Local interpretation of the Shared Socioeconomic Pathways: Scenario linking strategies and techniques

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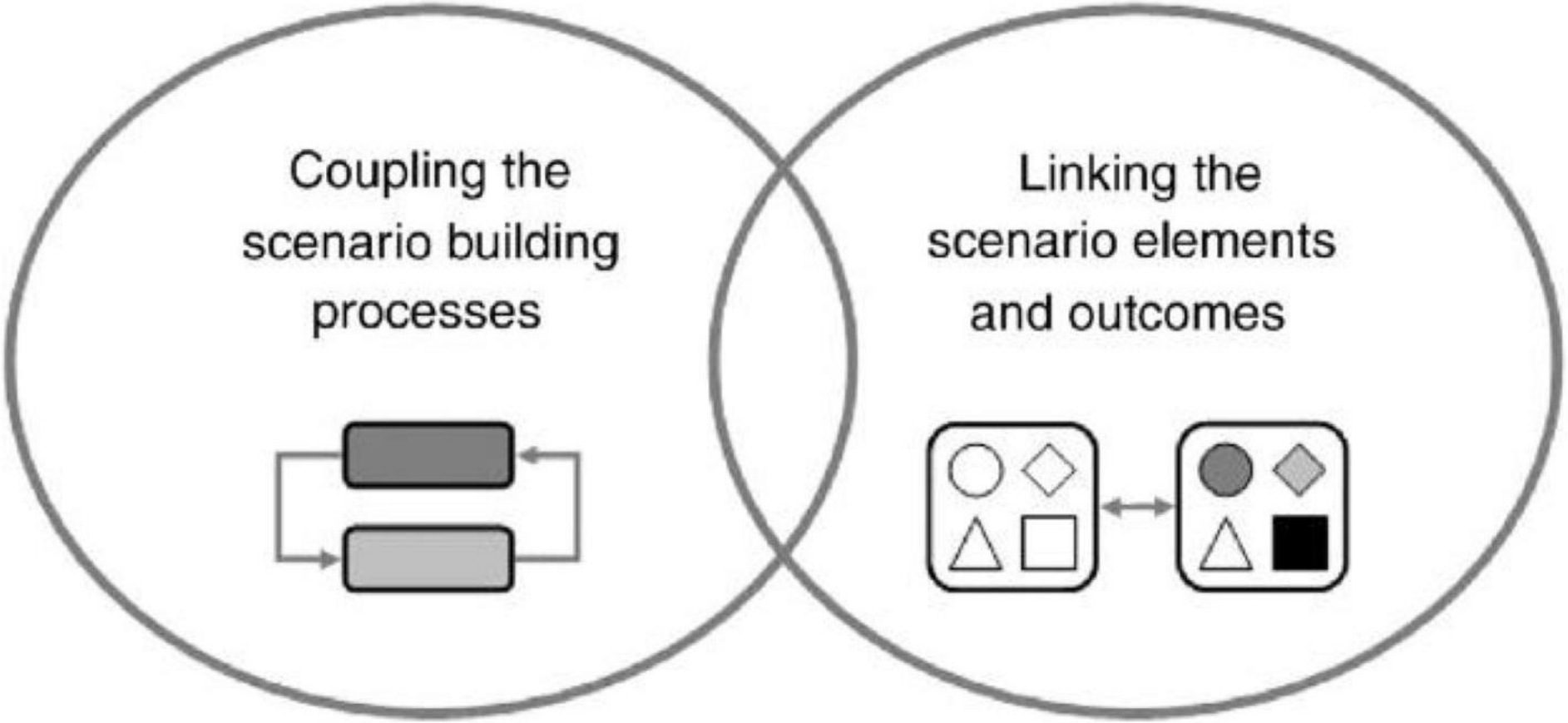
Three main ideas

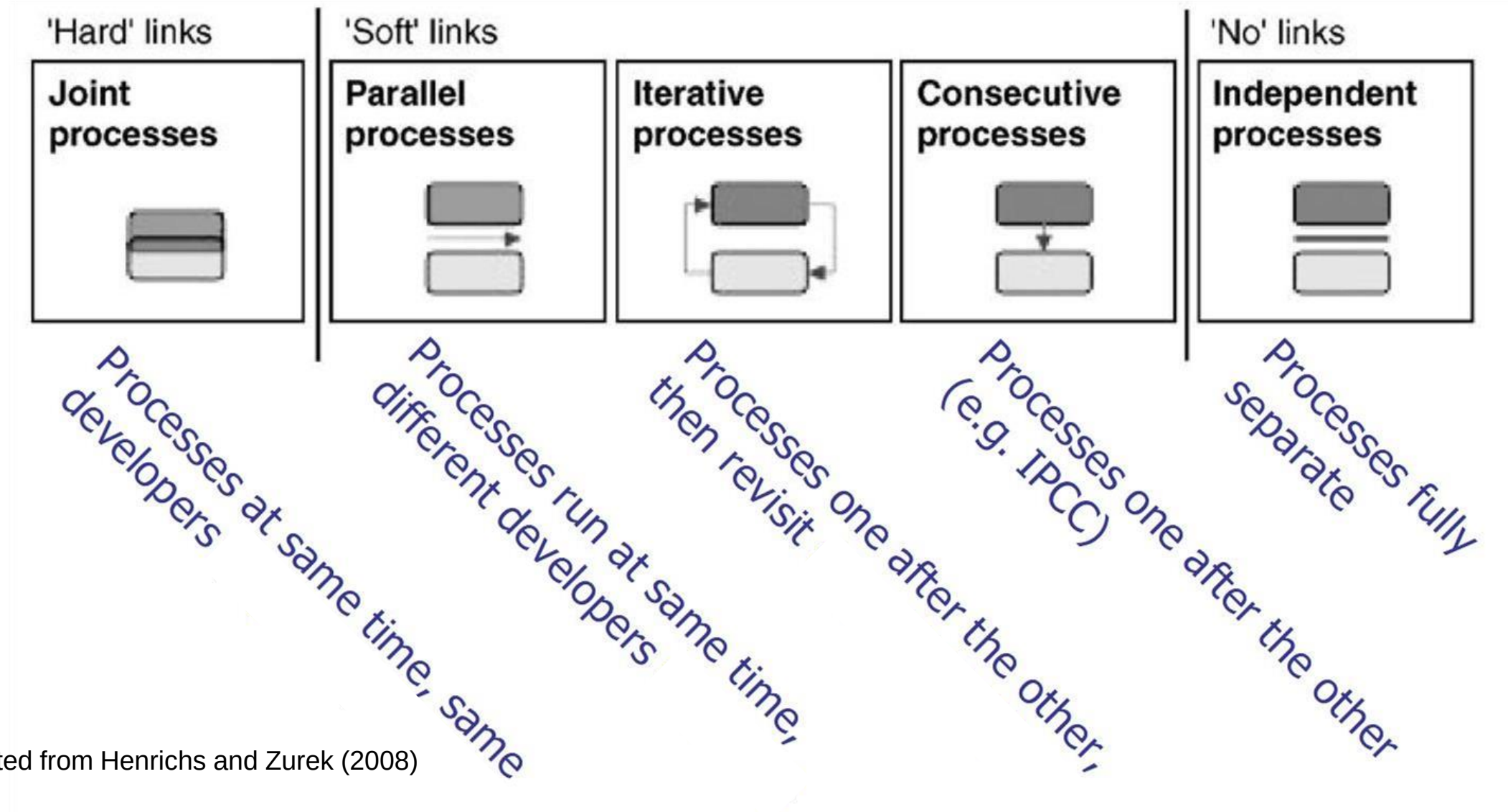
1. Linking strategies for multi-scale scenarios
   - Do strategies matter?
2. Key features of Shared Socioeconomic Pathways (SSPs)
   - Aiming to improve local-level impact/policy analysis
3. Multi-scale scenario iteration to improve analysis for a post-Paris world

