

# Community efforts to advance equity considerations in decarbonization pathways; 1.5°C Overshoot Pathways in the context of the Paris Agreement

Dr. Shonali Pachauri and Dr. Keywan Riahi

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18<sup>th</sup> Research Dialogue, June 9, 2026

# Community efforts to advance equity considerations in decarbonization pathways

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# The Power and Challenge of Scenarios



## Policy-shaping

Climate mitigation scenarios are policy-shaping and feed IPCC WGIII assessments, NDC design, and 1.5°C framing



## Burden / Benefit Sharing

What scenarios assume determine which regions cut emissions fastest, and which communities bear residual risks.



## The Legitimacy Gap

Pathways are technically optimal but not always politically and socially credible.

**Key question:** *How do we move beyond lowest-cost pathways alone toward scenarios that also embed equity and justice as **first-order design criteria** and are **more inclusive**?*

# Four entry points to strengthen equity and justice in climate mitigation futures



## 1 Inclusive participation

*Who shapes the futures?*

Development-Focused  
Socio-Economic Projections (DSPs)



## 2 Narratives and assumptions

*What futures are imagined?*

### Healthy SSPs

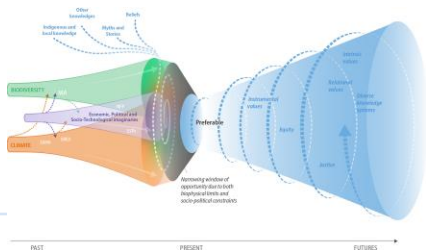
Health-focused Shared Socioeconomic Pathways

Extending the SSPs to better represent health.



## 3 Models and metrics

*How are futures assessed?*



Integrated  
transformative  
scenarios



## 4 Use and interpretation

*How are results used?*

**Scenario Compass Initiative**

Transparent and  
vetted scenario access

Open, curated and easily accessible scenario data



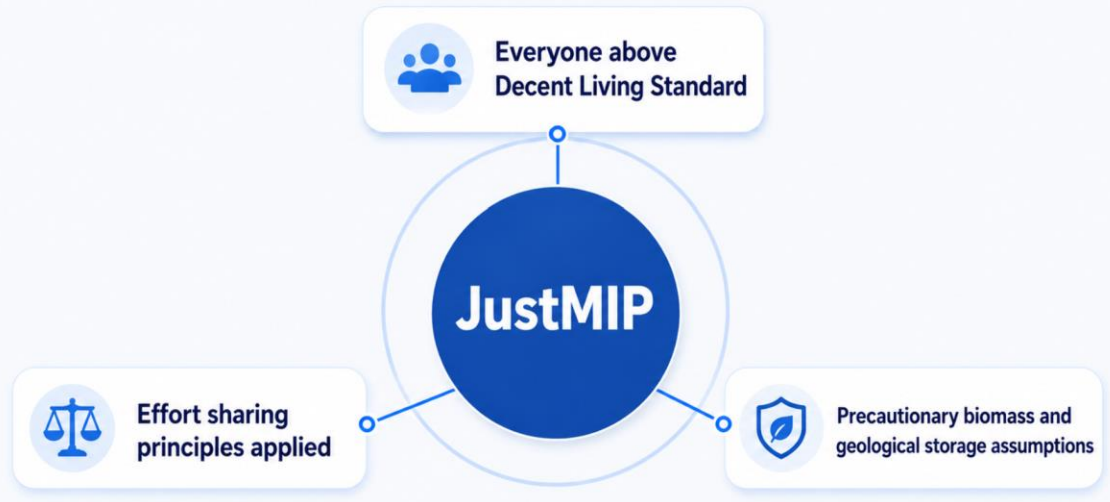
Advancing equity and justice in climate mitigation futures

# A model intercomparison effort embedding justice into Integrated Assessment Models (IAMs)

Detailed protocol available for **public**



## Justice considerations informing JustMIP



Open to **collaboration** with **global, national and sub-national models**

**Key question:** *Is decent living standards for all as a near-term floor compatible with reaching the long-term temperature goal; and what minimum international cooperation does it require?*

### IIASA NETWORK

Governed by Council of Representatives from 18 Member Organizations & 1 Regional Membership Organization (SSARMO)

19 member organizations

over 560 full-time and guest researchers

from 60 countries



<https://iiasa.ac.at/members/ssarmo>

RMO secretary:  
Ministry of Environment, Science, Technology & Innovation (MESTI)  
National Research Foundation of South Africa (NRF)





