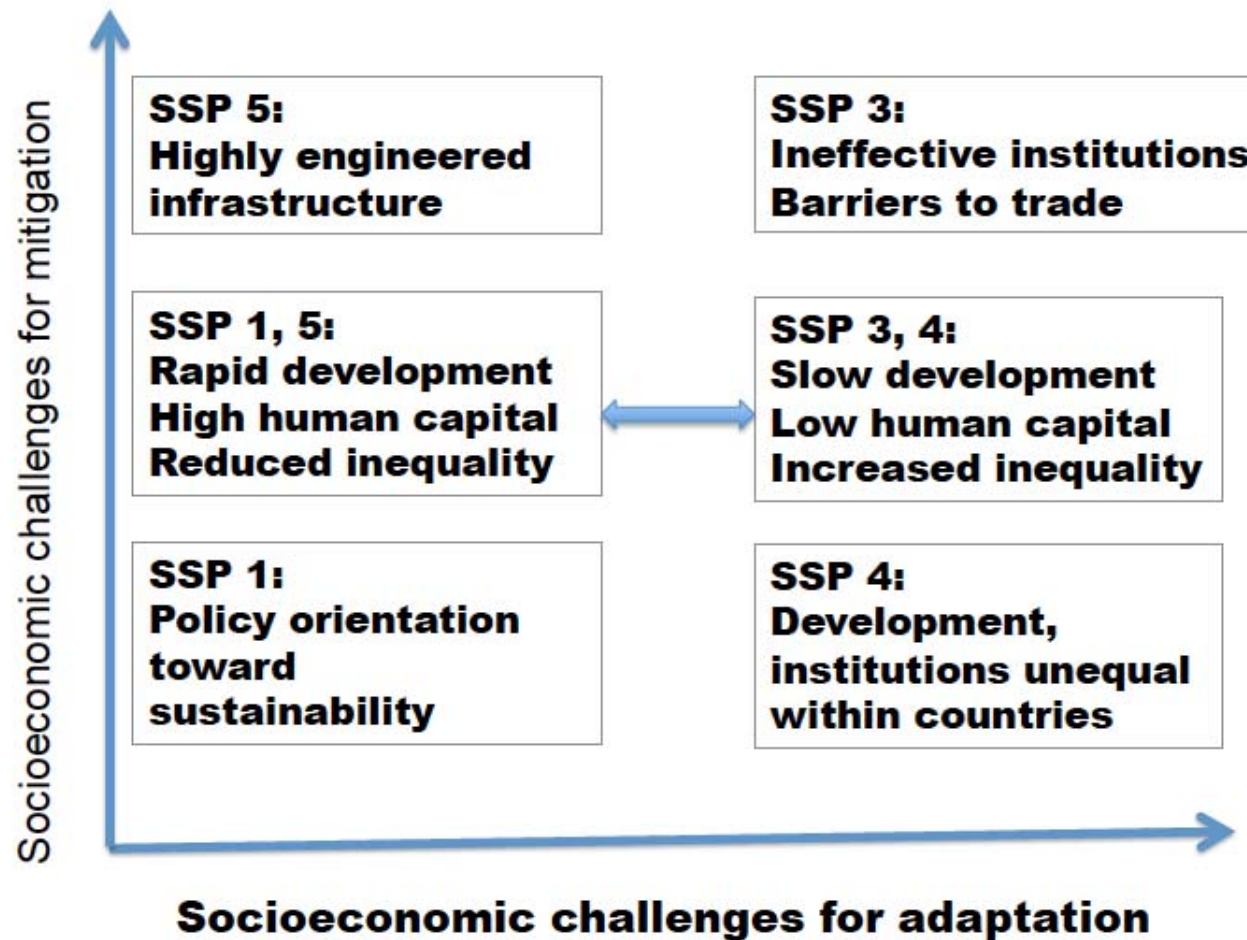
# SSP elements (cont.)

