

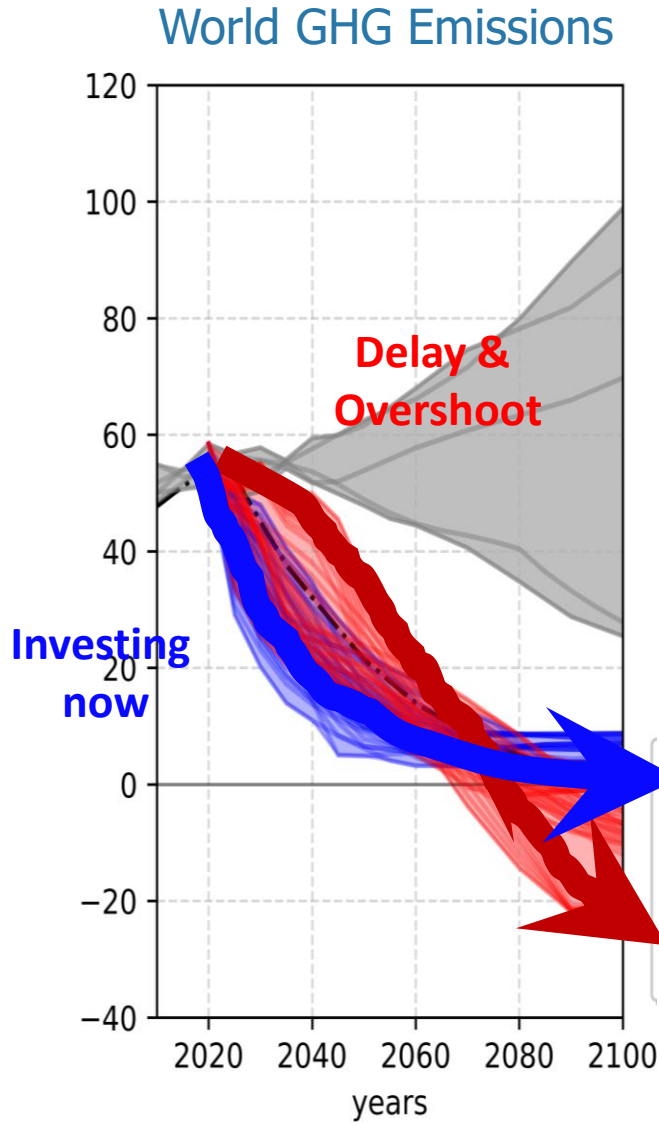
Insights from recent mitigation pathways and related scientific community activities

Keywan Riahi, Elmar Kriegler, Bas van Ruijven,
Elina Brutschin, Christoph Bertram, Joeri Rogelj