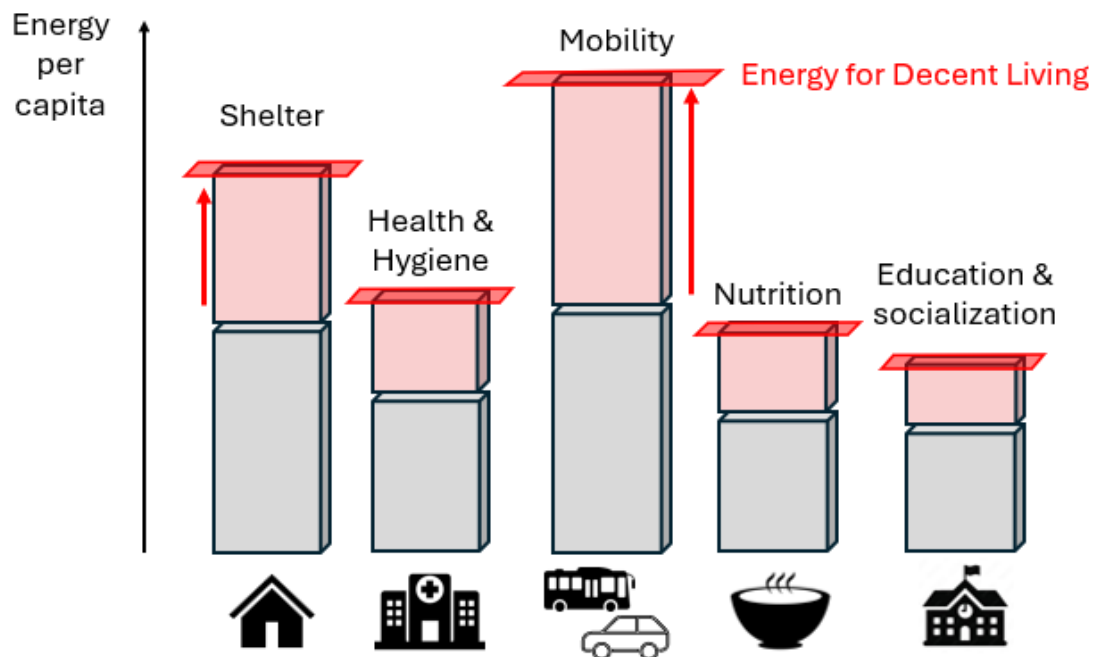
Everyone above  
Decent Living Standard

JustMIP

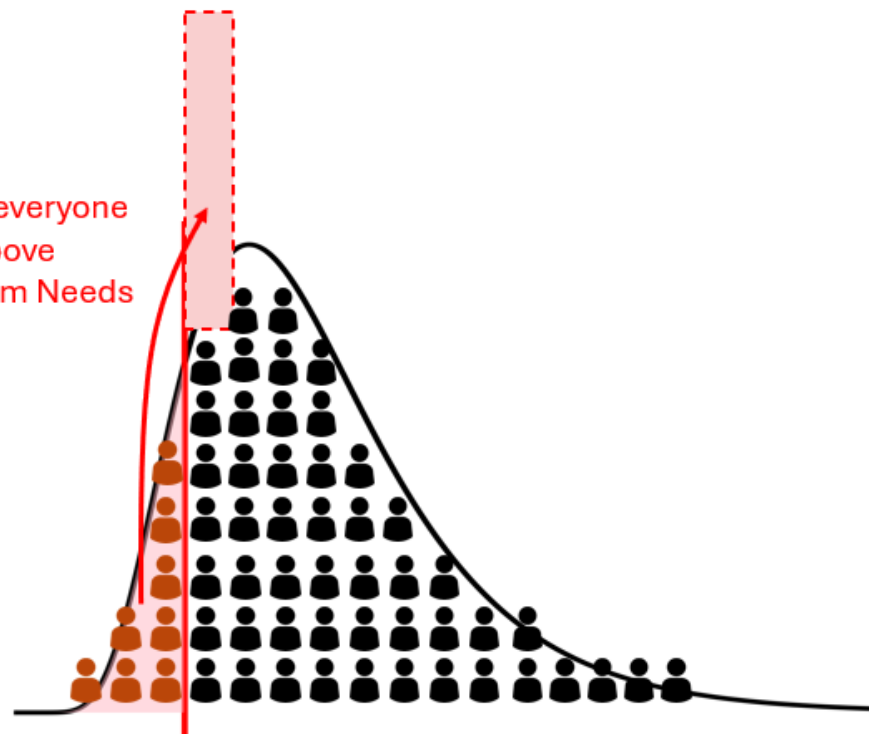


# A new tool to assess access to decent living energy needs in IAMs

## Lifting everyone above Decent Living Standards

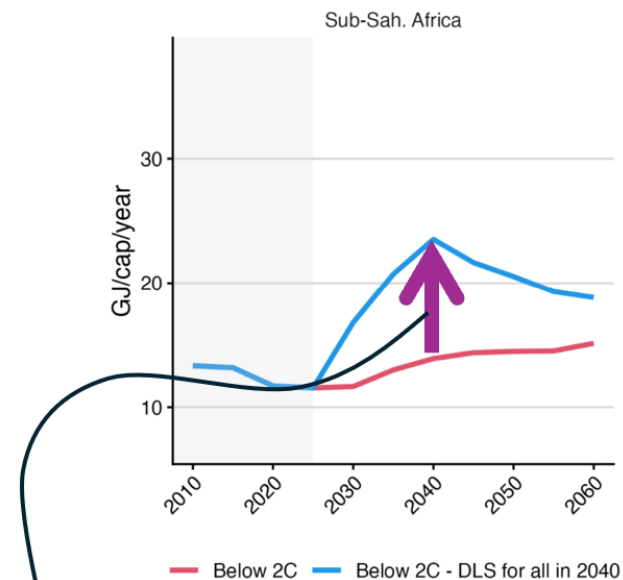
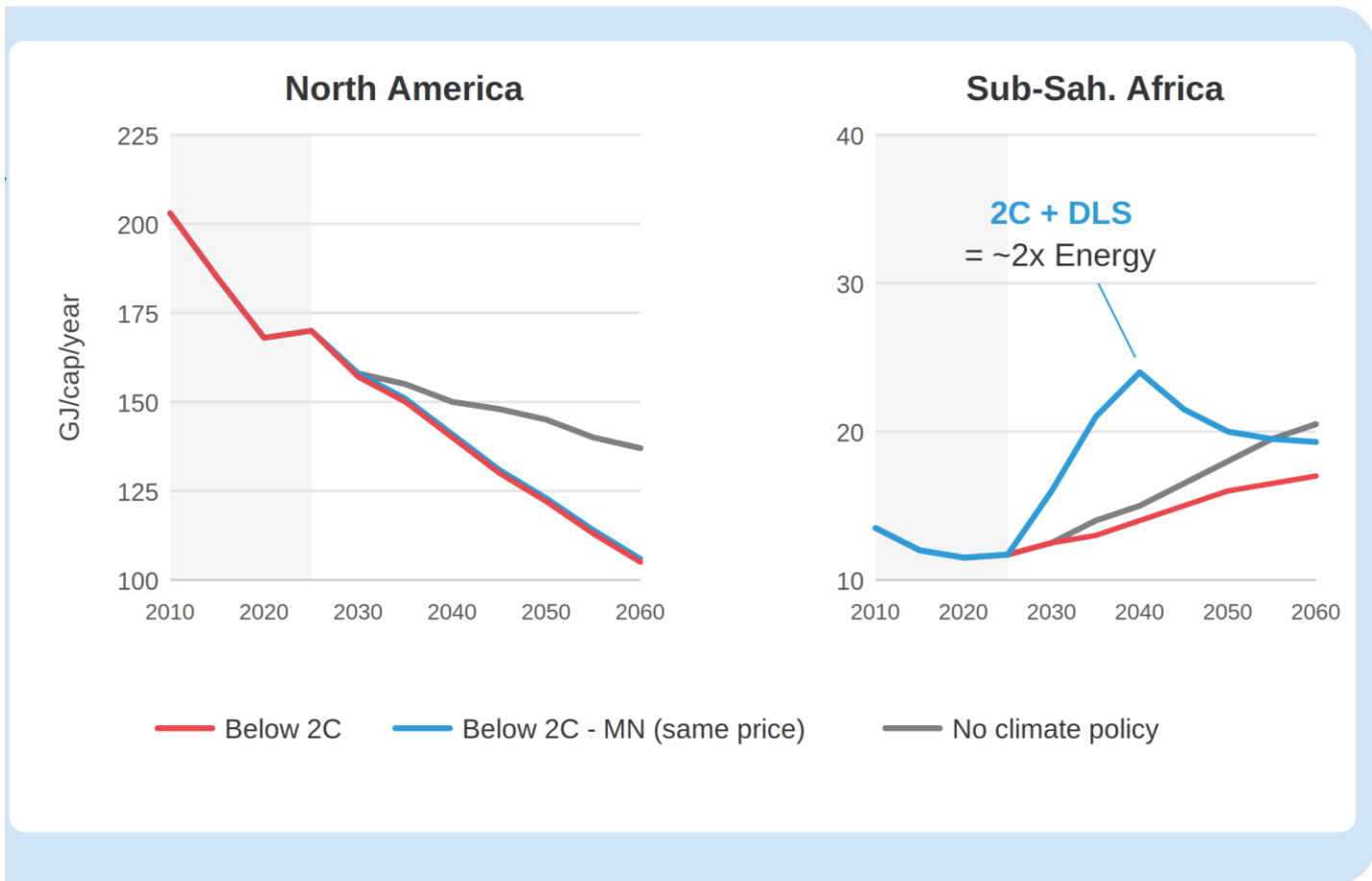


