New research on 1.5ºC mitigation pathways with integrated assessment models (IAMs)

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Mitigation pathway analysis more relevant than ever

Climate Change Assessment (IPCC 6th Assessment Cycle)

Implementation of the Paris Agreement
• Nationally determined mitigation action (2030) and mid century strategies (2050) to limit warming to well below 2°C or even 1.5°C (2100)

Sustainable Development Pathways for informing the UN SDG Agenda

Climate-related financial risk
Task Force recommendations on financial disclosures

Business opportunities and targets for the low-carbon and sustainability transformation
Integrated Assessment Modelling

- Scenarios of future emissions
- Transformation pathways for mitigating climate change
- Exploring (co-)benefits & (co-)impacts of mitigation/emissions pathways

**Associating pathways with climate targets**

- Coupled energy-economy-land-climate-(water etc.) system
- All sectors (energy, transport, buildings, industry, AFOLU)
- All GHGs (CO$_2$, N$_2$O, CH$_4$, F-gases) and other climate forcers (e.g. aerosols, ozone)
- Global coverage (distinguishing 10-30 regions)
- Time horizon 2100
- *Progress needed: Representation of climate damages and adaptation*
Global Warming of 1.5°C

An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.
IPCC SR1.5 findings on 1.5°C pathways

- Requires substantial emissions reductions until 2030 and global net zero CO2 emissions by mid century
- If NDCs until 2030 are implemented, 1.5°C will be breached, even if supplemented by drastic emissions reductions thereafter.
- Requires transformational change at unprecedented scale in all sectors

Global total net CO2 emissions
Billion tonnes of CO₂/yr

- NDCs in 2030: 52-58 GtCO₂e/yr
- 1.5°C pathways: 25-30 GtCO₂e/yr
- 40-60% reductions of CO₂ wrt to 2010

Four illustrative model pathways

Timing of net zero CO2
Line widths depict the 5-95th percentile and the 25-75th percentile of scenarios

Source: IPCC Special Report on Global Warming of 1.5°C, Fig. SPM3a
The Story of 1.5°C & below 2°C Mitigation Pathways

- Peak in 2020
- Steep emissions reduction
- Carbon neutrality
- Net CO₂ removal
- Re-directing investments from fossils to low carbon and efficiency solutions
- Carbon neutral economy
  - Electrification of end uses
  - Challenges:
    - Freight transport, aviation, shipping
    - Heavy industry
- Power sector decarbonization
  - Coal phase-out
- Compensate residual emissions (incl. agricultural N₂O emissions)
- Compensate budget overshoot

To what extent is carbon dioxide removal needed?

Breakdown of contributions to global net CO₂ emissions in four illustrative model pathways

- Fossil fuel and industry
- AFOLU
- BECCS

**P1**: A scenario in which social, business, and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A downsized energy system enables rapid decarbonisation of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

**P2**: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

**P3**: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

**P4**: A resource and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

Demand-side measures (energy intensity, diets) and early emissions reduction reduce need for CDR

Source: IPCC SR1.5. Fig SPM3b
1.5°C vs 2°C: trade-offs: 1.5°C faster decarbonization, more CDR
→ Both sustainability risks and benefits of mitigation are amplified under 1.5°C in comparison to 2°C

- Dedicated policies can offset most of the risk increases and lead to even higher co-benefits
- The most important trade-offs are higher near-term costs and policy requirements

How to find short term entry points to 1.5°C / well below 2°C pathways?

→ Presentation by Niklas Höhne

Bertram et al. (2018) Targeted policies can compensate most of the increased sustainability risks in 1.5°C mitigation scenarios. Environ. Res. Lett. 13: 064038
Further resources

Primer on Climate Change Scenario Approaches: https://climatescenario.org/primer/
Developed by the SENSES project on scenario communication and visualization (senses-project.org)