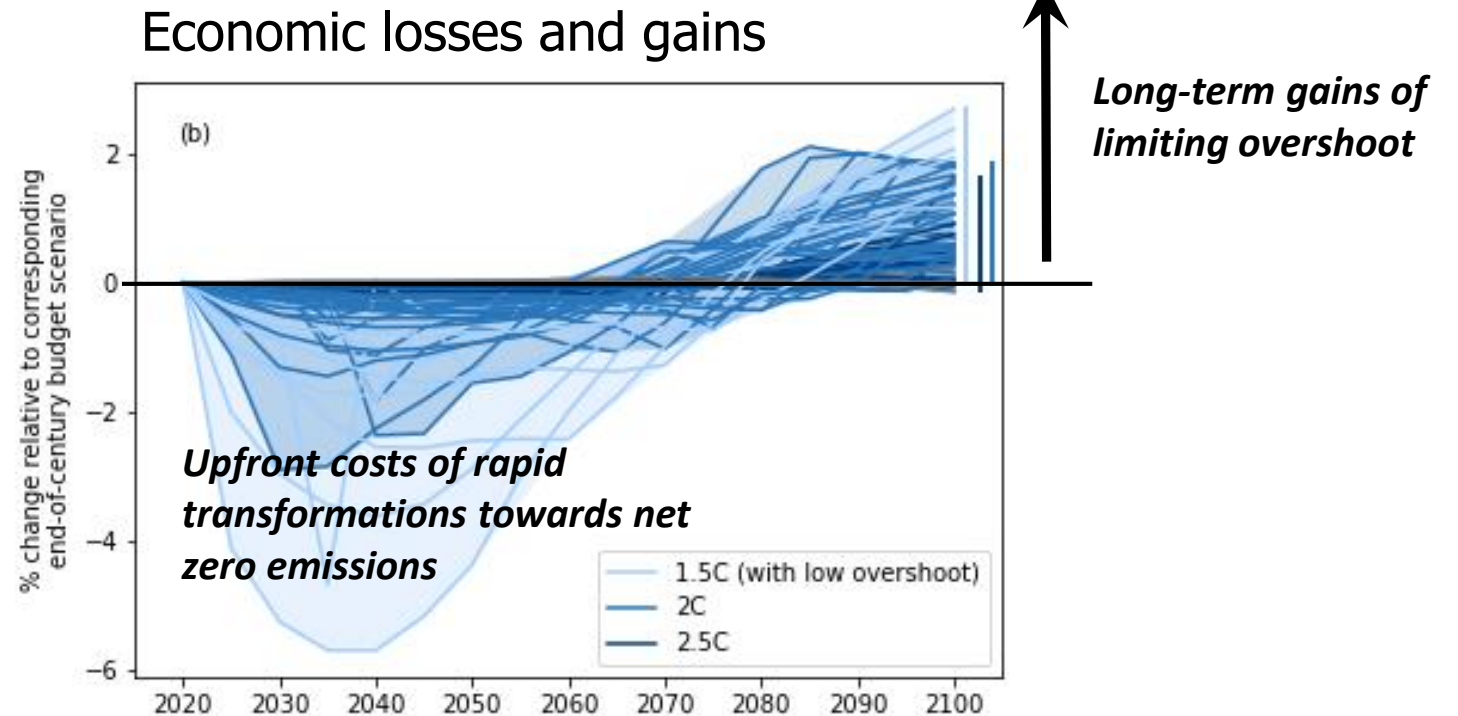
UNFCCC Research Dialogue, 1 June 2021

A new generation of pathways explore strategies to limit temperature overshoot

- new scenario design
- rethinking the economic story



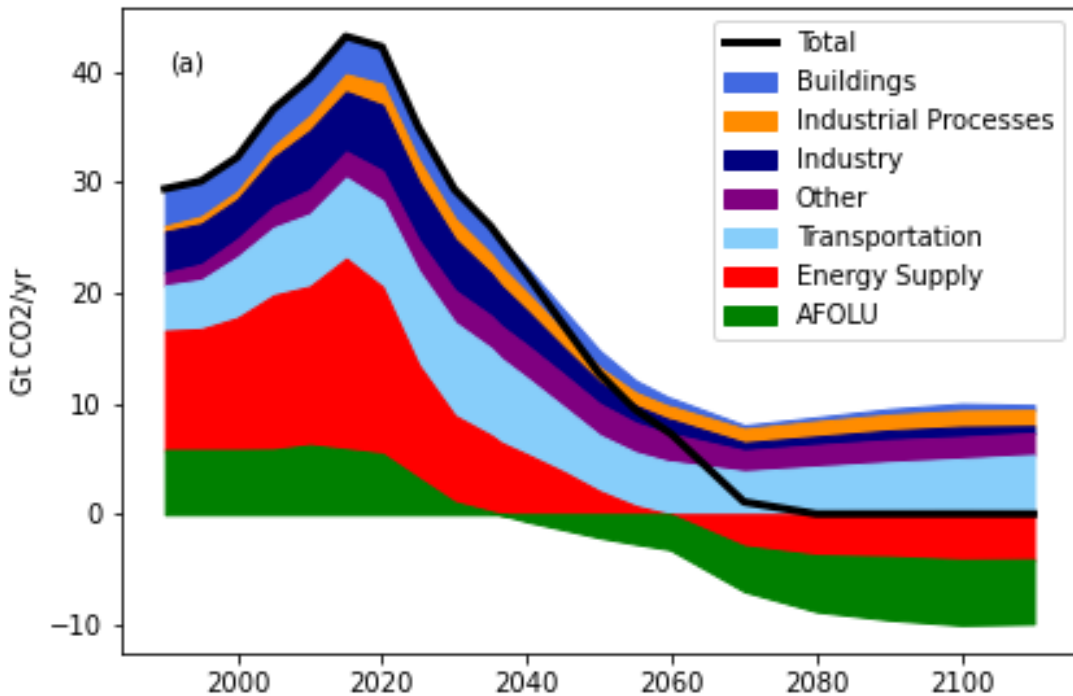
- NDC
- No net negative CO₂ emissions
- With net negative CO₂ emissions



Balancing CO₂ emissions sources and sinks

Reaching the long-term goal of the Paris Agreement requires to reach net zero CO₂ emissions globally

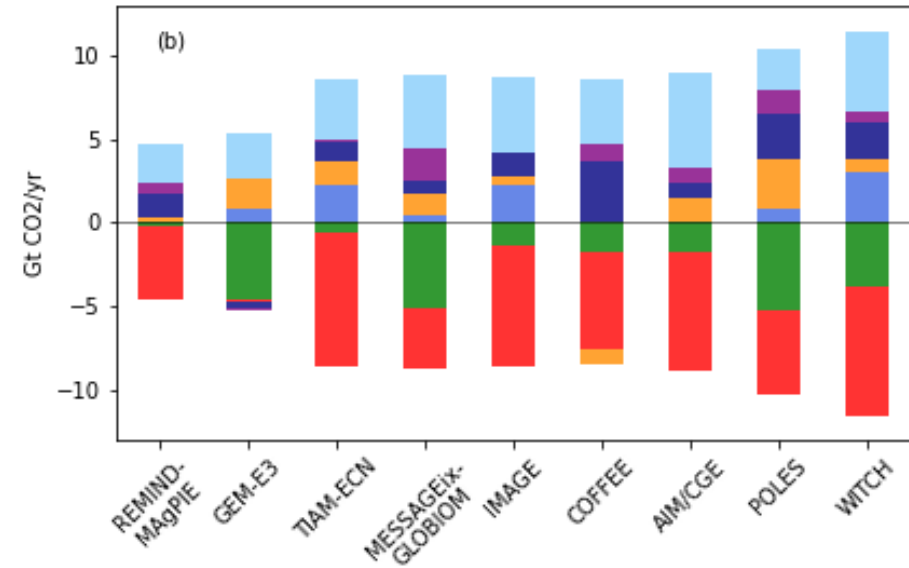
Illustrative net zero CO₂ emissions pathway