Lifting everyone  
above  
Minimum Needs



# Achieving climate targets and development needs is feasible

Full century 800Gt scenarios



## ENERGY-USE COMPARISON

**⚡** The annual energy needed to ensure nobody in Sub-Saharan Africa is deprived of decent living standards is equivalent to the annual energy use of the top 2 million global energy users.

1.7 billion people in Sub-Saharan Africa  
people needing at least decent living standards

Scaled people icons: 1 icon = 2 million people.

**=**

equivalent annual energy demand

Top 2 million global energy users

# 1.5°C Overshoot Pathways in the context of the Paris Agreement

Dr. Keywan Riahi (IIASA, IAMC Steering Committee)

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18<sup>th</sup> Research Dialogue, June 9, 2026



# The Scenario Compass Initiative

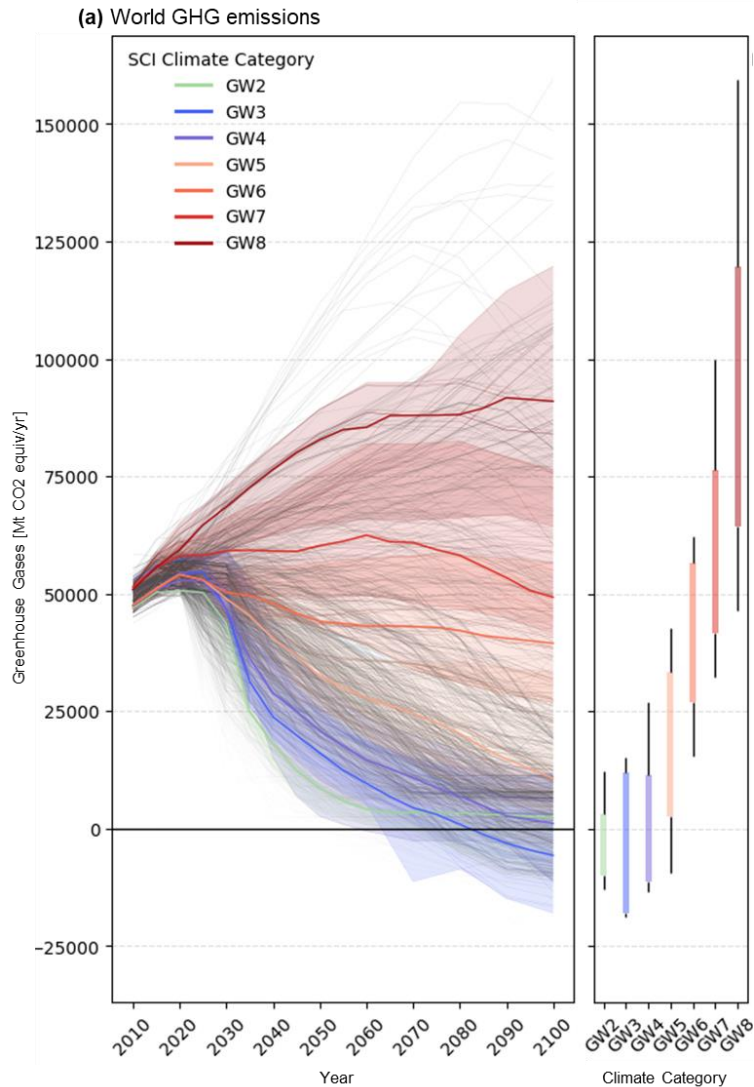
Community initiative towards a live benchmark framework for global emissions pathways

- A new resource for scenario users, including a **continuously updated, curated ensemble** of global emissions scenarios
- Moves beyond static scenario snapshots (e.g. IPCC AR6) to a **“living” benchmark framework**
- Enables **transparent comparison of pathways** against policy-relevant feasibility and sustainability criteria
- **CMIP7-style grass-roots community activity** designed to support policy assessments and tracking progress over time
- Responds to the recommendations of the IPCC Scenarios Meeting (2023) on **inclusivity and transparency**





