

Where are we in the global energy transition?

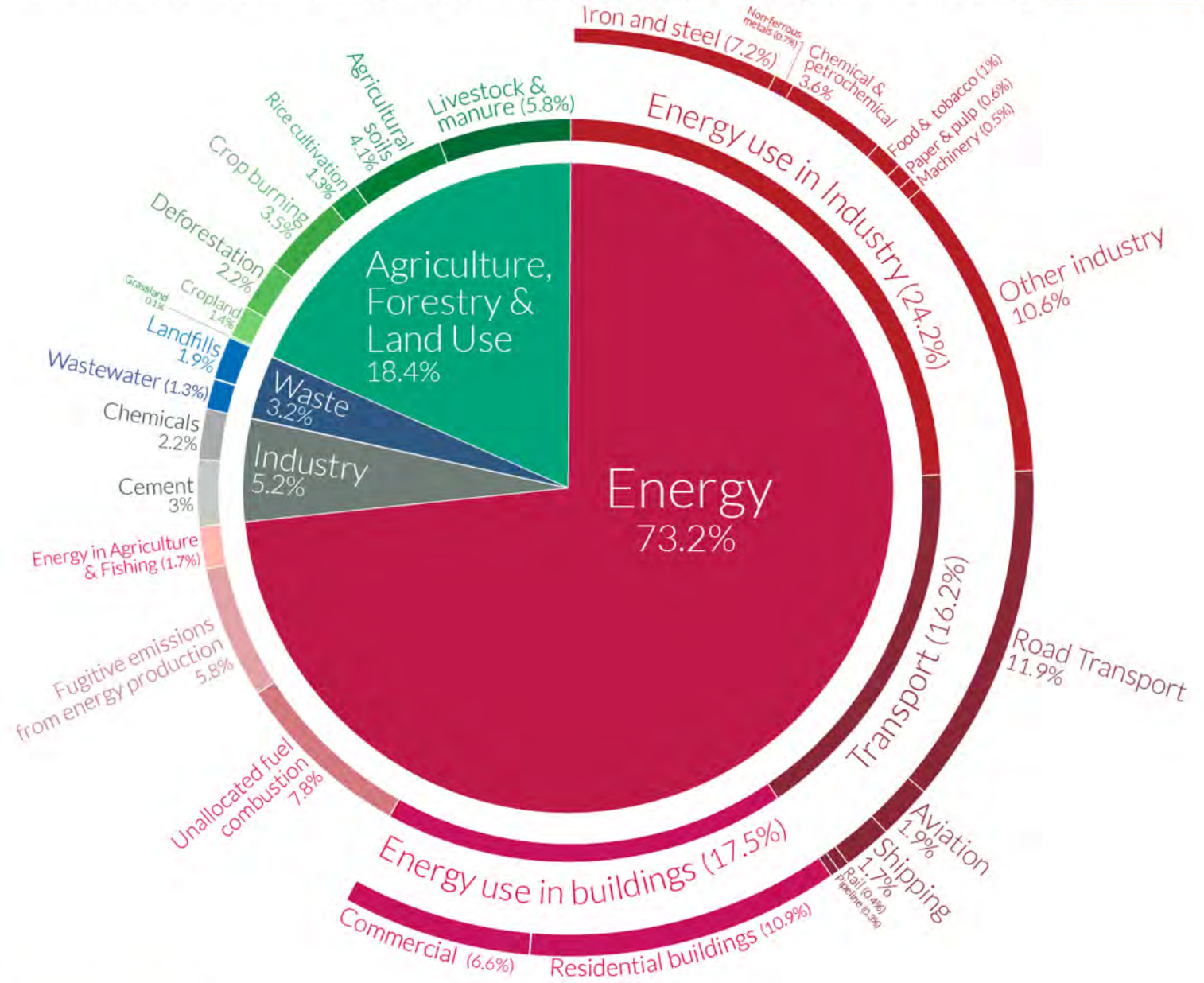
Sergey Paltsev
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Conference