- Key determinants of adaptation challenges:

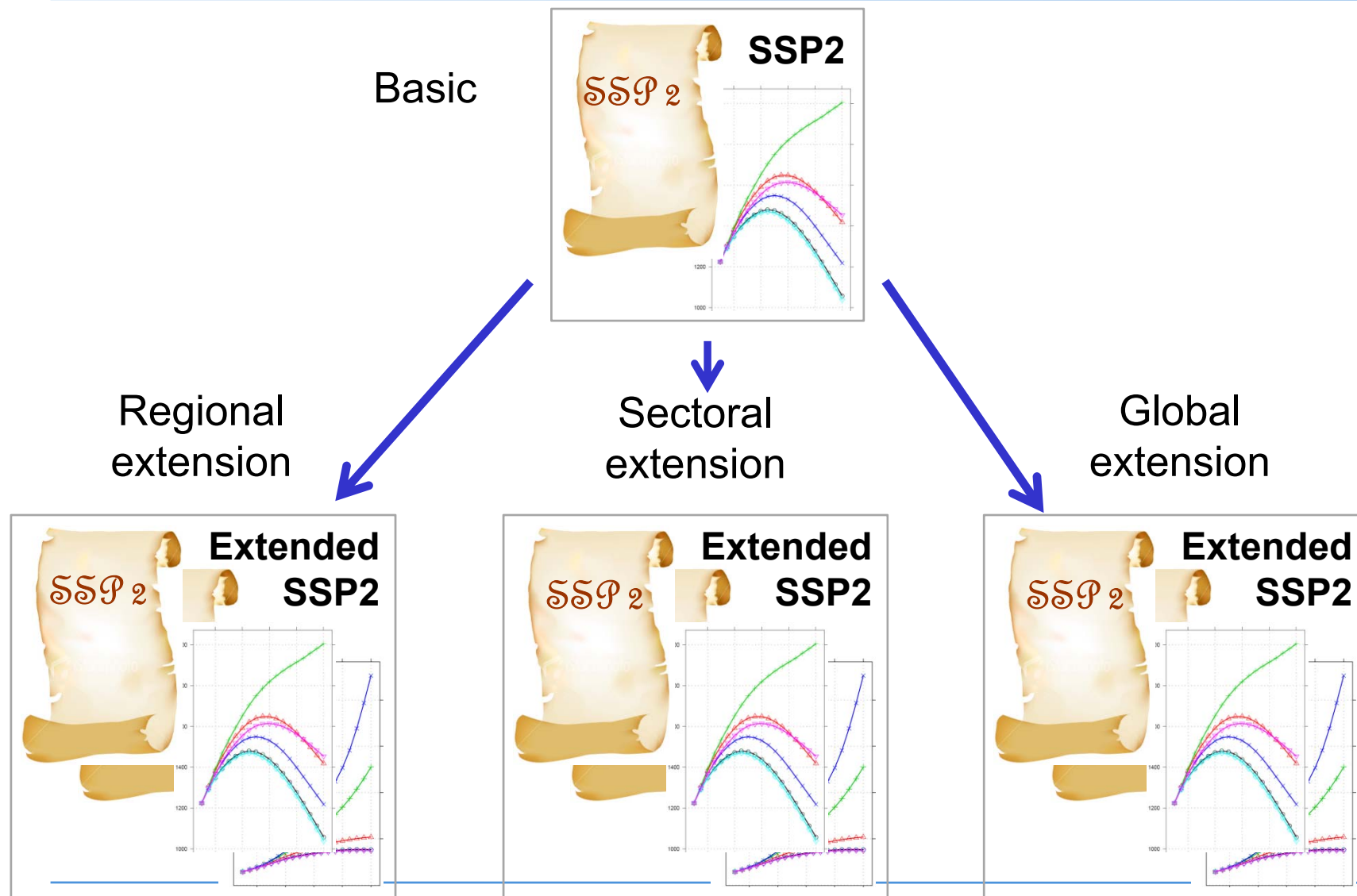
Determinant:	SSP variable:	
Average wealth	GDP projection	
Poverty	Income distribution	
Quality of governance	Governance	Storyline
People in coastal zones	Spatial population projection	IAM elements
Urbanization	Urbanization	IAV elements
Education	Education	
Innovation	Innovation	
Quality of healthcare	Health projections	