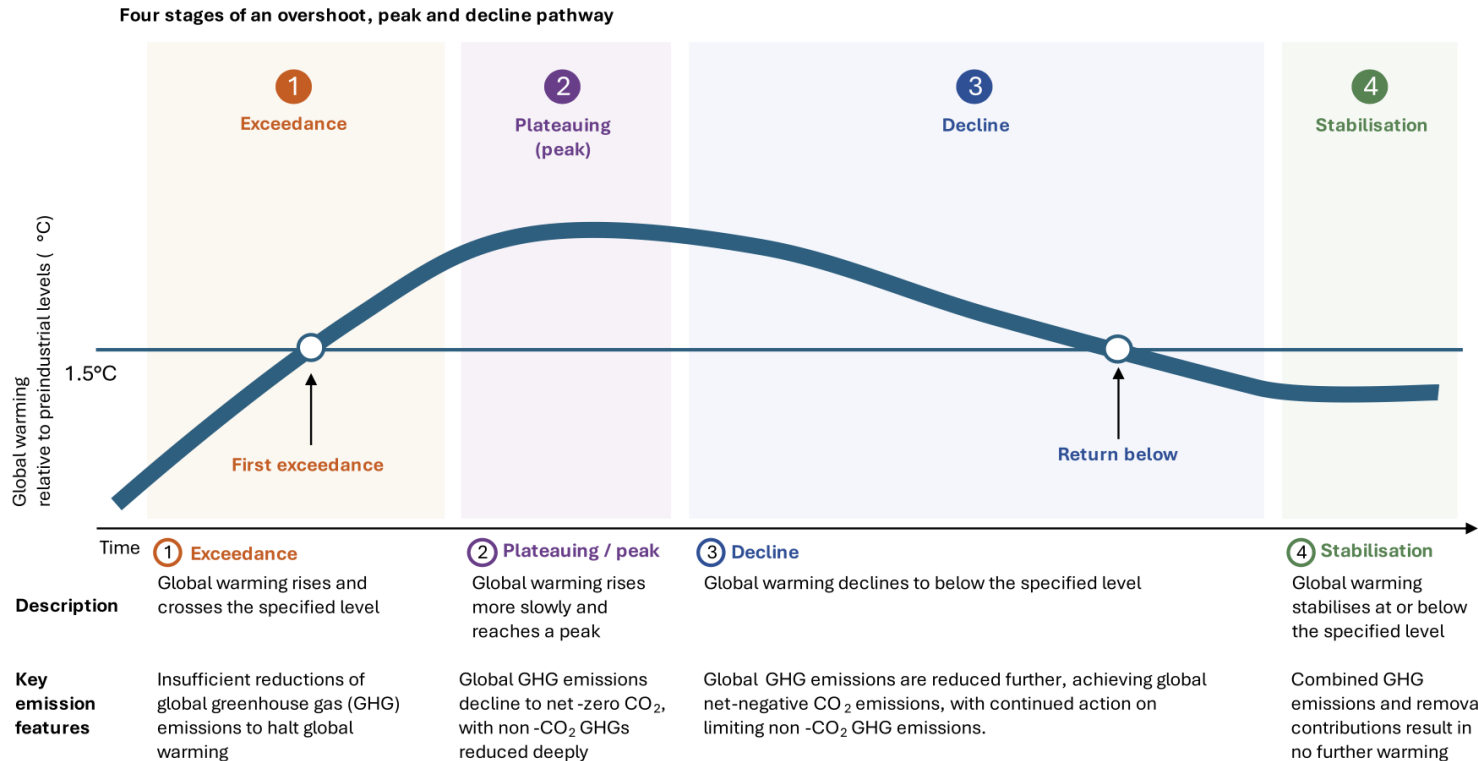
# The mitigation landscape has shifted since AR6



- **More than 350 new scenarios** + ~1200 AR6 scenarios
- **Lowest AR6 category scenarios** (C1, no overshoot) are **no longer available** in current ensemble
- **New categorization** with maximum peak warming level of 1.7C (50% chance)
- **Highest warming scenarios** of the AR6 **have become less plausible** given current ramp-up of non-fossil energy carriers around the world
- **Annual release of near-term policy benchmarks** consistent with different warming categories (update of AR6 SPM – Table 2):
  - Near-term emissions reductions
  - Timing of net-zero CO<sub>2</sub> and net-zero GHG
  - Renewable deployment rates
  - Transitioning away from fossil fuels
  - Scale of net-negative emissions



# What is an Overshoot, peak and decline pathway?

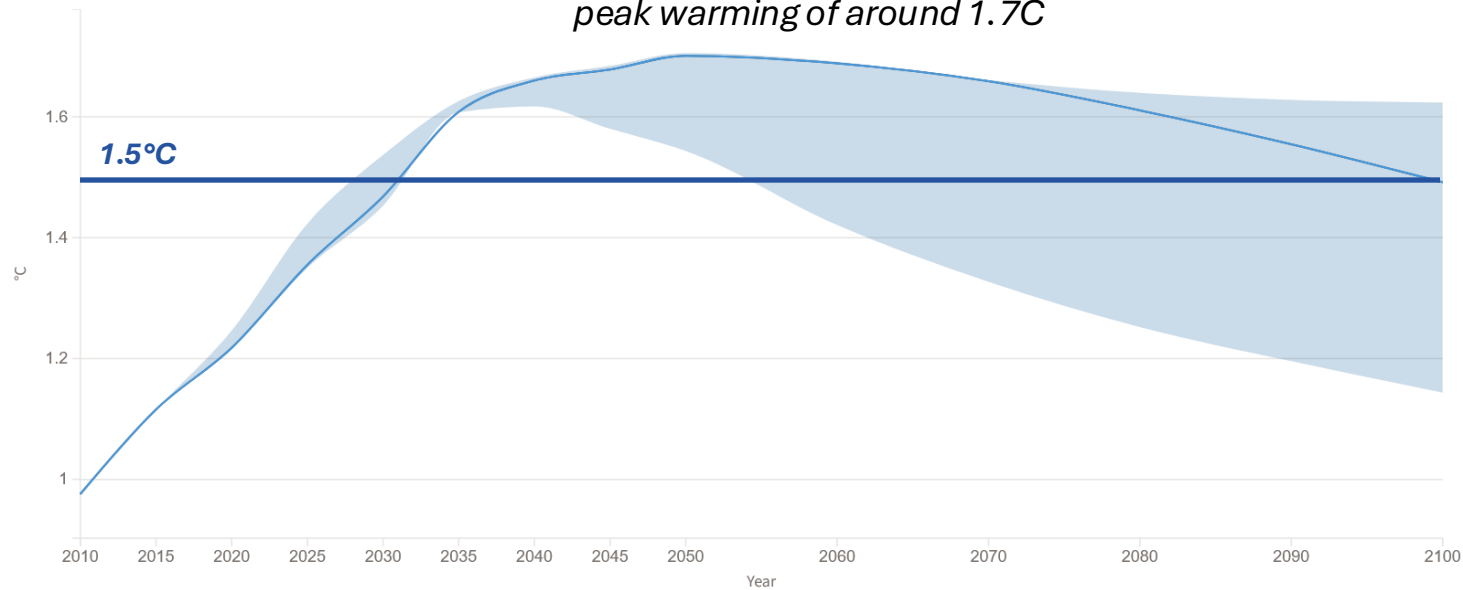


Rogelj et al. (2026)

- **Definitional clarity is key.** Ordinary meaning of "Overshoot" as "Exceedance" does not suggest long-term temperature decline
- **'Overshoot, peak and decline pathway'** is clear and can follow the established IPCC AR6 **overshoot pathway definition**: *"pathways that first exceed a specified concentration, forcing or global warming level, and then return to or below that level again before the end of a specified period of time"*
- Overshoot, peak and decline pathways can be **segmented into four stages relative to a specified global warming level or other target**

# What is an Overshoot, peak and decline pathway?

The lowest pathways since AR6 show a peak warming of around 1.7C



Many pathways manage to bring back warming to 1.5C before the end of the century

	Time ① Exceedance	Time ② Plateauing / peak	Time ③ Decline
<b>Description</b>	Global warming rises and crosses the specified level	Global warming rises more slowly and reaches a peak	Global warming declines to below the specified level
<b>Key emission features</b>	Insufficient reductions of global greenhouse gas (GHG) emissions to halt global warming	Global GHG emissions decline to net-zero CO <sub>2</sub> , with non-CO <sub>2</sub> GHGs reduced deeply	Global GHG emissions are reduced further, achieving global net-negative CO <sub>2</sub> emissions, with continued action on limiting non-CO <sub>2</sub> GHG emissions.