Current linking strategies



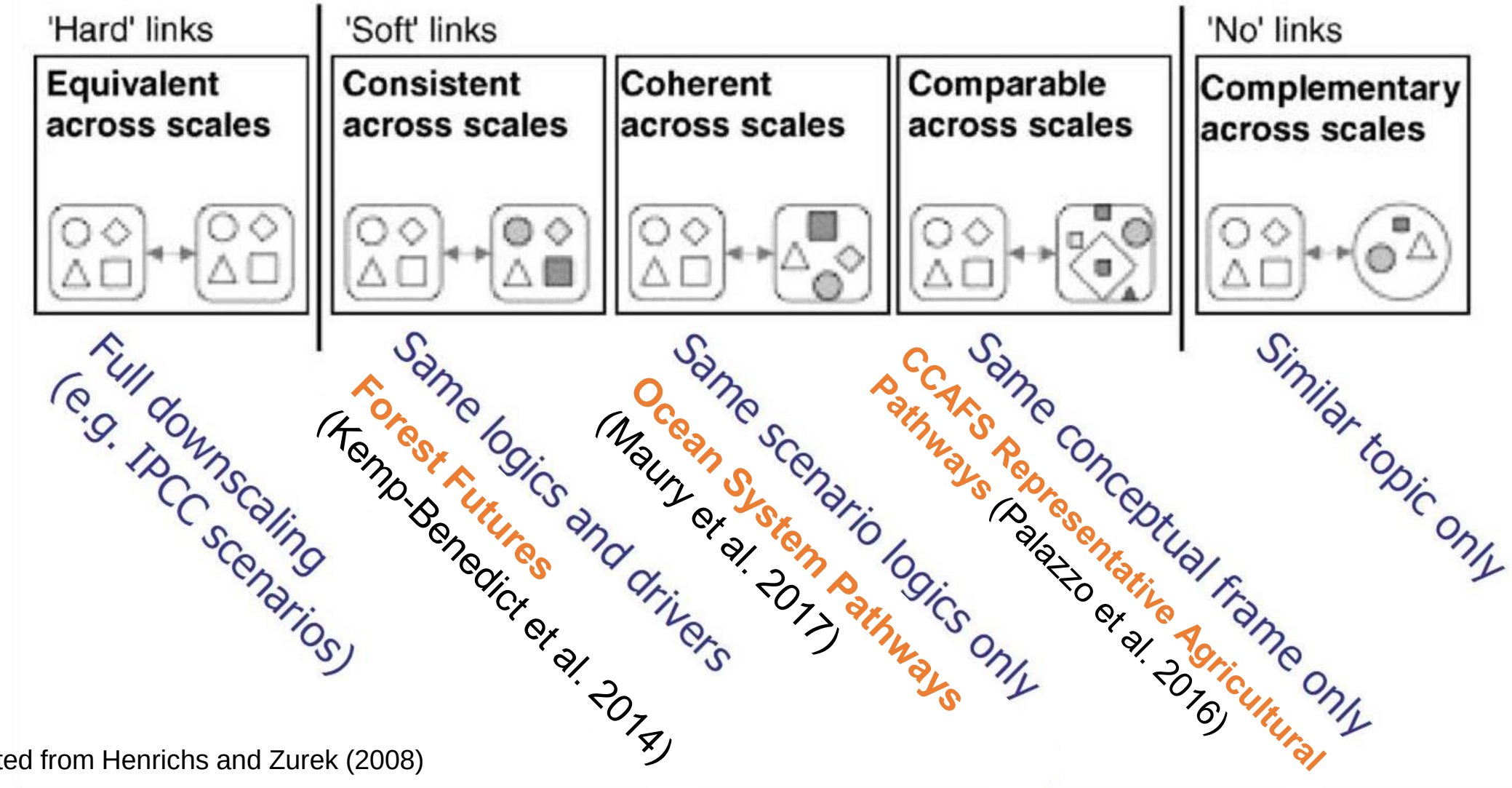
Zurek and Henrichs (2007)

“Coupling” across developers



Adapted from Henrichs and Zurek (2008)

“Linking” across scales, levels



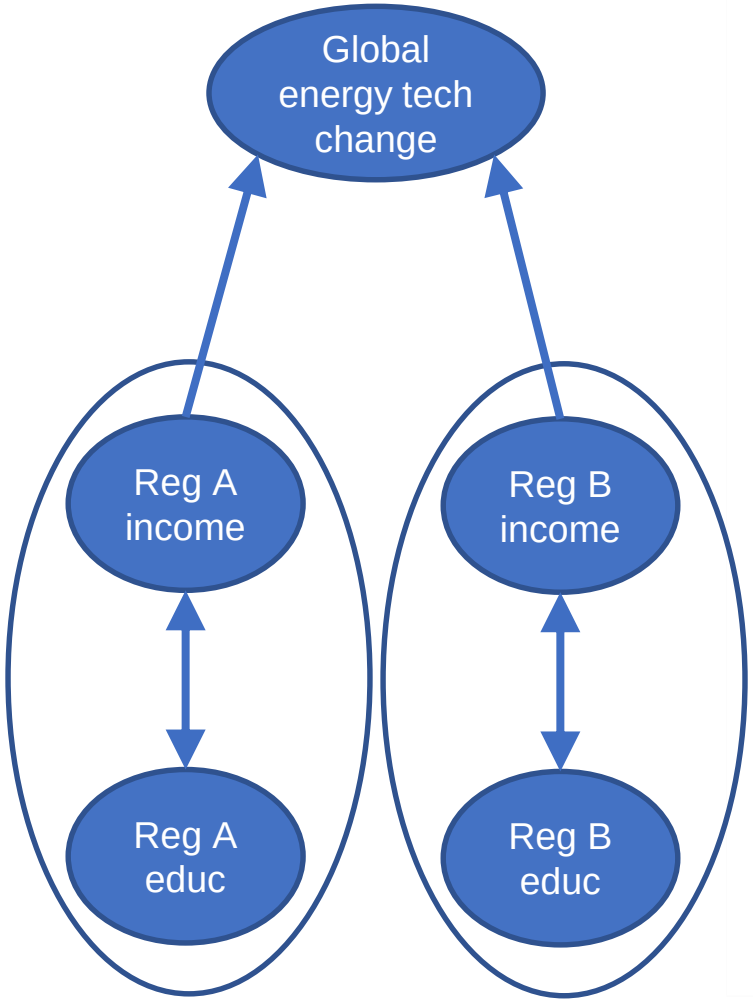
Adapted from Henrichs and Zurek (2008)

Shared Socioeconomic Pathways (SSPs) to explore range of policy options

Key features:

- In contrast to previous scenarios, *emissions* (RCPs) analytically decoupled from *socioeconomic context* (SSPs)
- Provides freedom to interrogate consequences from climatic vs. non-climatic factors
- Global (or “basic”) SSPs intended to be starting point for more localized impact/policy analysis (“extended” SSPs)

Enable *iteration* between global & 'local' scenarios



CROSS IMPACT MATRIX

Descriptors	World TC S M F	RegA inc L M H	RegA Edu L M H	RegB Inc L M H	RegB Edu L M H
World TC: Fossil Substitutes					
Slow		0 0 0	0 0 0	0 0 0	0 0 0
Moderate		0 0 0	0 0 0	0 0 0	0 0 0
Fast		0 0 0	0 0 0	0 0 0	0 0 0
RegA Income (GDP/Capita - US$ (2000))					
Low (<$5K)	3 0 -3	Innate RegA interactions	1 1 -2	0 0 0	0 0 0
Medium ($5K - $10K)	2 1 -3		-3 1 2	0 0 0	0 0 0
High (>$10K)	-2 1 1		-3 0 3	0 0 0	0 0 0
RegA Education (Net Secondary Enrollment)					
Low (<85%)	0 0 0	0 1 -1		0 0 0	0 0 0
Medium (85%-95%)	0 0 0	0 1 -1		0 0 0	0 0 0
High (>95%)	0 0 0	-3 0 3		0 0 0	0 0 0
RegB Income (GDP/Capita - US$ (2000))					
Low (<$5K)	3 0 -3	0 0 0	0 0 0	Innate RegB interactions	3 -1 -2
Medium ($5K - $10K)	2 1 -3	0 0 0	0 0 0		-1 1 0
High (>$10K)	-2 1 1	0 0 0	0 0 0		-2 1 1
RegB Education (Net Secondary Enrollment)					
Low (<85%)	0 0 0	0 0 0	0 0 0	2 1 -3	
Medium (85%-95%)	0 0 0	0 0 0	0 0 0	-1 1 0	
High (>95%)	0 0 0	0 0 0	0 0 0	-1 -1 2	