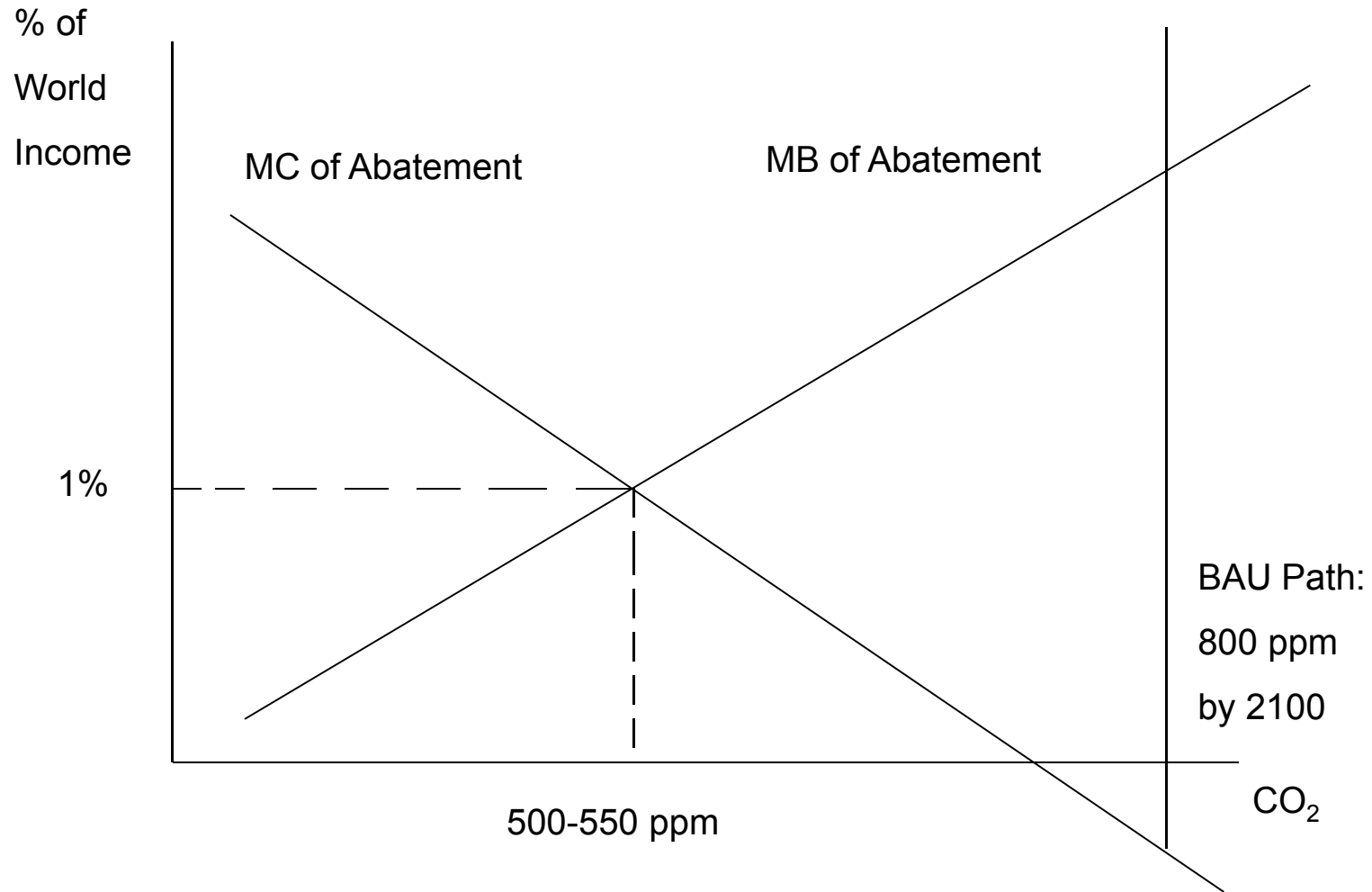
## SSP elements that contribute to high or low challenges to adaptation