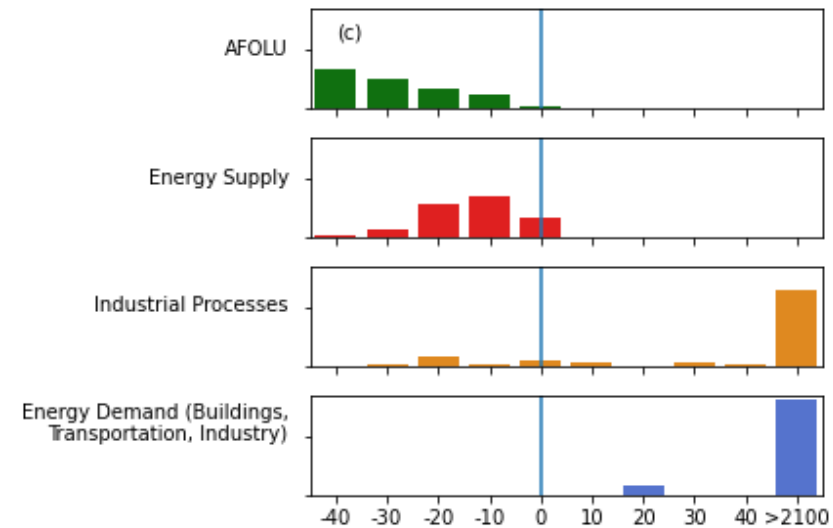
Note that regional potentials differ substantially, and deployment eventually depends on ethical and fairness considerations

Riahi et al, forthcoming, Bertram et al, forthcoming

Different strategies across models



Timing of sectors for net zero CO₂ emissions (compared to the timing of the overall system)



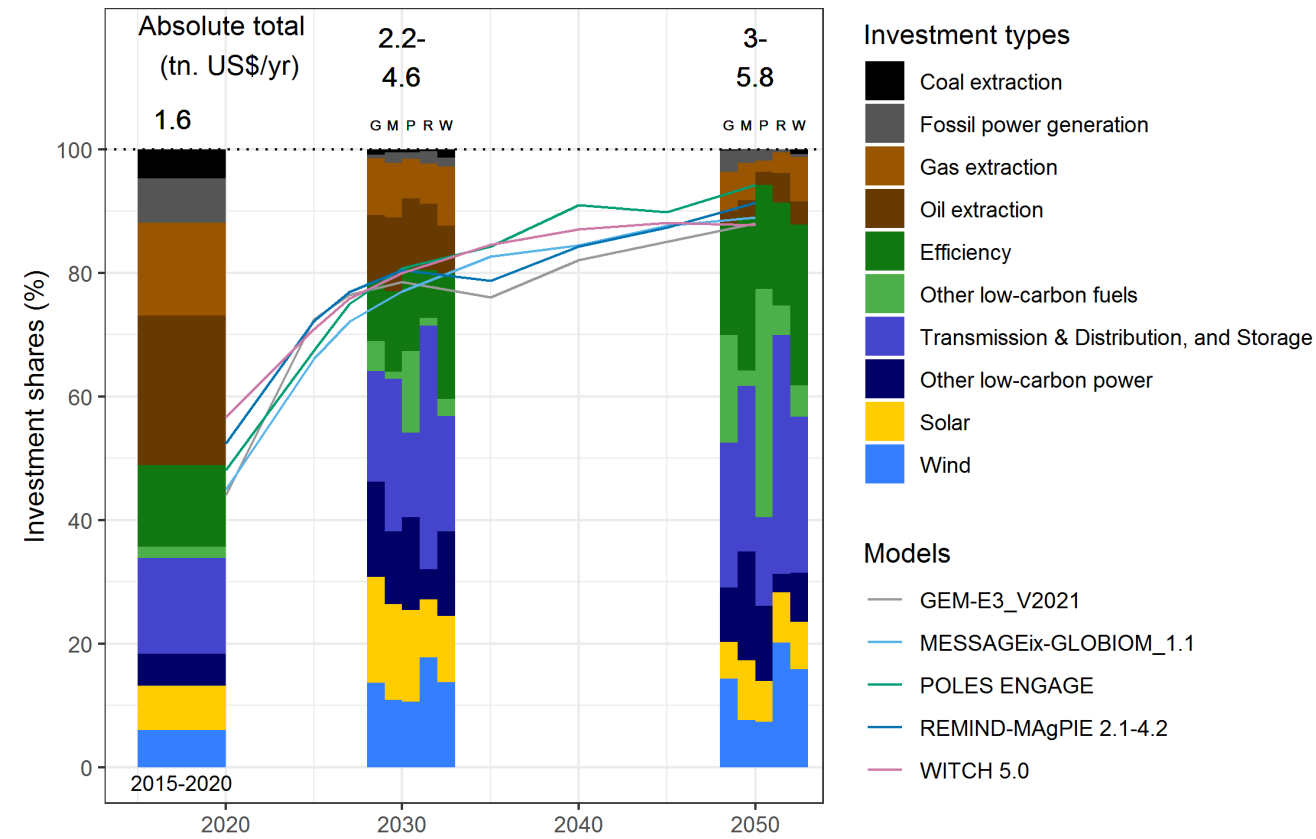
Energy investment requirements

- 1.5°C peak temperature scenarios require rapid shift and scale-up of energy investments:

- Coal, and fossil power generation investments are eliminated nearly immediately, and gas and oil investments strongly reduced
- In the next decade, investments into decarbonizing power are dominating, especially solar and wind, plus “system” investments into transmission & distribution and storage

⇒ Bertram, C., et al. (*in review*): Energy system developments and investments in the decisive decade for Paris Agreement targets

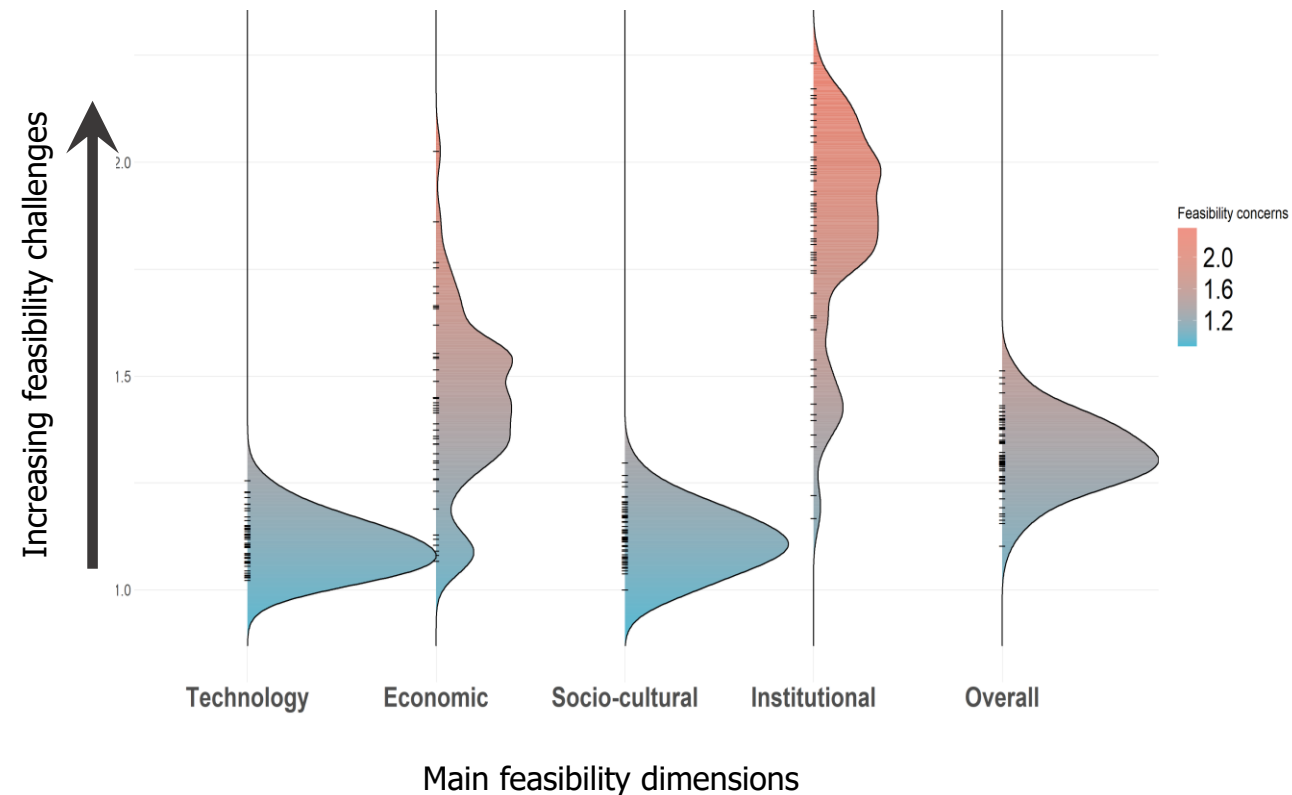
Share of investments 1.5°C scenarios



How feasible are the global mitigation pathways?