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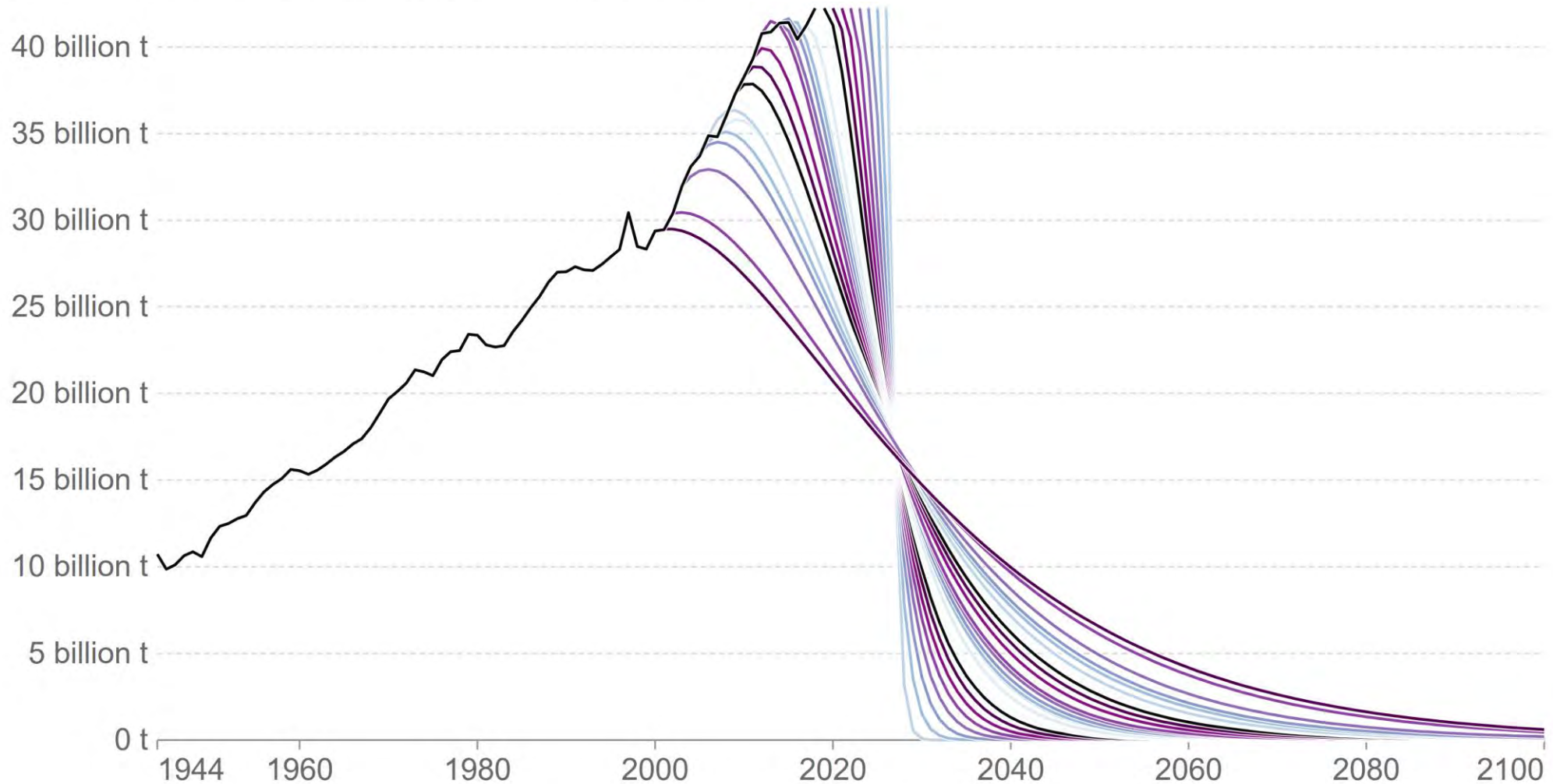
Global greenhouse gas emissions by sector

This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO₂eq.