World interacts RegA and RegB

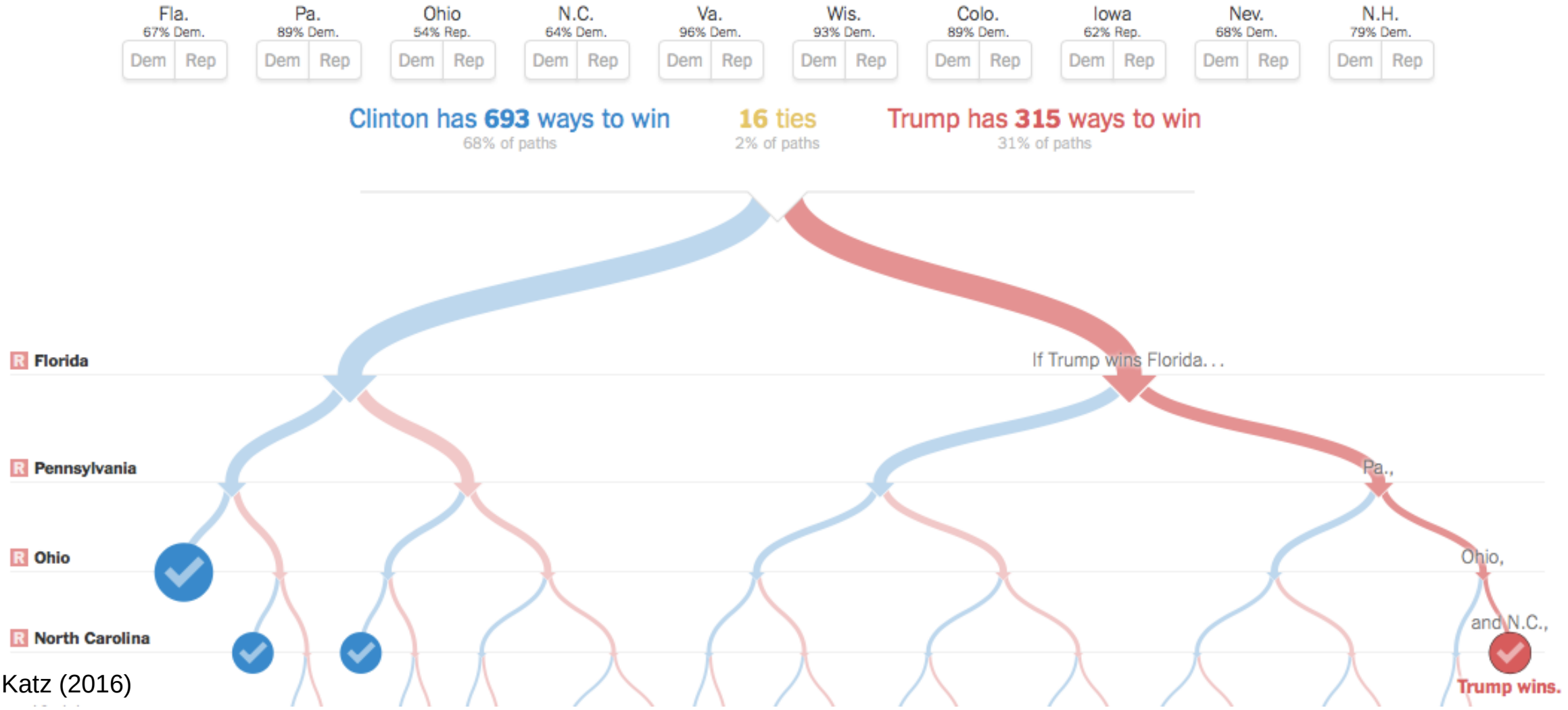
RegA interacts RegB

RegA and RegB interacts World

RegB interacts RegA

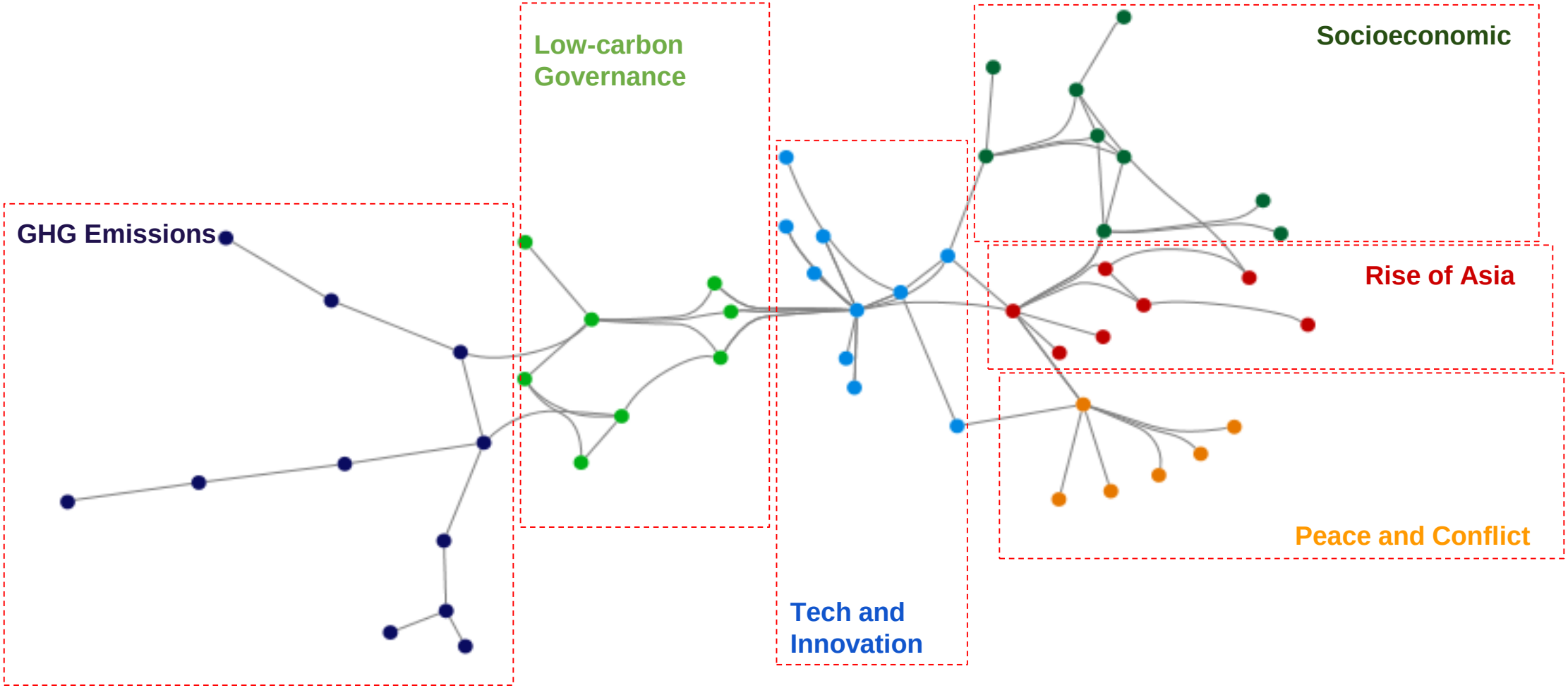
Schweizer & Kurniawan (2016)

Combinatorial linking: New middle ground between hard and “consistent” links?



Katz (2016)

Content analysis of global energy scenarios
(World Energy Council, 2017)



Kurniawan (in prep)

Summary

1. “Harder” soft-link strategies desirable for scientific assessment
   -Easier to trace links across scales
2. Local interpretations of SSPs appear on track for hinting at range of mitigation effort, adaptation possibilities, residual impacts.
   However, caveats with current soft-links for a post-Paris world:
   -Large proliferation of multi-scale scenario studies
   -Unclear/insufficient **iteration** across scales
   -Ranges of studies may end up too broad to be informative
3. A combinatorial/event-tree approach (e.g. linked cross-impact balances) for assessing & building multi-scale scenarios shows promise for addressing above limitations