- Multidimensional feasibility framework (Brutschin et al, 2021)
- Grounded in empirical assessments
- Bringing social science into modelling
- Applied to scenarios assessed by IPCC SR1.5 (and used by AR6 authors)
- Key conclusion: Institutional/governance challenges dominate over technology and economic concerns

Feasibility assessment of 1.5°C scenarios assessed by IPCC SR1.5



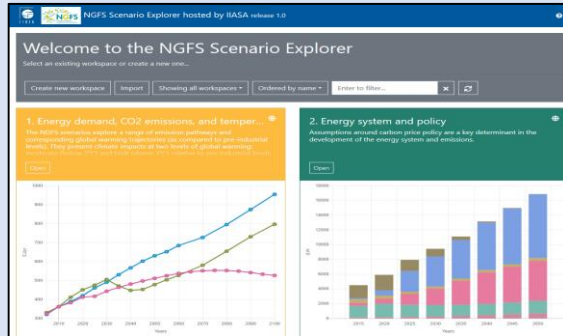
Climate scenarios as a public good for the financial sector



First products (June 2020)

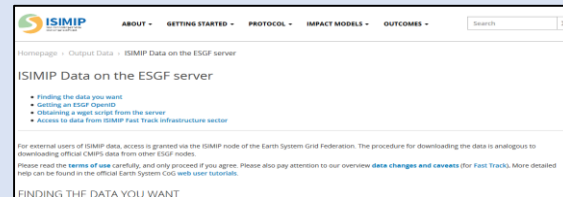


NGFS Presentation and Documentation



NGFS scenario explorer (hosted by IIASA)

<https://data.ene.iiasa.ac.at/ngfs>



Climate impacts info (ISIMIP)

Applications



Scenario analysis



Targets



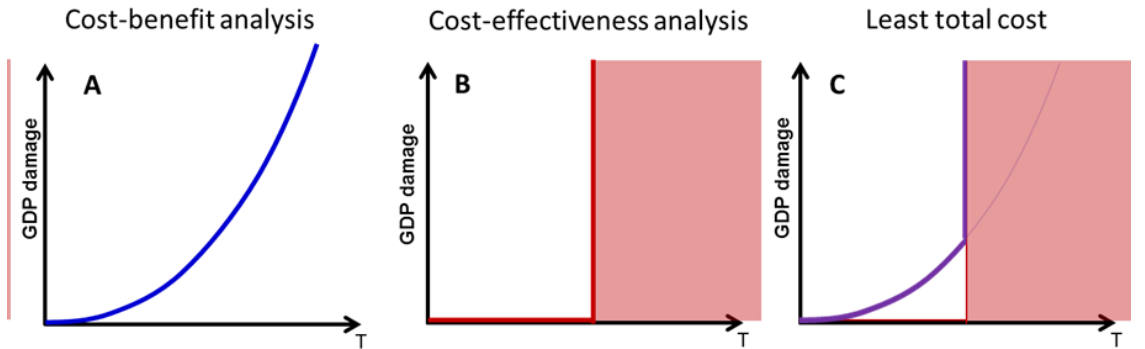
Research

Next release (7th June 2021)



<https://www.ngfs.net/en/publications/ngfs-climate-scenarios>

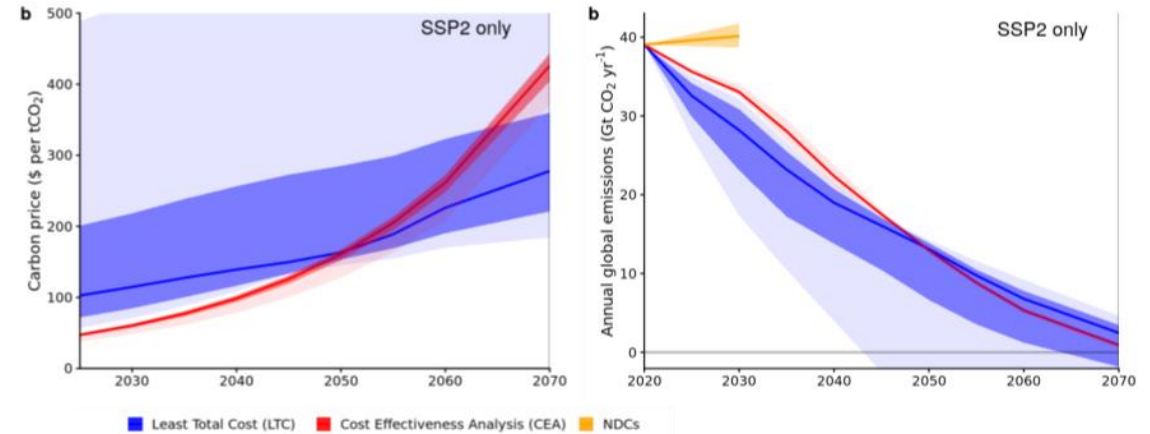
Including impacts into integrated assessment leads to more ambitious mitigation



- Assumed damage function explicitly drives analysis
- Hampered by incompleteness of damage estimates, in particular missing tipping points and societal disruptions

Ignores damages occurring below the defined temperature limit

- reconciles both pathways
- cost-minimizing mitigation strategies for staying below a long-term target and accounting for damages below



Leads to more ambitious mitigation in the near term while reducing carbon prices in the long run. The gap to emissions under the nationally determined contributions increases. (Schultes et al. 2020)

