Pathways to a sustainable future; governance of CO_2 removal & mitigation strategies for industry

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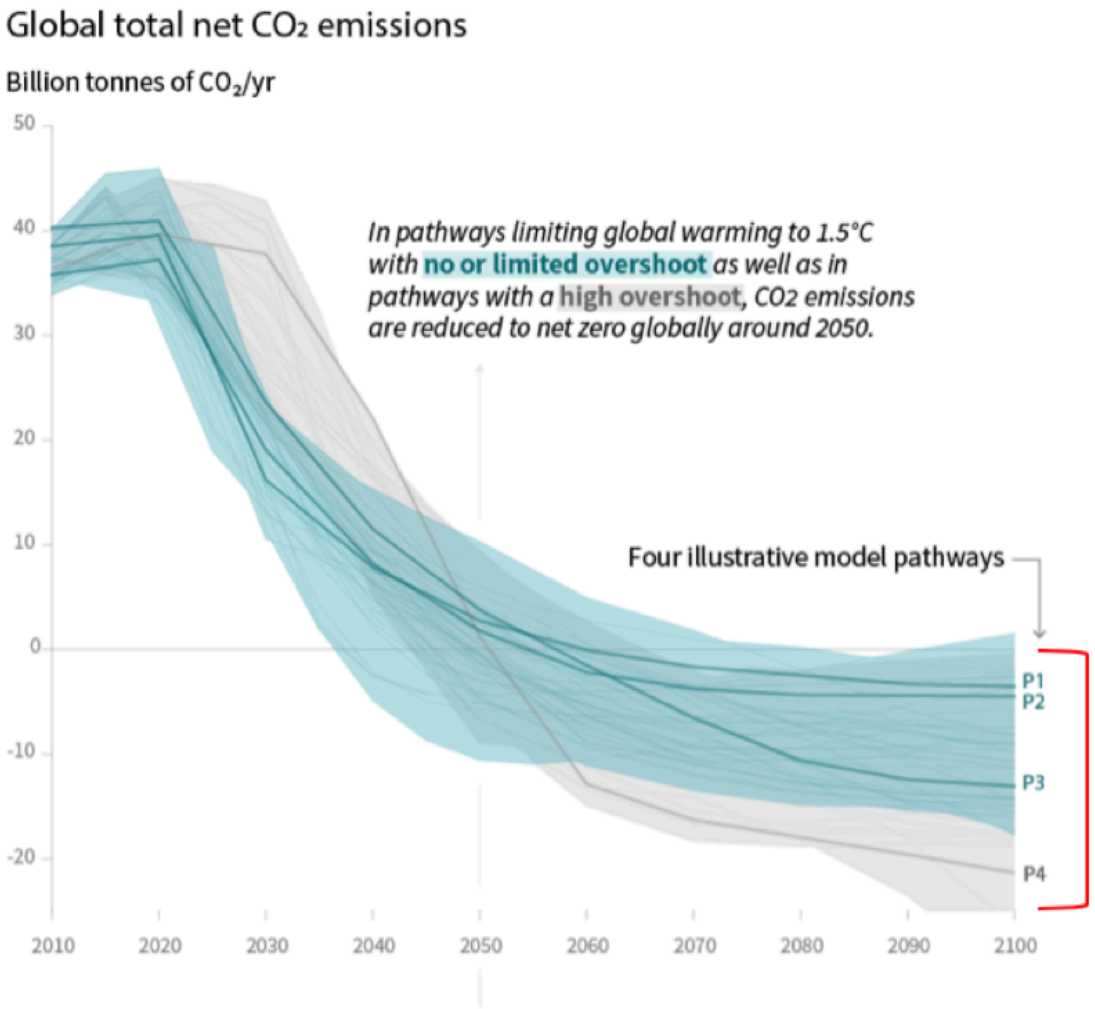
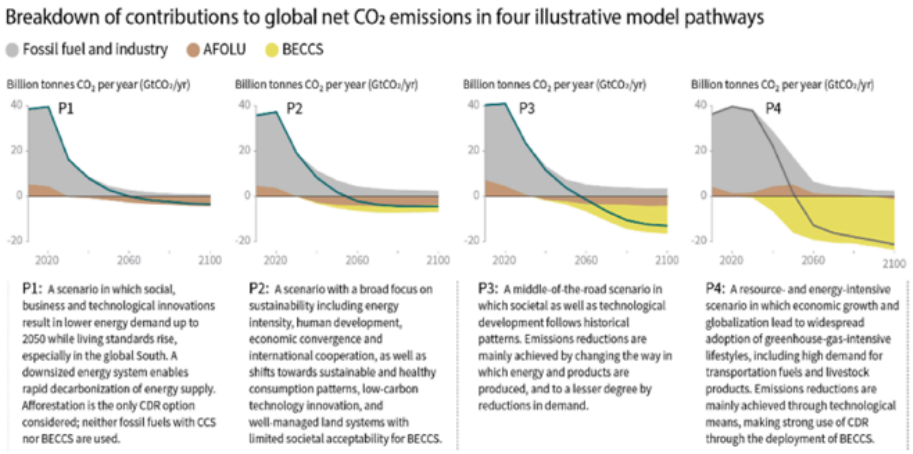
Global Warming of 1.5°C

- Not impossible to limit global warming to 1.5°C
  - Unprecedented transformation across all areas of society
    - Global net zero CO_2 emissions around 2050
    - Concurrent emission reduction of other non-CO_2 emissions
- Requires transformative systemic change
  - Upscalling and acceleration of far-reaching, multi-level and cross sectoral climate mitigation
  - Greater scale and pace of change to transform energy, land and ecosystems, urban and infrastructure, and industrial system transitions globally

Global Warming of 1.5ºC



Illustrative pathways for 1.5°C



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 decarbonization 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.

Pathways to limit warming to 1.5°C

- **Illustrative pathway P1** : scenario of low energy demand up to 2050, energy system that allow for rapid decarbonization of energy supply
  - Use of CDR is limited : only afforestation/reforestation
- **Illustrative pathway P4** : resource and energy intensive scenario with high demand for transportation fuels and livestock products
  - Substantial reliance on CDR measures
    - Bionergy with Carbon Capture and Storage
    - Afforestation and Reforestation

Robert van Waarden / Aurora Photos

How do we get there: industrial transitions

- Energy efficiency
- Electrification and hydrogen
- Industrial carbon capture, utilization and storage
- Bio-based industry
- Circular economy

Executive Summary, Chapter 4, SR 1.5°C

- Electrification, hydrogen, bio-based feedstocks and substitution, and, in several cases, carbon dioxide capture, utilization and storage would lead to the deep emissions reductions required in energy-intensive industries to limit warming to 1.5°C.
- Options limited by institutional, economic and technical constraints, which increase financial risks to many incumbent firms (medium evidence, high agreement).
- Energy efficiency in industry is more economically feasible and helps enable industrial system transitions
  - Need to be complemented with greenhouse gas (GHG)-neutral processes or carbon dioxide removal (CDR) to make energy-intensive industries consistent with 1.5°C

Governance aspects

- Whether CDR (and bioenergy in general) has large adverse impacts on environmental and societal goals depends in large part on the **governance of land use**.
  - accountable multilevel governance that includes non-state actors, such as industry, civil society and scientific institutions
  - improved climate education and greater public awareness
  - arrangements to enable accelerated behaviour change
  - strengthened climate monitoring and evaluation systems

- Governance challenges have been related to scenarios with high inequality and high population growth in the 1.5°C pathway literature