Thank you

Looking forward to your comments and questions

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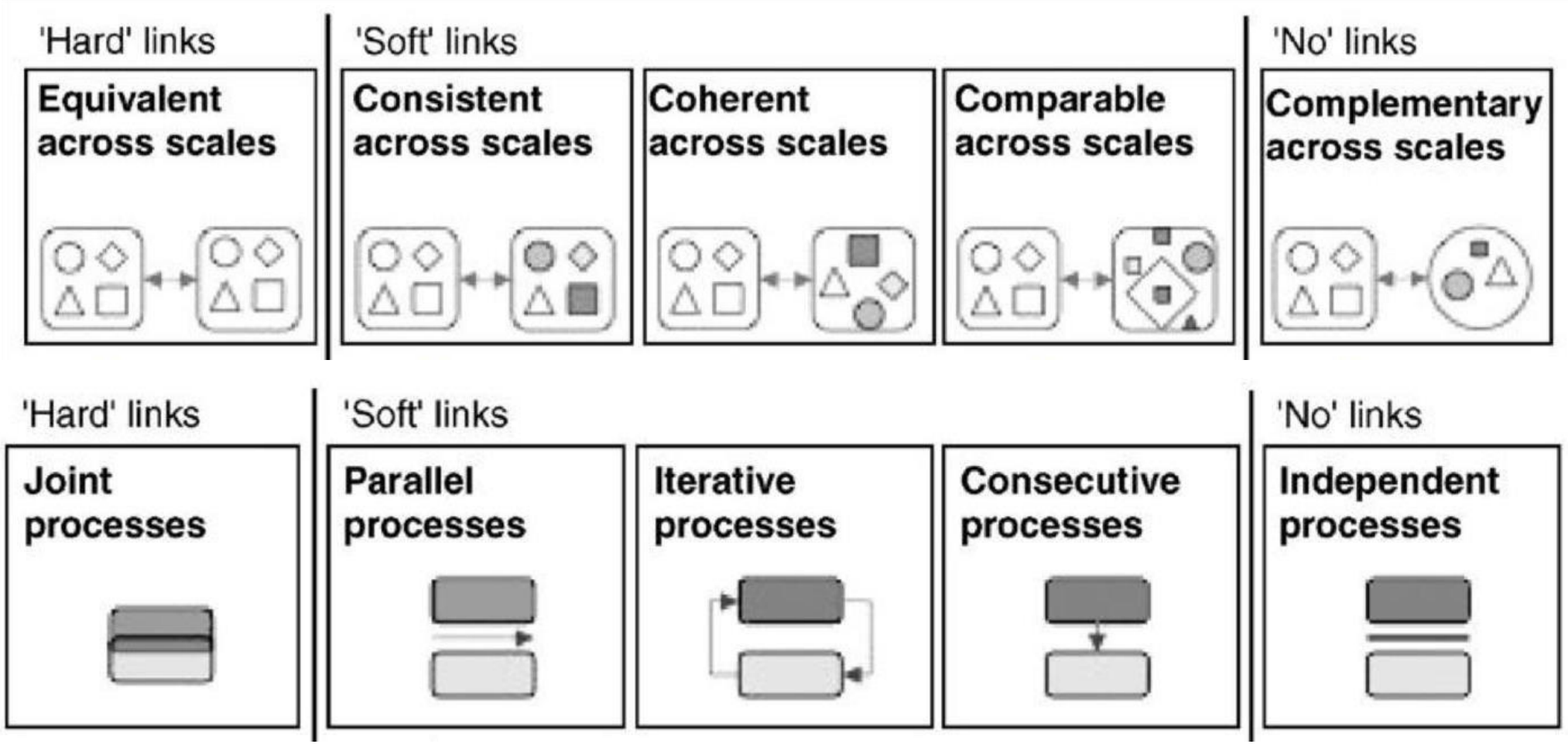
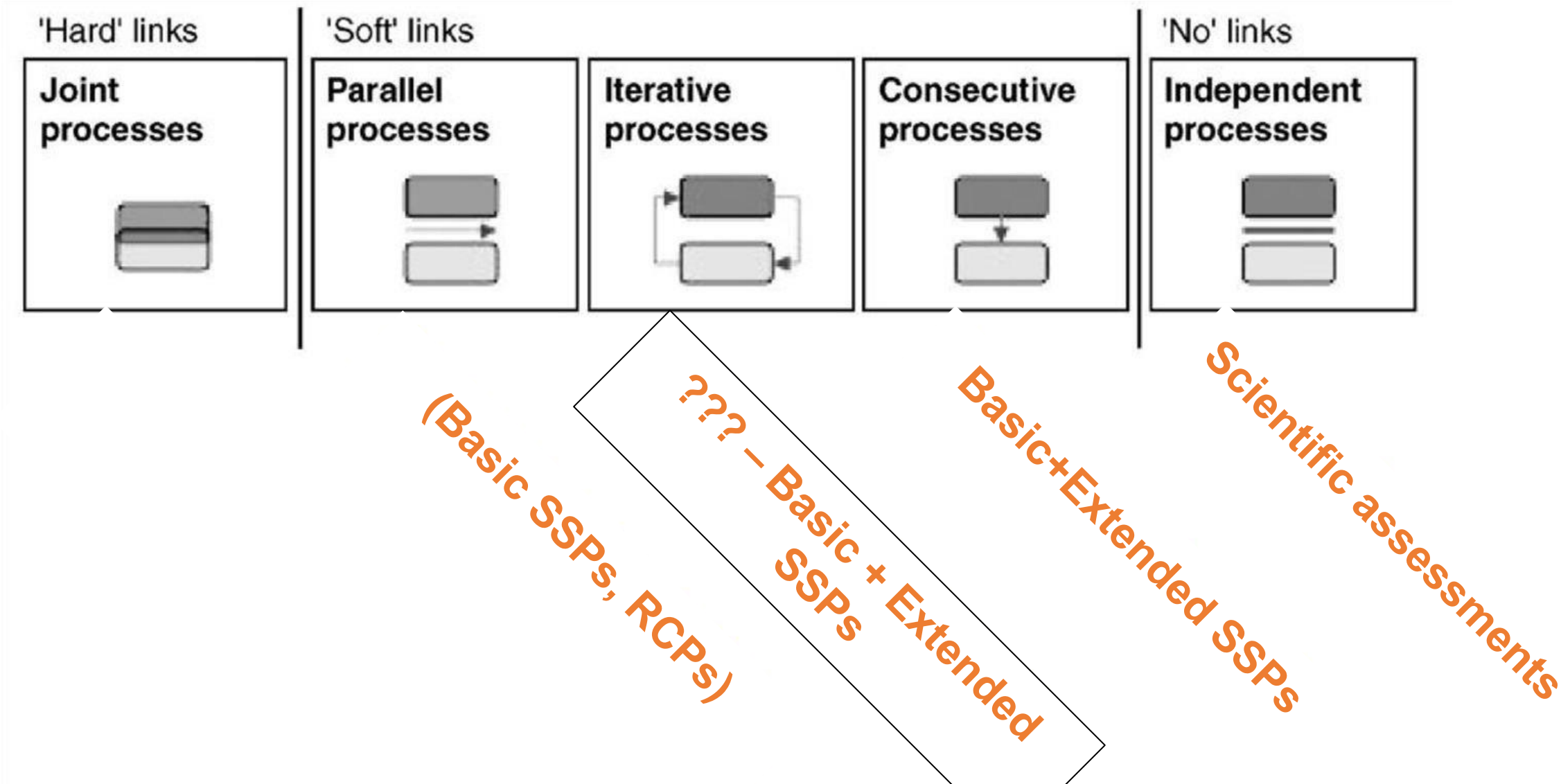
BACKUP SLIDES

“Linking” strategies across scales, levels



Zurek and Henrichs (2007)