Five SSP Narratives

O'Neill, Kriegler et al., Global Env. Change, 2017

Socio-economic challenges for mitigation

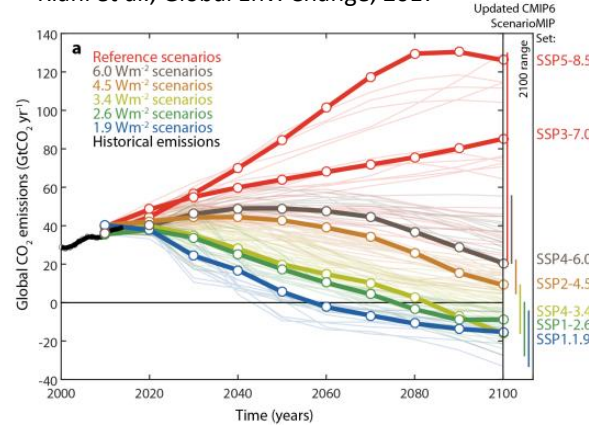


Socio-economic challenges for adaptation

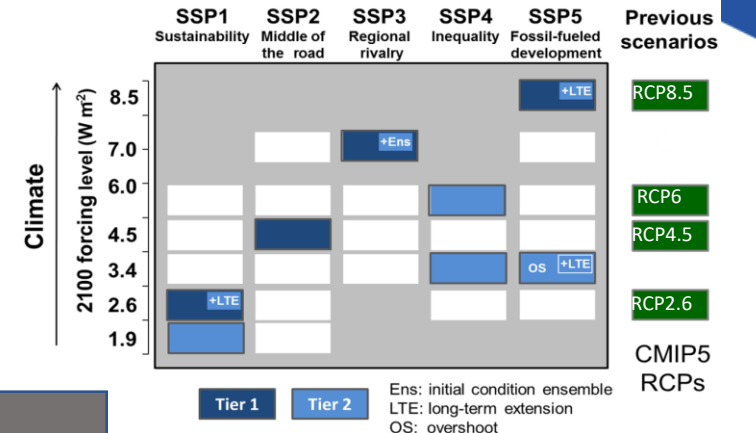
SSP-based Emissions Pathways



Riahi et al., Global Env. Change, 2017



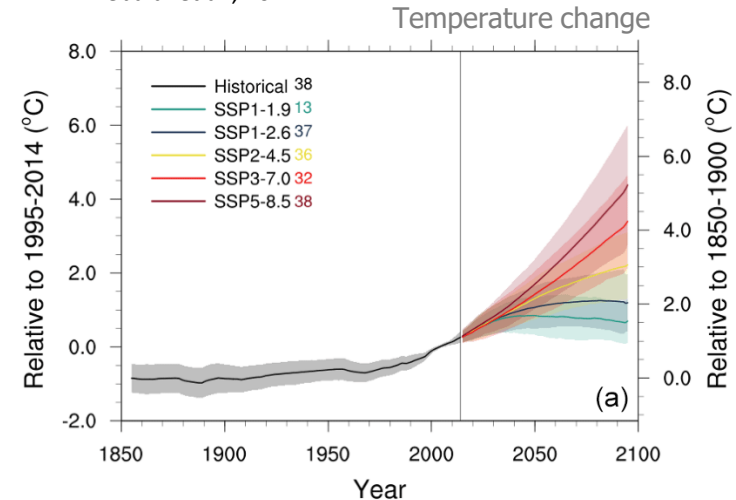
Shared socioeconomic pathways



O'Neil et al., 2018

CMIP6 climate assessment

Tebaldi et al., 2021



?

Full Integrated assessment of climate impacts, mitigation and adaptation possible now