**Overshoot Conference 2026**  
**Beijing on November 24–25**  
 co-hosted by Tsinghua University and IIASA

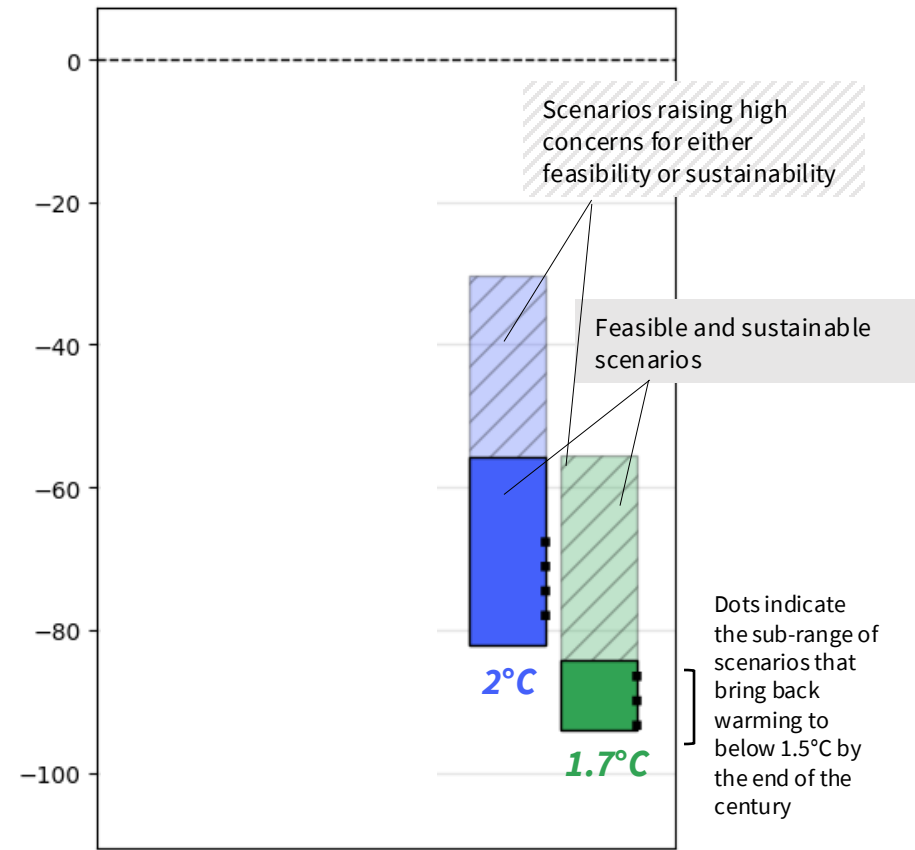


Rogelj et al. (2026)



# Updated Scenario benchmarks - 2025

## GHG Emissions Reductions



← 2050 →

Distribution of IPCC AR6 scenarios in categories C1, C2, and C3, 13

Range of vetted 2025 scenarios for category GW2 ( $PW_{50} < 1.7^{\circ}\text{C}$ ) and GW3 ( $PW_{67} < 2^{\circ}$ )



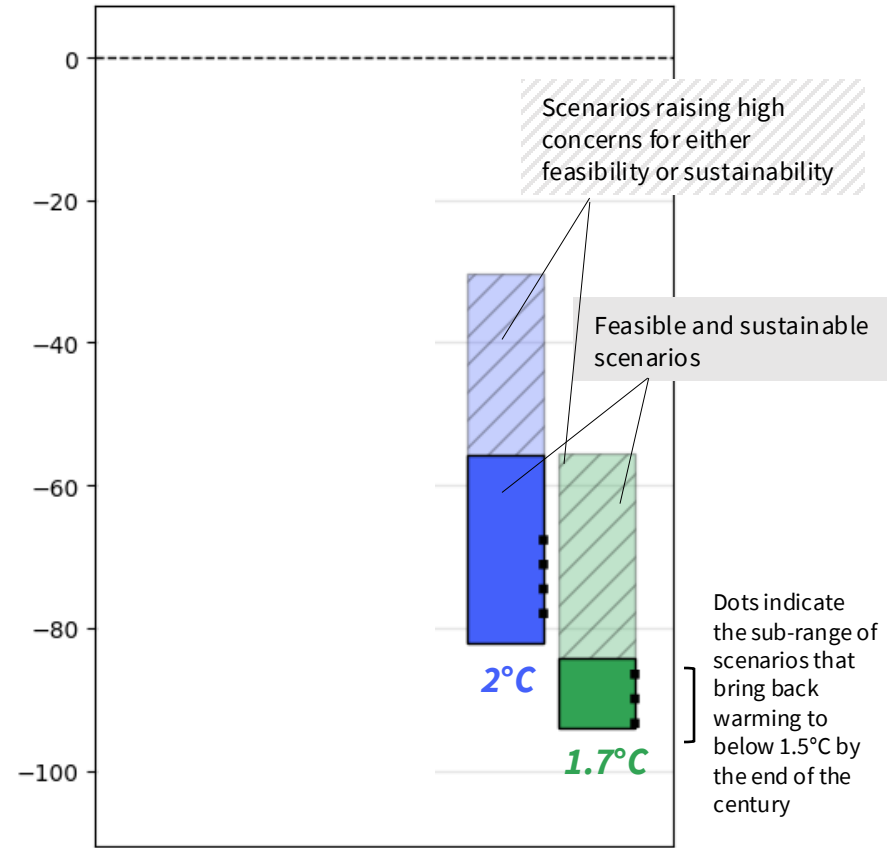
SCI assessment (forthcoming)



# Updated Scenario benchmarks - 2025

## GHG Emissions Reductions

- **More than 350 new scenarios**  
+ ~1200 AR6 scenarios
- **Lowest AR6 category scenarios** (C1, no overshoot) are **no longer available** in current ensemble
- **New categorization** with maximum peak warming level of 1.7C (50% chance)