Processes and the SSPs

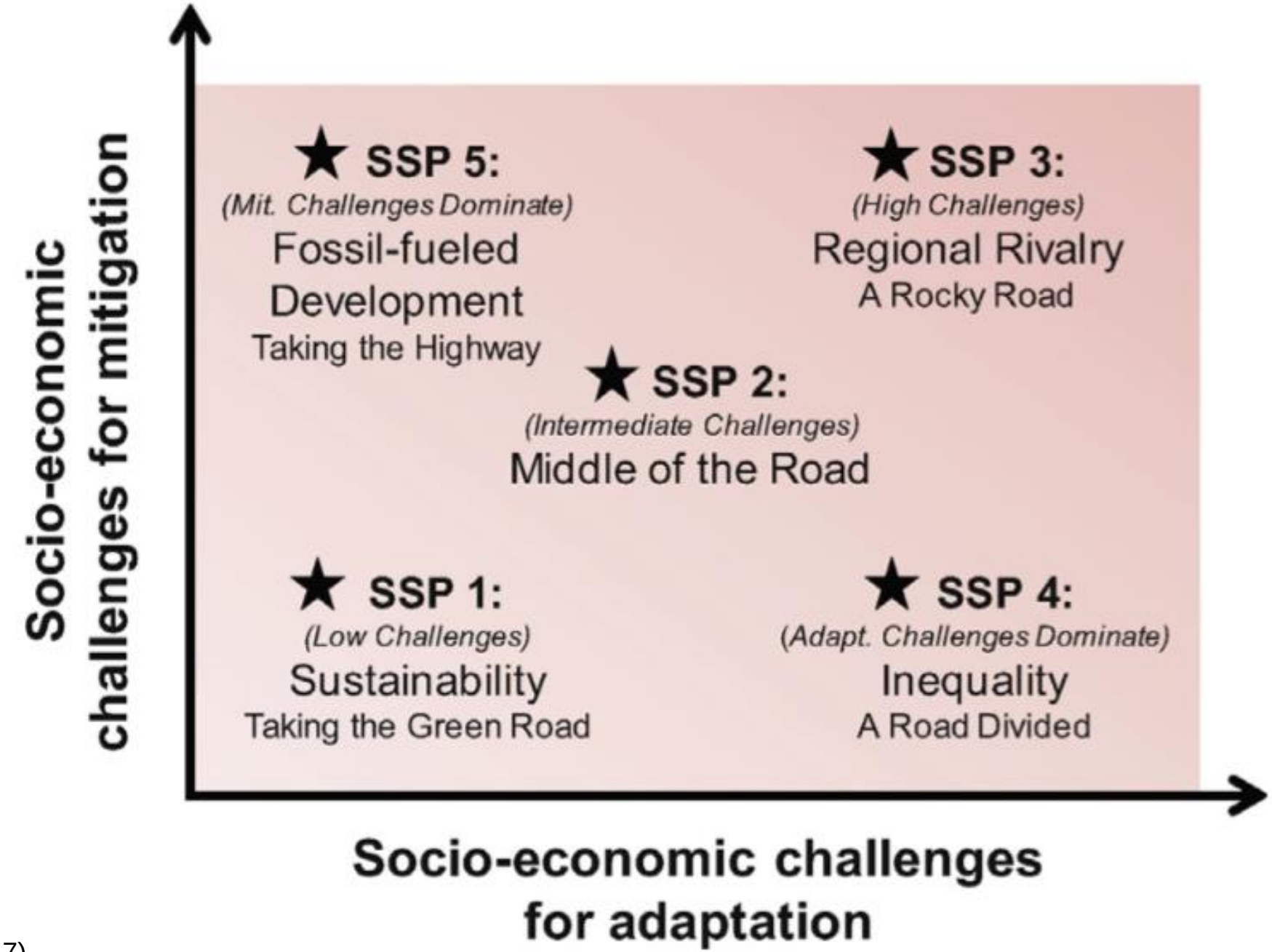


“Basic” and “extended” SSPs

Basic SSPs -- global megatrends

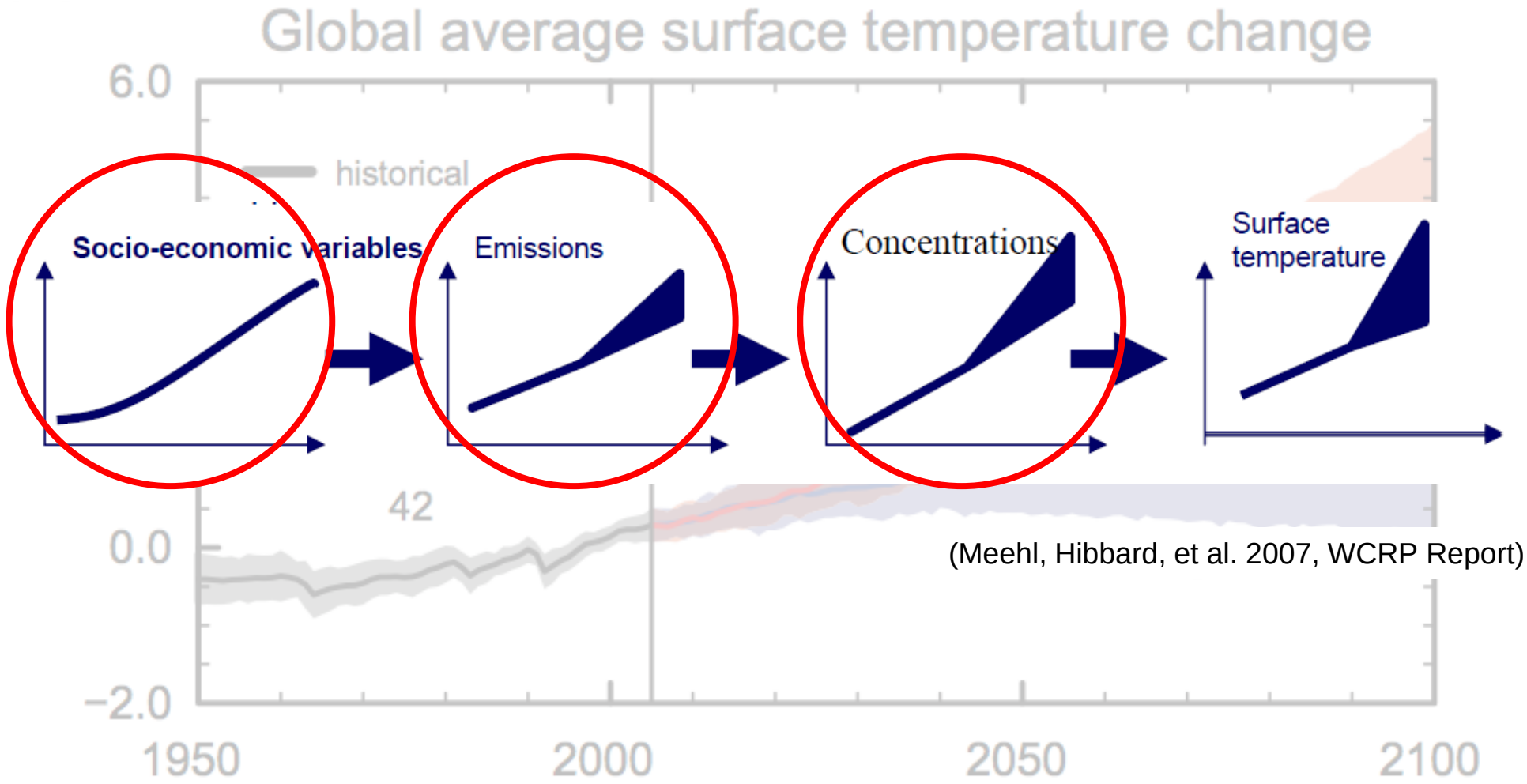
- Harmonized inputs
  - Official narratives: O’Neill et al. (2017)
  - Quantitative inputs: https://tntcat.iiasa.ac.at/SspDb/dsd?Action=htmlpage&page=about
- “Marker” scenarios/outputs
  - Special issue: *Global Environmental Change* Issue 42
  - Intended to be starting point for extended SSPs

Extended SSPs -- sector-specific, ‘local’; expected to also include custom scenario drivers



O'Neill et al. (2017)

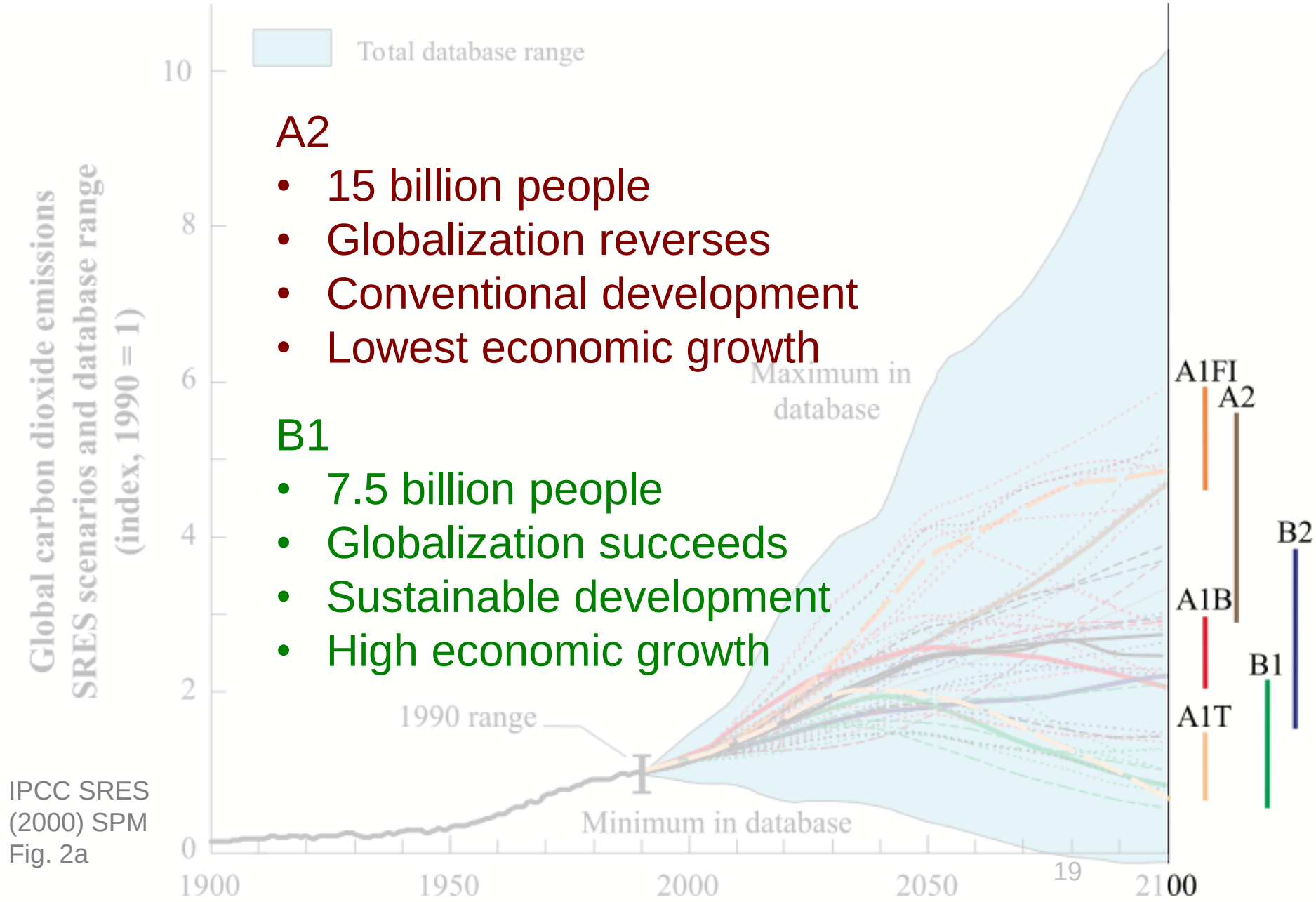
One view: Human choices determine climate