CO₂ reductions needed to keep global temperature rise below 1.5°C

Annual emissions of carbon dioxide under various mitigation scenarios to keep global average temperature rise below 1.5°C. Scenarios are based on the CO₂ reductions necessary if mitigation had started – with global emissions peaking and quickly reducing – in the given year.



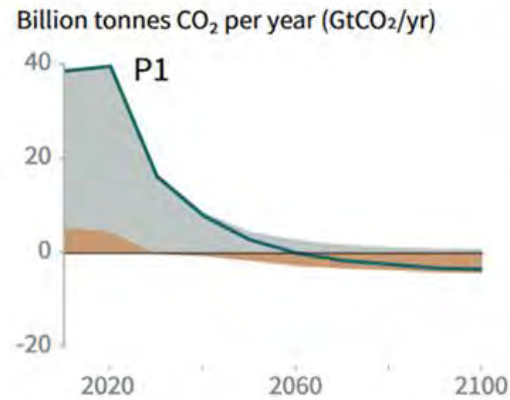
Source: Robbie Andrews (2019); based on Global Carbon Project & IPCC SR15
Note: Carbon budgets are based on a >66% chance of staying below 1.5°C from the IPCC's SR15 Report.
OurWorldInData.org/co2-and-other-greenhouse-gas-emissions • CC BY



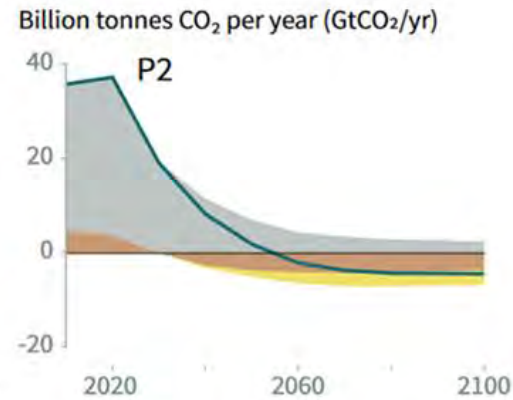
The world has to decarbonize...

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

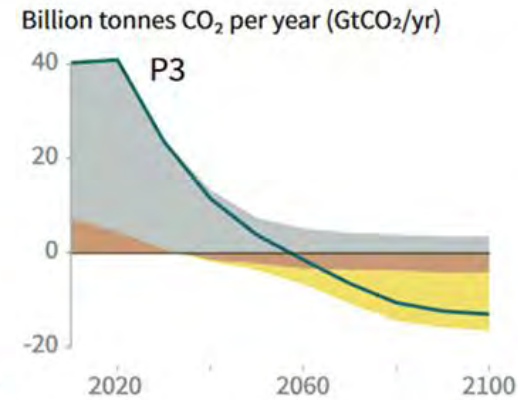
● Fossil fuel and industry ● AFOLU ● BECCS



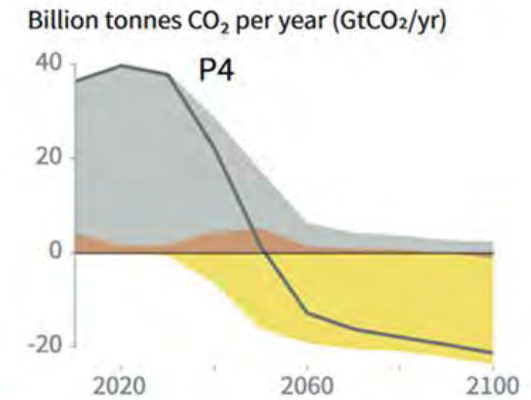
P1: A scenario in which social, business and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A downsized energy system enables rapid decarbonization of energy supply. Afforestation is the only CDR option considered; neither 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.