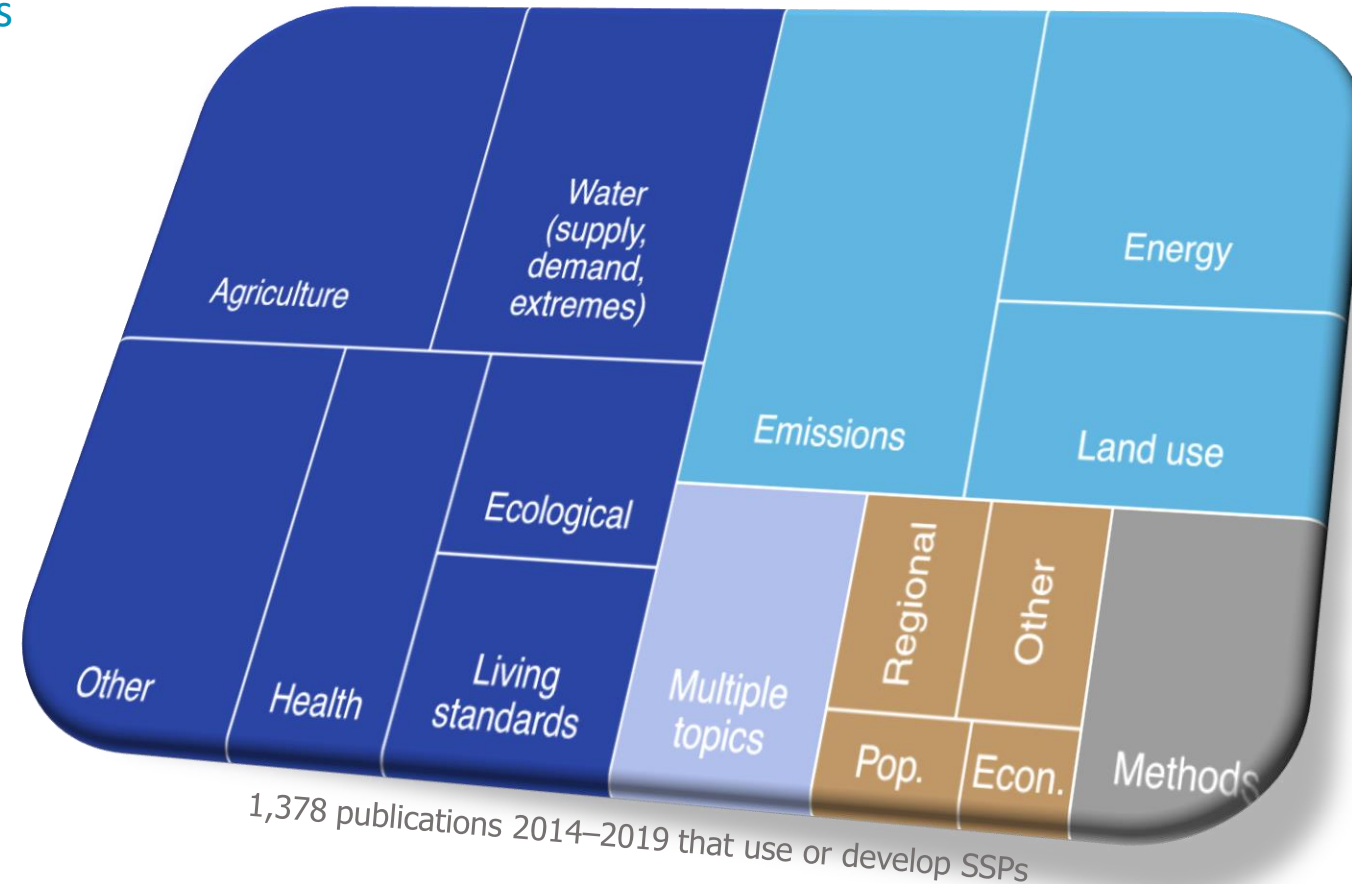
Achievements and needs for the climate change scenario framework (Brian C. O'Neill et al, 2020)

nature
climate change

Needs:

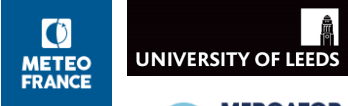
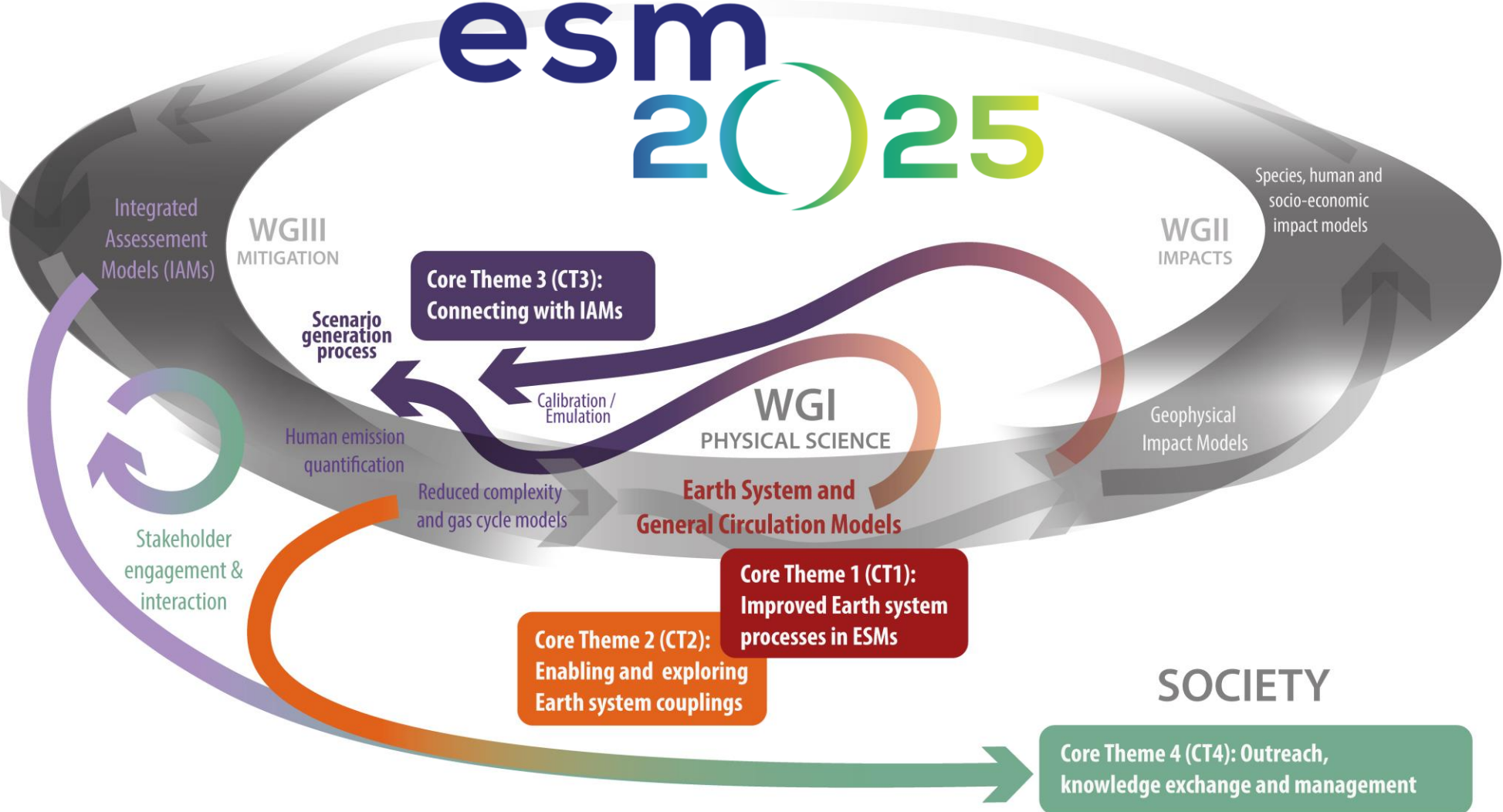
- Improve integration of societal and climate conditions
- Improve applicability to regional and local scales
- Improve relevance beyond the climate research community
- Produce a broader range of reference scenarios that include impacts and policy
- Capture relevant perspectives and uncertainties
- Keep scenarios up to date
- Improve relevance of climate change scenario applications for users