← 2050 →  
Distribution of IPCC AR6 scenarios in categories C1, C2, and C3, 14

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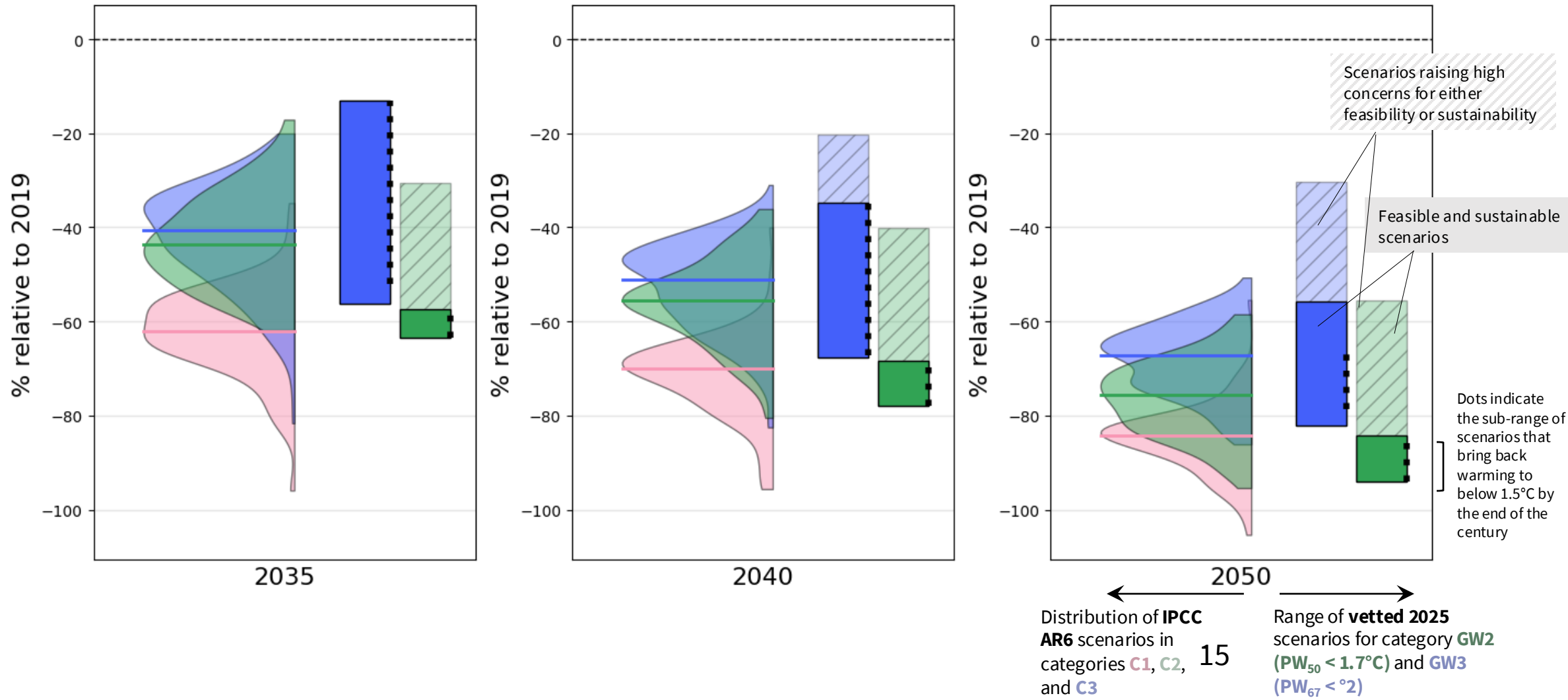


SCI assessment (forthcoming)



# Updated Scenario benchmarks - 2025

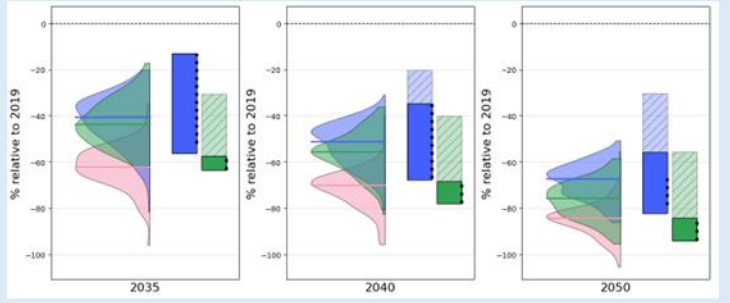
## GHG Emissions Reductions



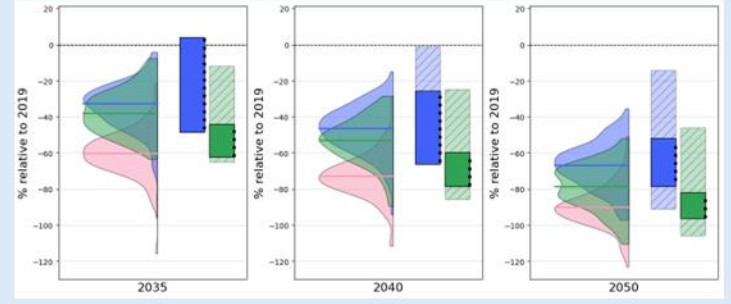


# Main scenario benchmarks - 2025

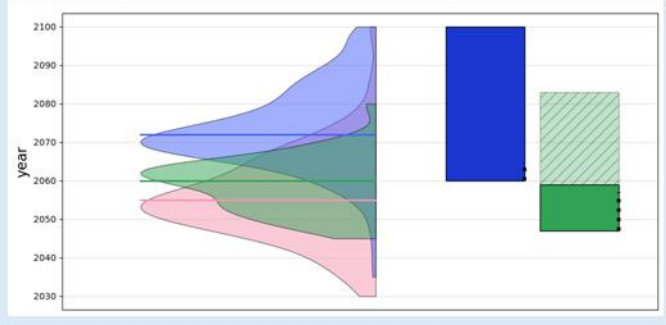
(a) GHG Emissions



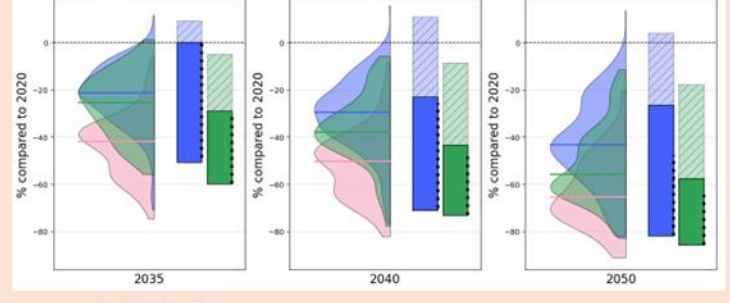
(b) CO<sub>2</sub> Emissions from Fossil Fuels and Industry