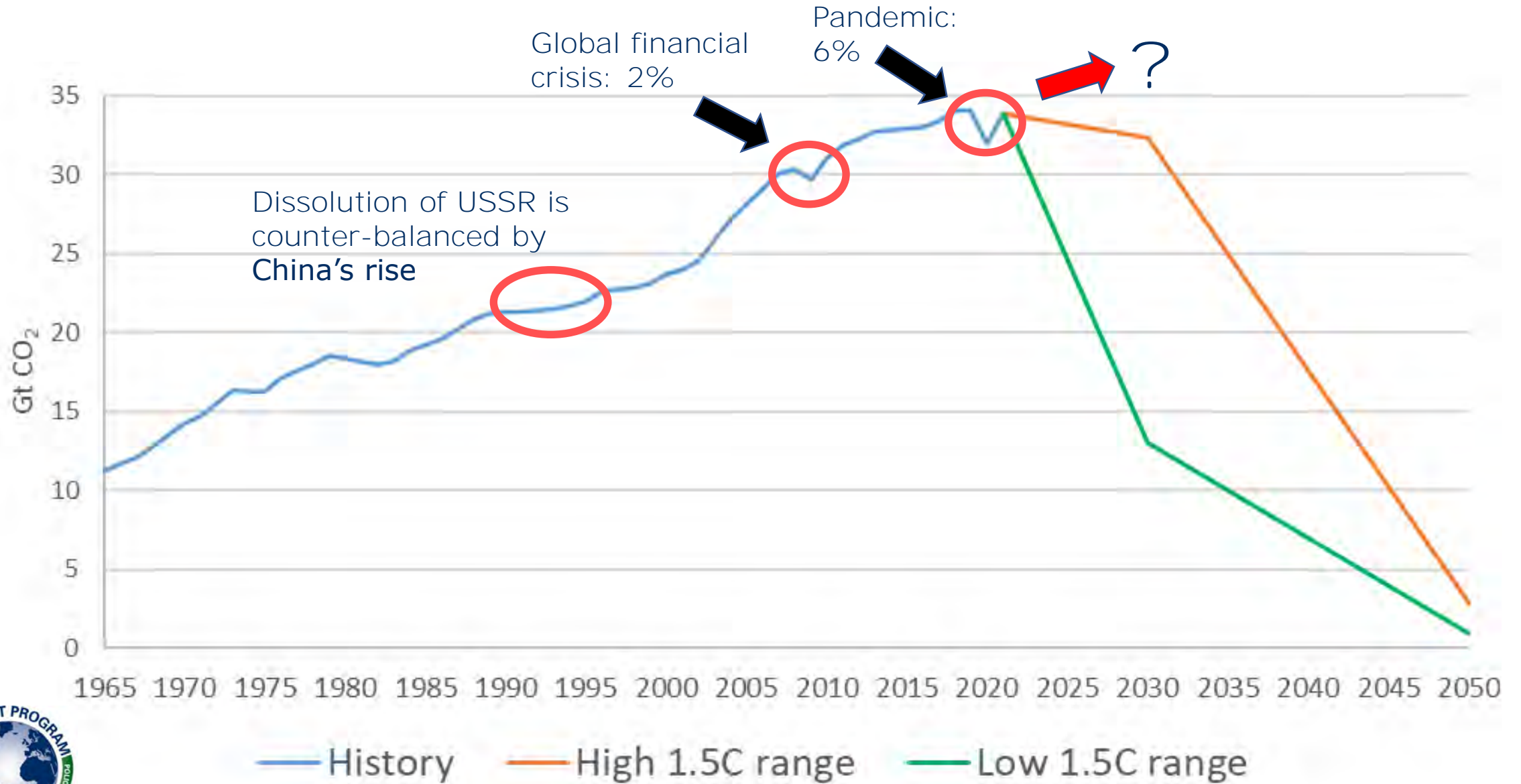


P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

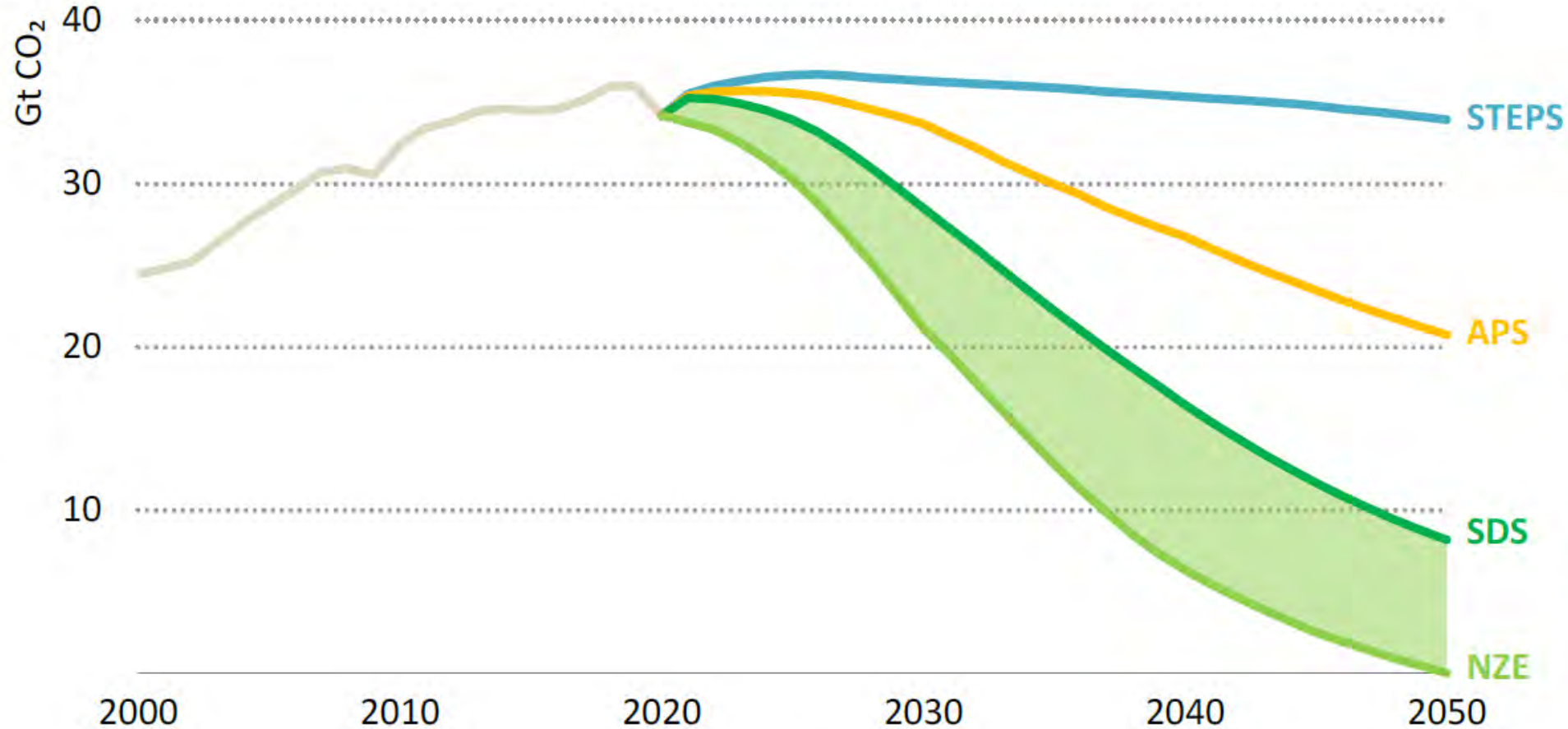


P4: A resource- and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas-intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making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