(Meehl, Hibbard, et al. 2007, WCRP Report)

Adapted from IPCC (2013), Fig. SPM.7

Another view: Human choices, similar outcomes

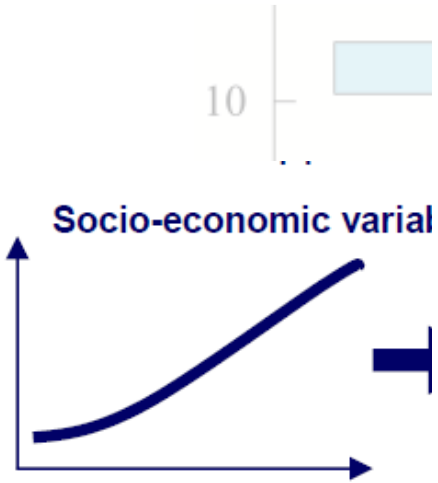


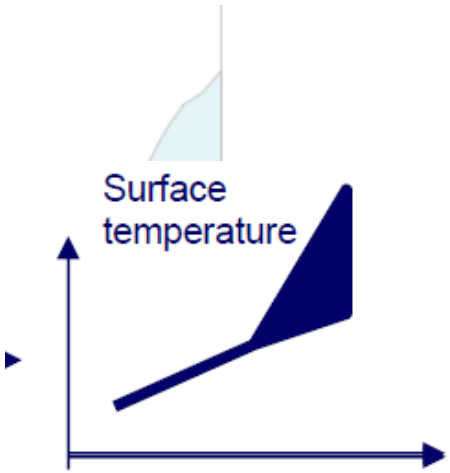
A2
- 15 billion people
- Globalization reverses
- Conventional development
- Lowest economic growth

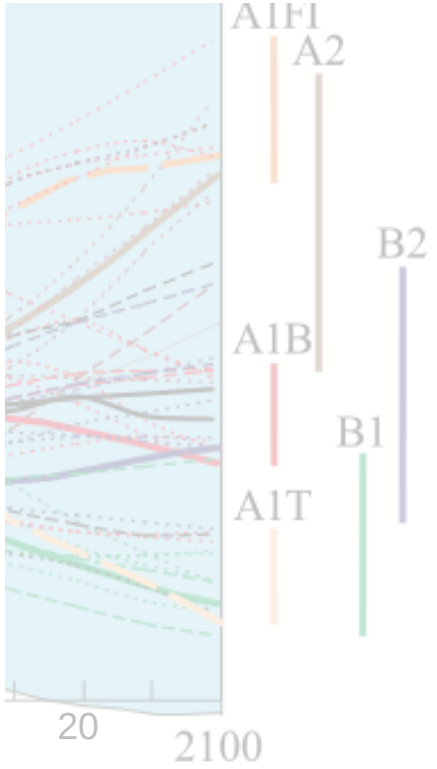
B1
- 7.5 billion people
- Globalization succeeds
- Sustainable development
- High economic growth