Main areas of SSP research



ESM2025: Earth System Models for the Future

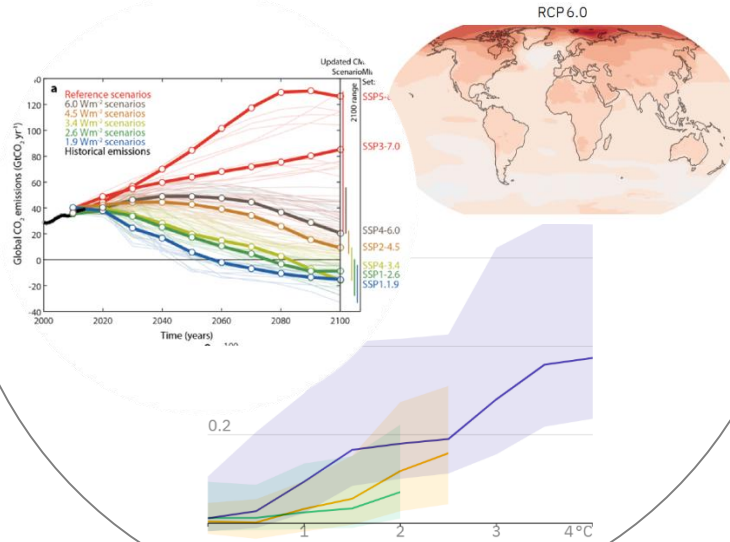
connecting Earth system modelling to society to inform the effective operationalisation of the Paris Agreement



SENSES Toolkit & Portals

Tools and approaches for scenario visualization, contextualization, co-production of knowledge

Scenarios



Users

Climate Policy Makers
Business Actors
Finance Actors
Regional Actors

Primer to Climate Scenarios

This interactive primer gives an introduction to what climate change scenarios are and how they are connected to socioeconomic, energy & land use, emissions, climate change and climate impacts.

[More information](#) [Read the module](#)

Extreme Events

Climate change makes extreme events more frequent and more severe. This module investigates how exposure to crop failures, river floods, tropical cyclones, heatwaves, wildfires, and droughts changes with rising temperature levels.

[More information](#) [Read the module](#)

Senses Earth

Discover how the world could be affected by extreme events at different global warming levels.

[More information](#) [Explore the module](#)

Scenario Finder

This explore module allows you to quickly filter all available scenarios from the IAMC 1.5 database.

[More information](#) [Explore the data](#)

Transition Risks - Preamble

The transition towards a low carbon future requires large changes in the production, conversion and use of energy. This is the preamble to our three modules, that guide you through the main risks related to this transition.

[More information](#) [Read the module](#)

End-Use Risks

The end-use sector goes through a transition from carbon-emitting fuels towards cleaner fuels that don't emit CO2. In this module we explore the risks and opportunities that result from this shift.

[More information](#) [Read the module](#)

Co-production Techniques Finder

How can we do co-production? The co-production database provides an overview of different methods and tools for specific co-production objectives.

[More information](#) [Explore the data](#)

Scenario Explorer

This Scenario Explorer presents an ensemble of quantitative, model-based climate change mitigation pathways.

[More information](#) [Visit the website](#)



The SENSES toolkit: <https://climatescenarios.org/>

Model documentation

- **Macro:** General overview on model features

IAMC model documentation:

https://www.iamcdocumentation.eu/index.php/IAMC_wiki

- **Micro:** Equations and open source code

- GCAM: <https://github.com/JGCRI/gcam-core>
- MESSAGEix: https://github.com/iiasa/message_ix
- REMIND: <https://github.com/remindmodel/remind>
- MAgPIE: <https://github.com/magpiemodel/magpie>
- ...



Model diagnostics

Harmsen et al., 2021, *Integrated assessment model diagnostics: key indicators and model evolution*.
Env Res Lett 16: 054046.