# Basic vs. extended SSPs



# How to select an optimal target scenario?



# Developing socio-economic storylines

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- Develop a baseline of current socioeconomic and other vulnerabilities to climate variability and change and of the effectiveness of policies and programs designed to manage those vulnerabilities;
- Project how the outcomes of interest could change under different climate change scenarios, assuming current vulnerabilities remain the same;
- Use the SSPs to develop several socioeconomic storylines, with narrative elements and quantifications, for future time periods, such as 2030 and 2070;
- Project how the outcomes of interest could change between the future and baseline period under different socioeconomic storylines, to estimate how development pathways could alter risks; and then
- Project how the outcomes of interest could change under different climate change scenarios and socioeconomic pathways. The projected magnitude and pattern of risks would reflect the interactions of climate and development.



## Develop a baseline of current socioeconomic vulnerabilities

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- Examine the current conditions with respect to the factors responsible for vulnerability to climate variability and change.
  - a) Current conditions are used as a baseline to for further storylines because today's conditions are known
  - b) It can be easier to communicate how today's conditions could change with climate change than communicate risks regarding a hypothetical future set of socioeconomic conditions.
- Identify key indicators for each sector being assessed. In this context, an indicator is a socioeconomic variable, factor, or condition that can determine or be closely related to vulnerability to climate variability and change.





## Project how the outcomes could change with climate change, assuming current vulnerabilities

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- Using the qualitative or quantitative relationships identified during the V&A assessment between weather patterns and particular outcomes, project how these outcomes could change under different climate change scenarios
- This approach is taken by many studies projecting the risks of climate change



## Use the SSPs to develop several future socioeconomic storylines

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- The SSPs can be used to develop regional and sectoral socioeconomic storylines, with narrative elements and quantifications for future time periods, such as 2030 and 2080.
  - a) Storylines are a qualitative view of the general structure and values of society, and consider national and regional development plans. The development of effective storylines requires close engagement with stakeholders. The storylines can be developed using expert judgment.
  - b) Quantifications of key variables, such as population and GDP, should be available from national or regional governments or other resources.
- Because the consequences of greenhouse gas emission pathways do not diverge until about mid-century, projections of risks until then need not consider the RCPs.
- The storylines should be evaluated to determine their usefulness. In particular, determine whether the scenarios provide estimates of variables that can help estimate how indicators could change. Using an estimate already developed can save time and resources in preparing national communications.



## Project how outcomes could change under different socioeconomic storylines

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- This step estimates how development pathways could alter risks over the time period of interest without consideration of climate change
- The resource manual shows an example of how improved socioeconomic conditions could reduce the number of undernourished children could change between 2000 and 2050



## Project how the outcomes could change under different climate change and socioeconomic scenarios

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- This step projects the magnitude and pattern of risks, reflecting the interactions of climate and development. These projections can be quantitative or qualitative.
- Continuing the example from the previous slide, in 2000, there were nearly 148 million undernourished children under the age of five worldwide. In 2050, assuming improved socioeconomic conditions, the number would be 113 million. When climate change was added to the model, the number increased to about 138 million. Under the A2 emission scenario, the authors found that yields of most important crops would decline in developing countries by 2050, that per capita calorie availability would drop below levels that applied in the year 2000, and that child underweight would be approximately 20% higher, affecting about 25 million children. Substantial improvements would be necessary to counteract the effects of climate change, including a 60% increase in yield growth (all crops) over baseline, 30% faster growth in animal numbers, and a 25% increase in the rate of expansion of irrigated areas.
- These projections are useful for adaptation and for mitigation.



Thank you