IPCC SRES (2000) SPM Fig. 2a

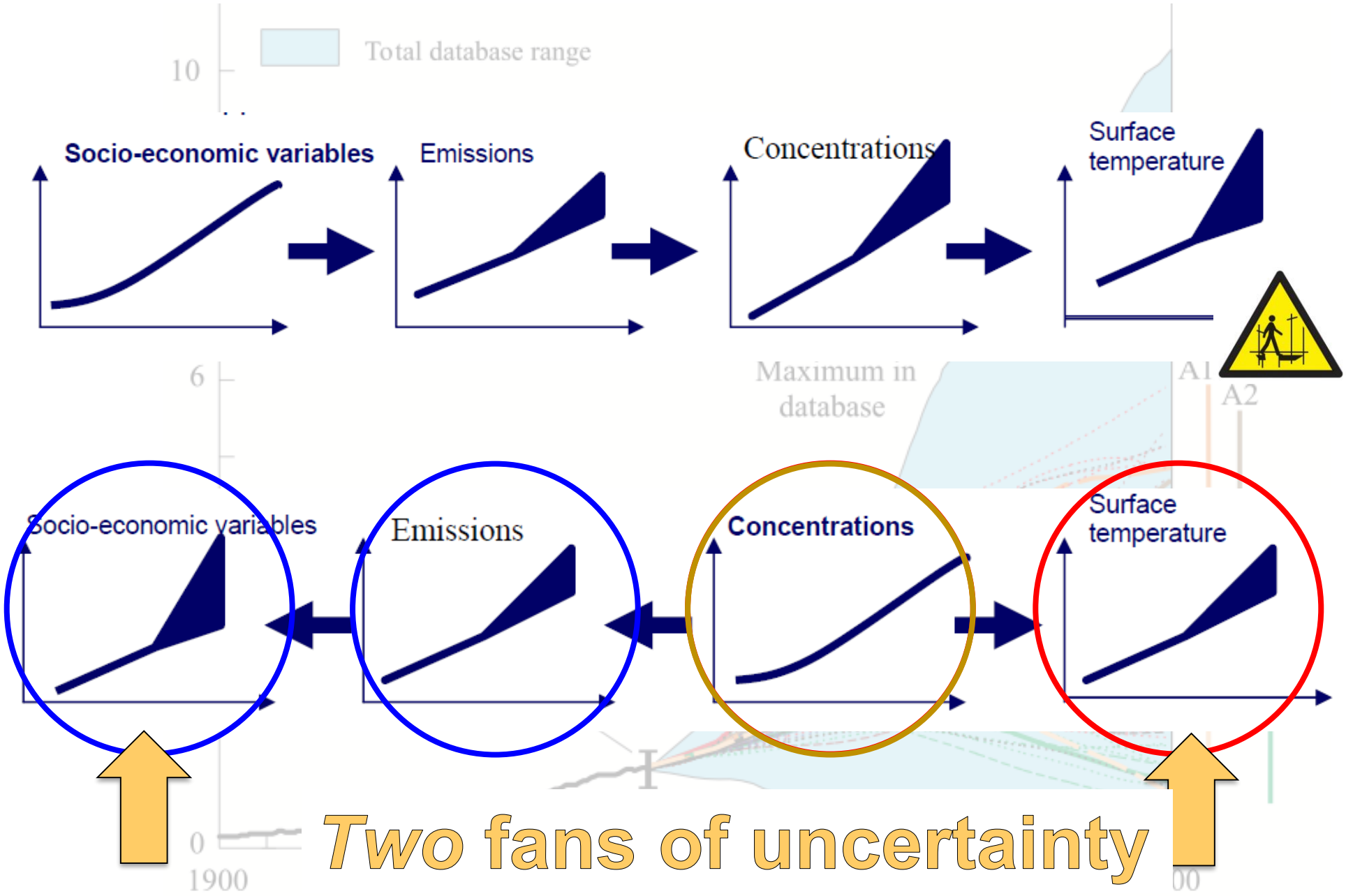
Alternative climate



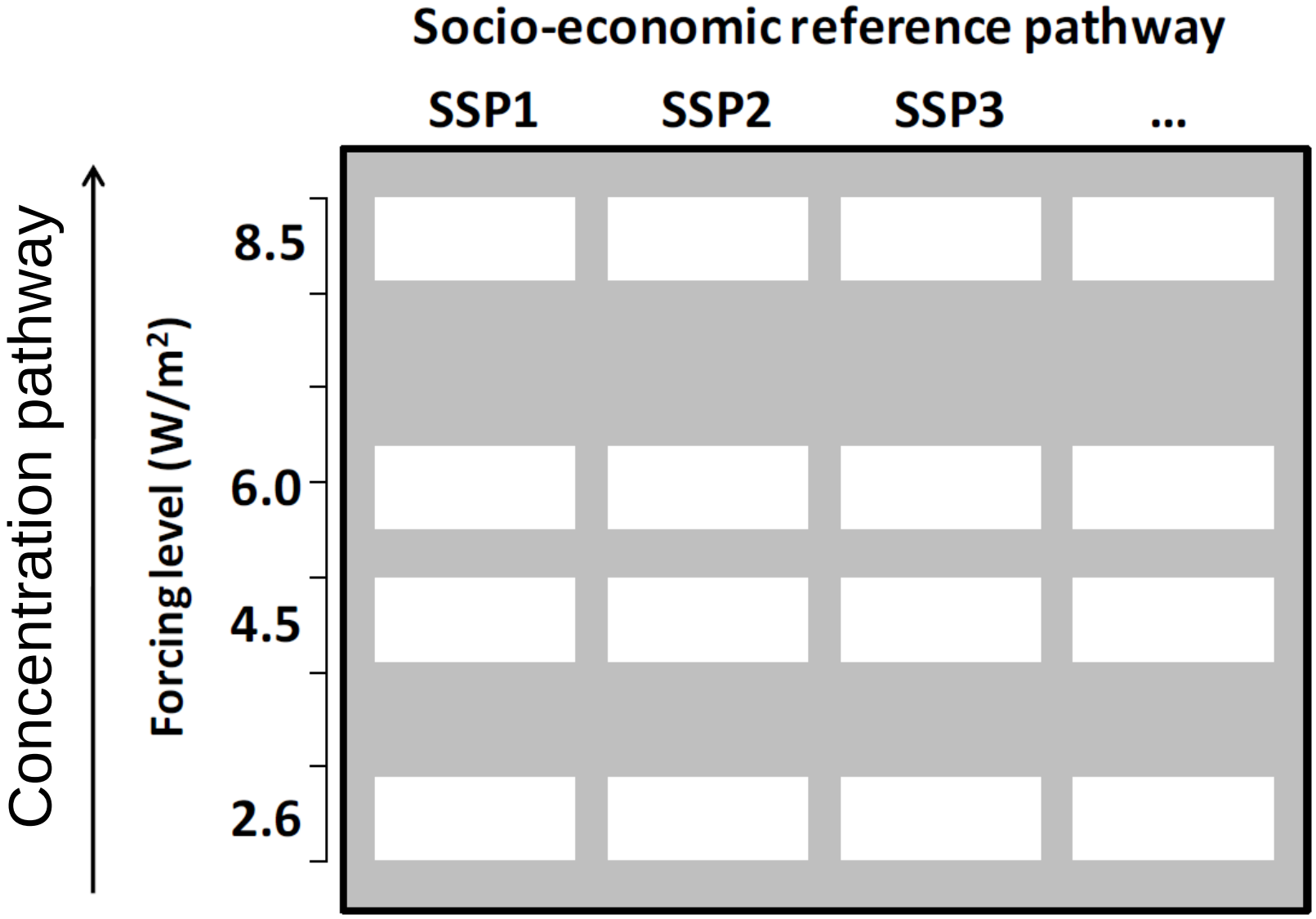




Alternative views: Human choices & climate

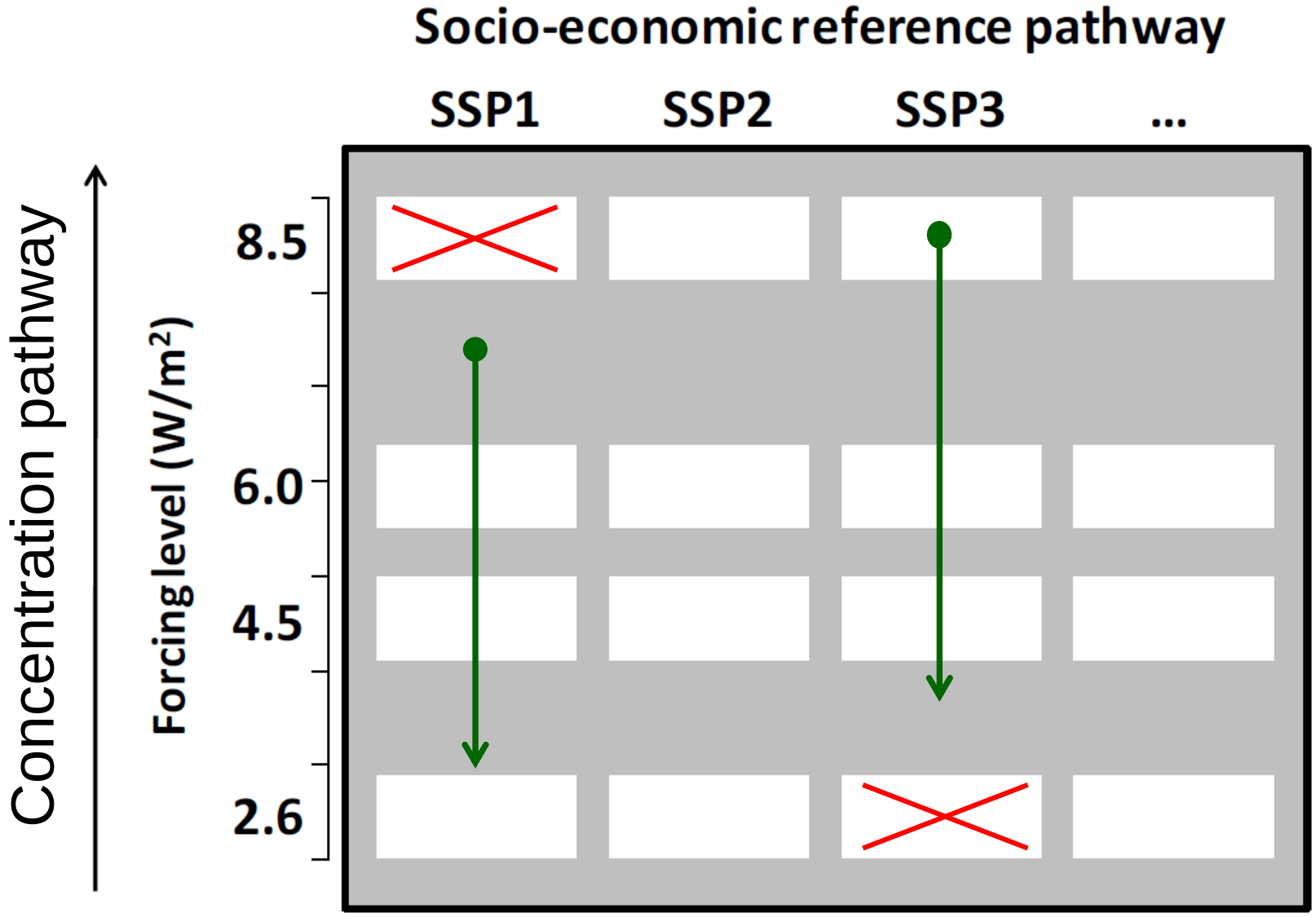


Beyond individual scenarios to scenario matrix



Slide from B.C. O'Neill explaining van Vuuren et al. (2013)
A new scenario framework for Climate Change Research, *Climatic Change*