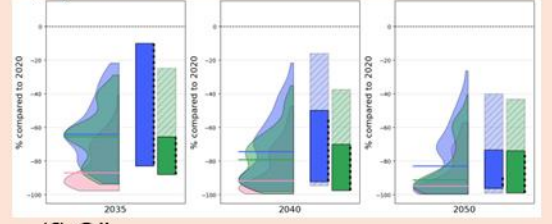
(c) Timing of Net-Zero CO<sub>2</sub> Emissions



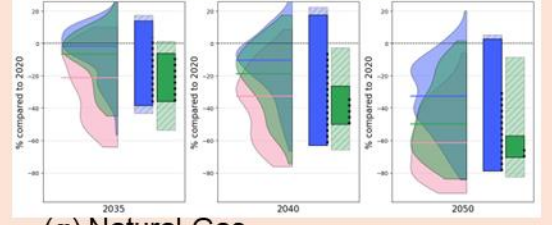
(d) Transitioning Away From Fossil Fuels



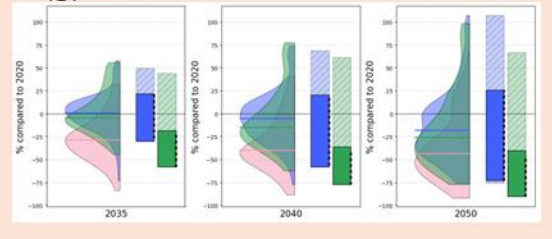
(e) Coal



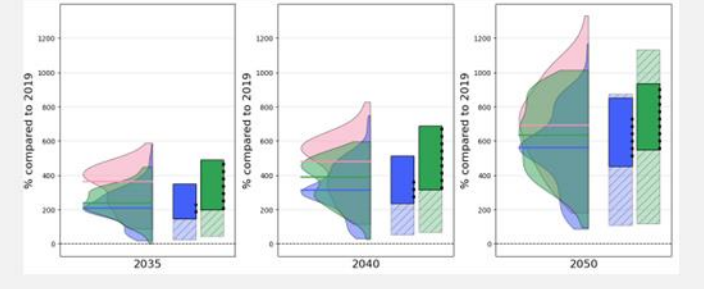
(f) Oil



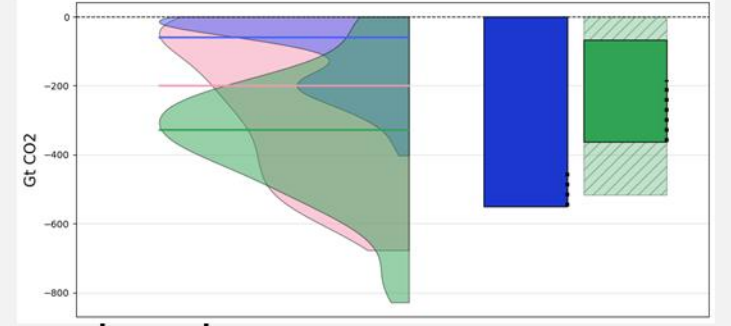
(g) Natural Gas



(h) Upscaling of Renewables



(i) Cumulative Net-negative Emissions



## Legend

C3 scenarios of AR6 broadly consistent with GW3 category of the new 2025 ensemble

C2 scenarios of AR6 correspond broadly to GW2 category of the new 2025 ensemble

C1 (all AR6 scenarios in this category failed the 2025 vetting and/or the sustainability & feasibility assessment)

Scenarios raising high concerns for either feasibility or sustainability

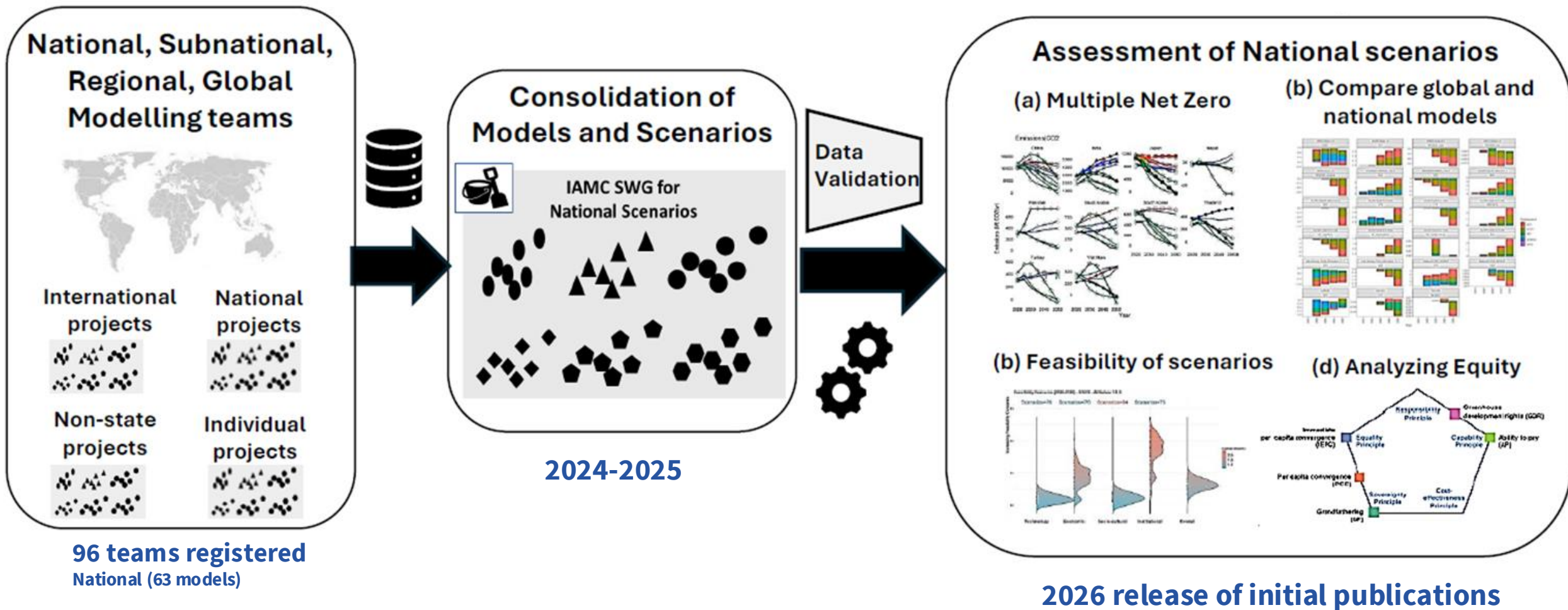
Feasible and sustainable scenarios

Dots indicate the sub-range of scenarios that bring back warming to below 1.5C by the end of the century

Distribution of IPCC AR6 scenarios in categories C1, C2, and C3

Range of vetted 2025 scenarios for category GW2 and GW3

# National Model and Scenario Intercomparison





Thank you!