Bounding effects of human drivers on climate



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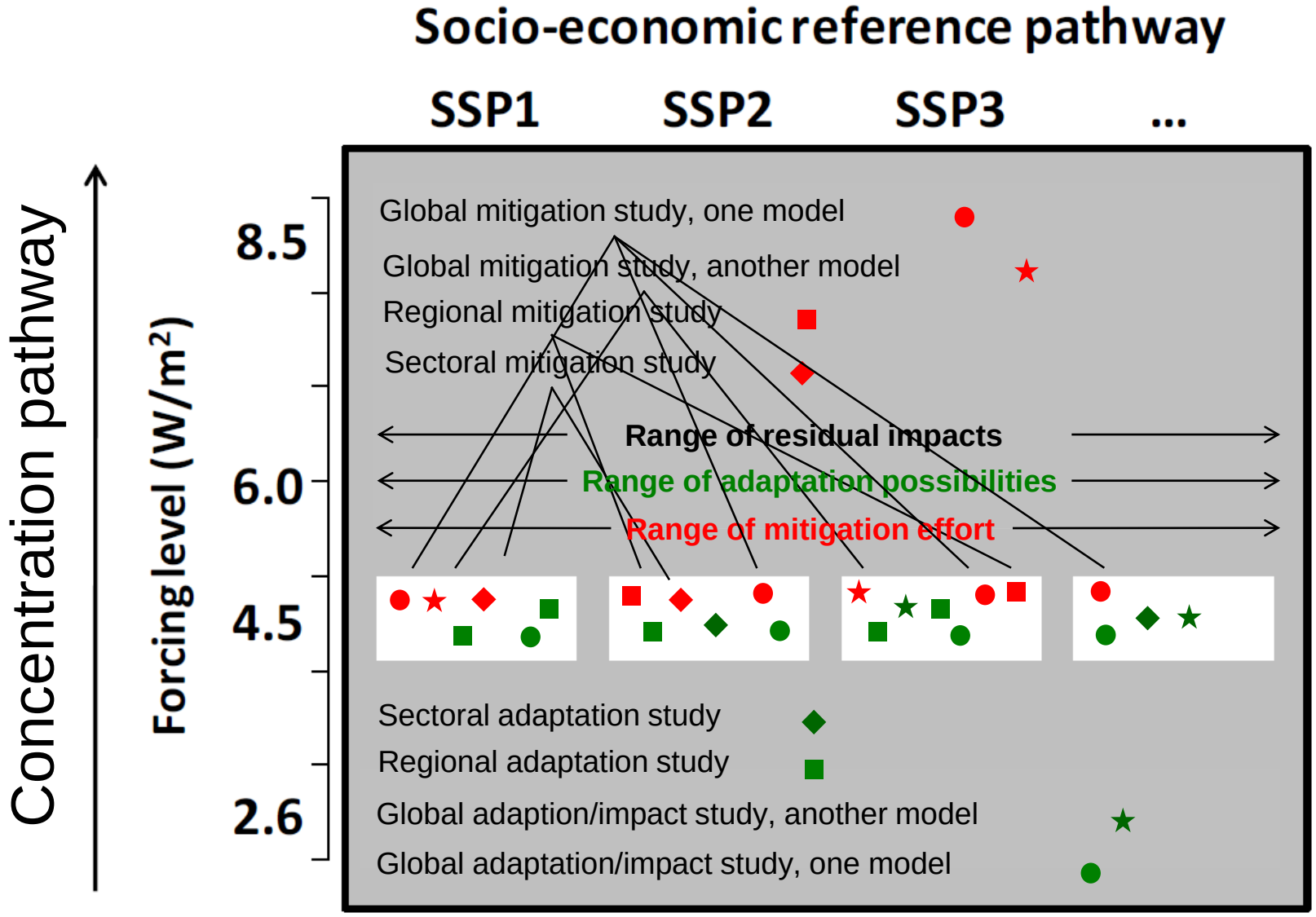
Bounding effects of climate on human & natural systems



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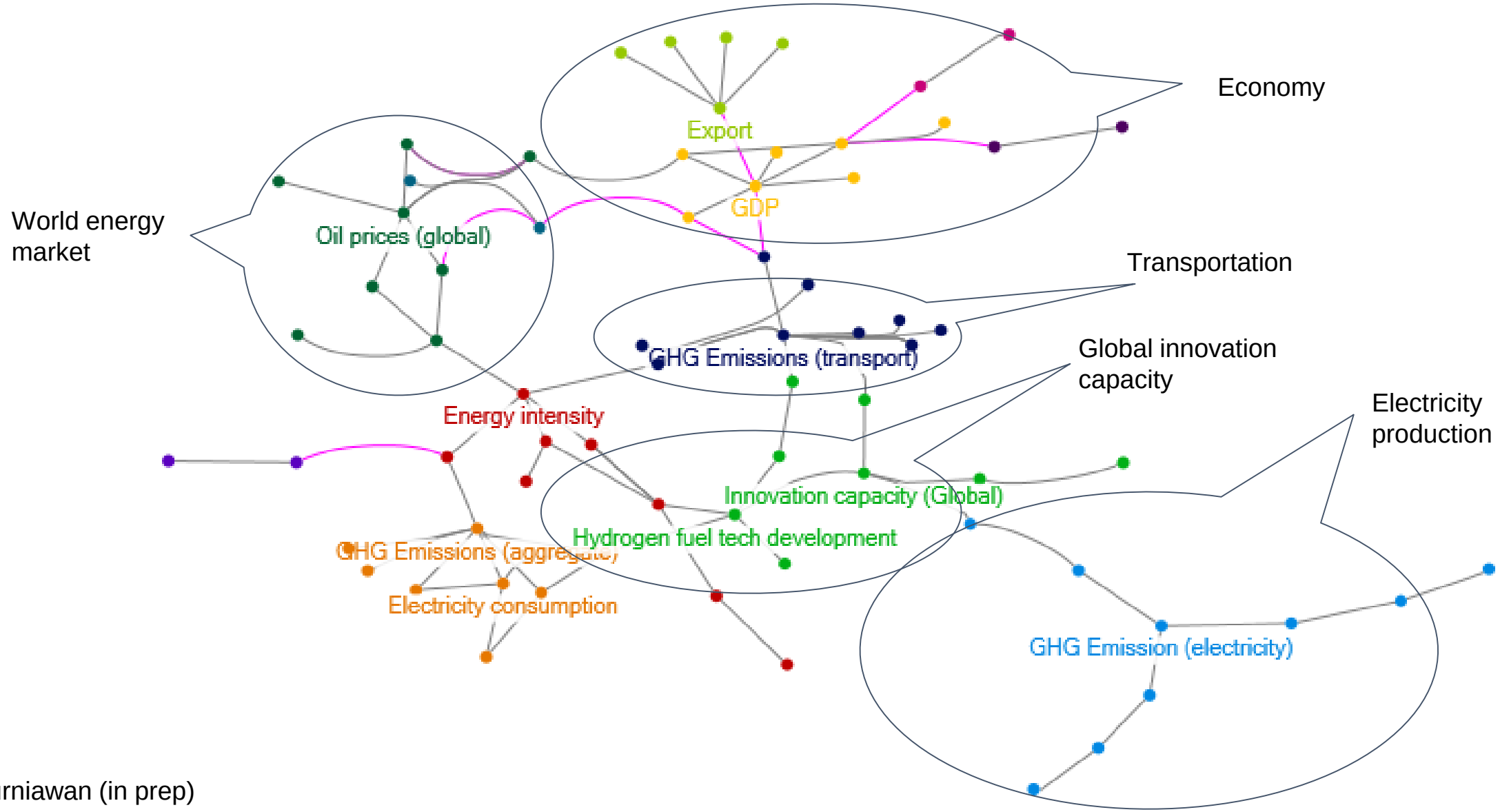
Details on linking of recent 'localized' SSPs

	Forest Futures (Kemp-Benedict et al. 2014)	**CCAFS Representative Agricultural Pathways (Palazzo et al. 2016)**	**Ocean System Pathways (Maury et al. 2017)**
Q1. How are boundary conditions derived from basic SSPs?	Distilling SSP stories to obtain scenario drivers related to sustainable forest management	Combining global SSP dataset (IIASA) + output from coupled climate+agriculture models to produce scenario drivers	Introducing 3 domains for analysis (economy, governance, management); each domain contains relevant scenario drivers for each SSP narrative
Q2. How are extended scenarios constrained by boundary conditions?	Scenarios were produced using cross-impact balances; scenario drivers were distilled from global SSPs	Scenarios were developed with Intuitive Logics approach using scenario drivers partly derived from SSP dataset	Scenario development based on Intuitive Logic using 2x2 matrix for each domain (i.e. there are three 2x2 scenario matrices)
Q3. How are extended scenarios shown to be consistent *across* scales?	No explicit consistency testing of scenarios. But scenario drivers were 're-matched' with global SSPs (**consistent link**)	Consistency with global scenarios was suggested using IAM, but RAP logic deviated from SSPs (**comparable link**).	NA. Study objective is adaptation of SSPs to OSPs; each OSP corresponds to an SSP (i.e. OSP1 happens in SSP1 world) (**coherent/comparable link**)
Q4. How might the next iteration of global scenarios learn from extended SSPs?	NA	NA	NA

Nodes in WEC network clusters

Cluster name	Scenario drivers
GHG Emission Reduction	Health risk awareness, nuclear power generation, fuel switching, LNG demand, GHG emissions, Adoption of EV, Gasification of marine feeder transport, Gasification of heavy freight transport, urbanization, electricity demand
Low Carbon Governance	Global environmental institutions, GHG reduction target, electrification of rail transport, environmental consciousness, carbon intensity, tech dev low carbon system (e,g. CCS), tech dev in energy efficiency
Tech and Innovation	Tech development in ICT, economic productivity, innovation capacity, tech dev in AI, tech dev in machine learning, tech dev in data analytics, tech dev in renewable energy, tech dev in energy storage, globalization, economic growth in developing countries
Socioeconomic	Labor force, educational attainment, growing middle class, energy demand, energy value chain, population, mass consumption, energy intensity
Rise of Asia	Rise of China, rise of India, rise of china and Asia, Asia contribution of world GDP, Tech investment, rate of energy tech change, energy production cost
Peace and Conflict	Geopolitical tension, rate of tech transfer, stability of Middle Eastern region, global institutions, oil prices, gas prices

Canada’s energy drivers are multiscale



Kurniawan (in prep)