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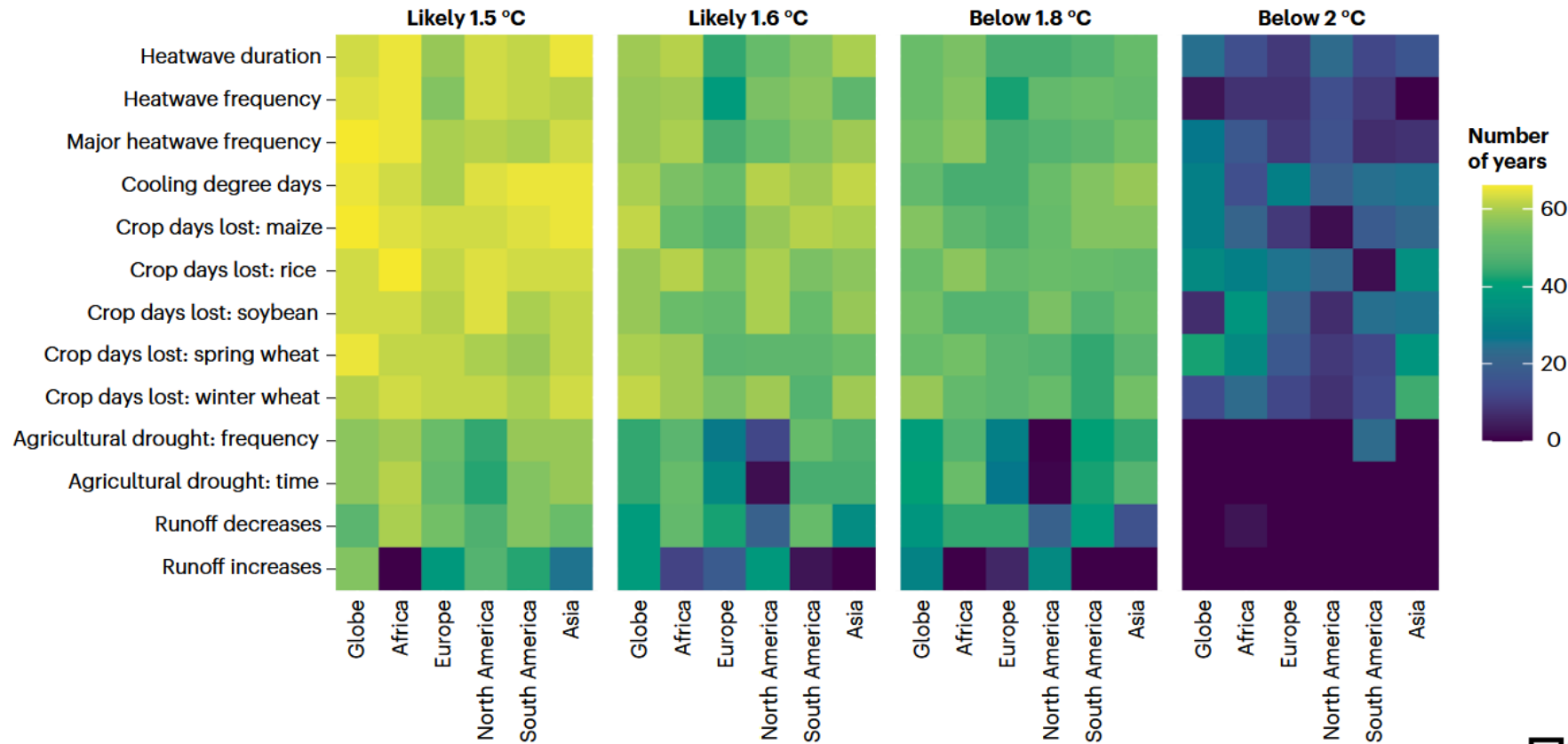
18<sup>th</sup> Research Dialogue, June 9, 2026



Supplementary Slides

# Even if global warming is brought back down by 2100, even temporary **1.5°C exceedance** still means many extra years of heat, drought, crop losses, and water-related risks.

**a** Years with significant additional impact from overshoot



The purple colors in the **below-2°C panel** do not mean there are **no climate impacts**. They mean overshoot does not add many extra years of impact compared **with non-overshoot scenarios in the same temperature category**.



# New Temperature Categorization

Main Category label	Sub-Category label	Peak warming (PW)	Warming at the end of the century (EoCW)	Similar category in the IPCC AR6 (C1-C8)
<b>GW0</b> Below 1.5°C with no overshoot		$PW_{50} < 1.5^{\circ}\text{C}$	$EoCW_{50} < 1.5^{\circ}\text{C}$	C0
<b>GW1</b> 1.5°C with limited overshoot		$PW_{50} < 1.6^{\circ}\text{C}$	$EoCW_{50} < 1.5^{\circ}\text{C}$	C1
<b>GW2</b> Below 1.7°C	GW2a Below 1.7°C returning to 1.5°C	$PW_{50} < 1.7^{\circ}\text{C}$	$EoCW_{50} < 1.5^{\circ}\text{C}$	lower part C2
	GW2b Below 1.7°C without returning to 1.5°C	$PW_{50} < 1.7^{\circ}\text{C}$	$EoCW_{50} < 1.7^{\circ}\text{C}$	N/A
<b>GW3</b> Likely below 2°C	GW3a Likely below 2°C returning to 1.5°C	$PW_{67} < 2^{\circ}\text{C}$	$EoCW_{50} < 1.5^{\circ}\text{C}$	Upper part C2
	GW3b Likely below 2°C without returning to 1.5°C	$PW_{67} < 2^{\circ}\text{C}$	$EoCW_{67} < 2^{\circ}\text{C}$	C3
<b>GW4</b> Below 2°C		$PW_{50} < 2^{\circ}\text{C}$	$EoCW_{50} < 2^{\circ}\text{C}$	C4
<b>GW4</b> Below 2.5°C		$PW_{50} < 2.5^{\circ}\text{C}$	$EoCW_{50} < 2.5^{\circ}\text{C}$	C5
<b>GW6</b> Below 3°C		$PW_{50} < 3^{\circ}\text{C}$	$EoCW_{50} < 3^{\circ}\text{C}$	C6
<b>GW7</b> Below 3.5°C		$PW_{50} < 3.5^{\circ}\text{C}$	$EoCW_{50} < 3.5^{\circ}\text{C}$	Lower part of C7
<b>GW8</b> Above 3.5°C		$PW_{50} \geq 3.5^{\circ}\text{C}$	$EoCW_{50} \geq 3.5^{\circ}\text{C}$	Upper part of C7+C8

*Riahi et al. (under review)*



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