...at an unprecedented pace



IEA 2021 World Energy Outlook: Goals vs Reality



STEPS (Stated Policies Scenario) reflects current policy settings

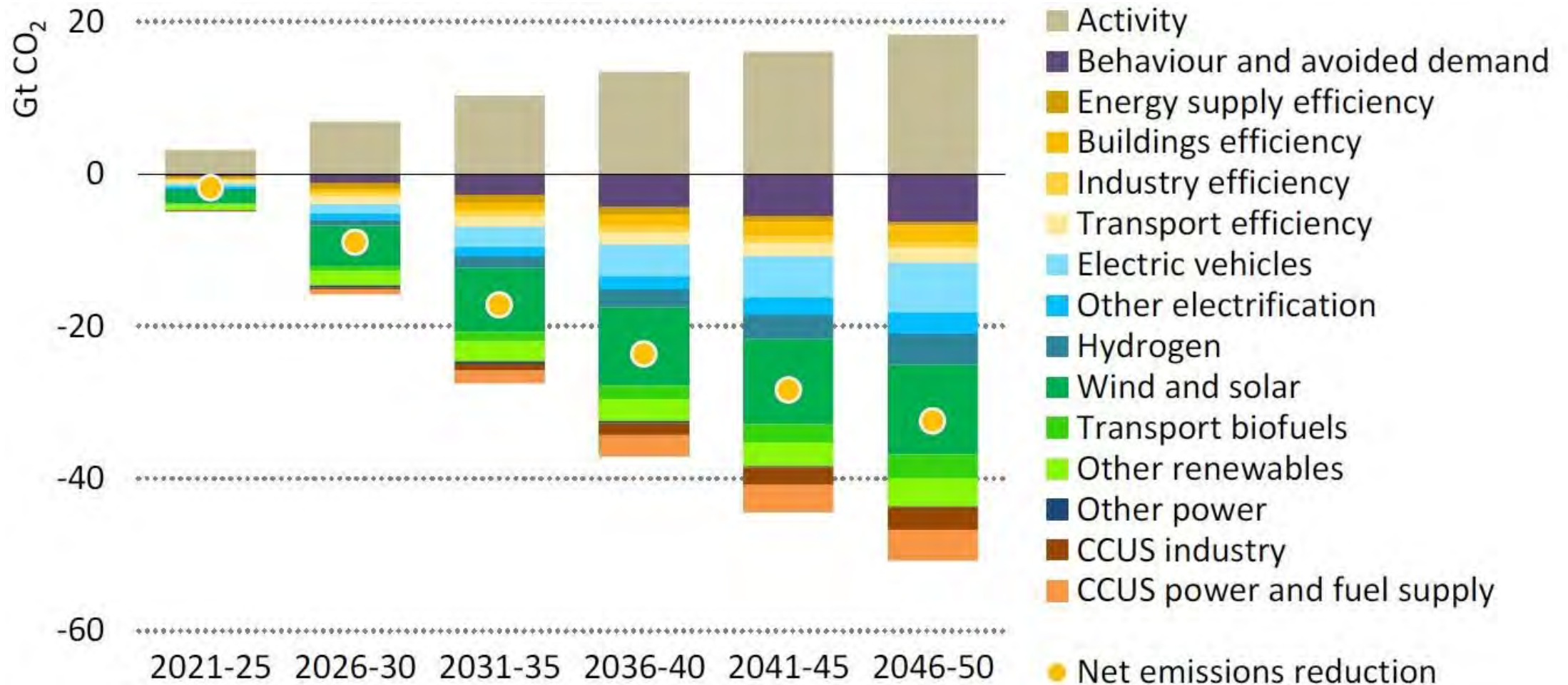
APS (Announced Pledges Scenario) assumes that all NDCs and longer term targets are met

SDS (Sustainable Development Scenario) meets UN SDGs

NZE (Net zero Emissions by 2050) for global energy sector



Wide range of measures and technologies are needed



IEA. All rights reserved.

Source: IEA Net Zero by 2050 (2021)





Power sector

- Nuclear fusion
- Next-generation energy storage
- Carbon Capture and Storage (CCS)



Industry

- Hydrogen in steelmaking
- Iron ore electrolysis
- Carbon Capture and Storage (CCS)



Transport

- Hydrogen aviation/shipping
- Hyperloops
- Advanced biofuel supply
- Next-generation energy storage



Buildings

- Alternative building materials for steel and cement

Carbon removal



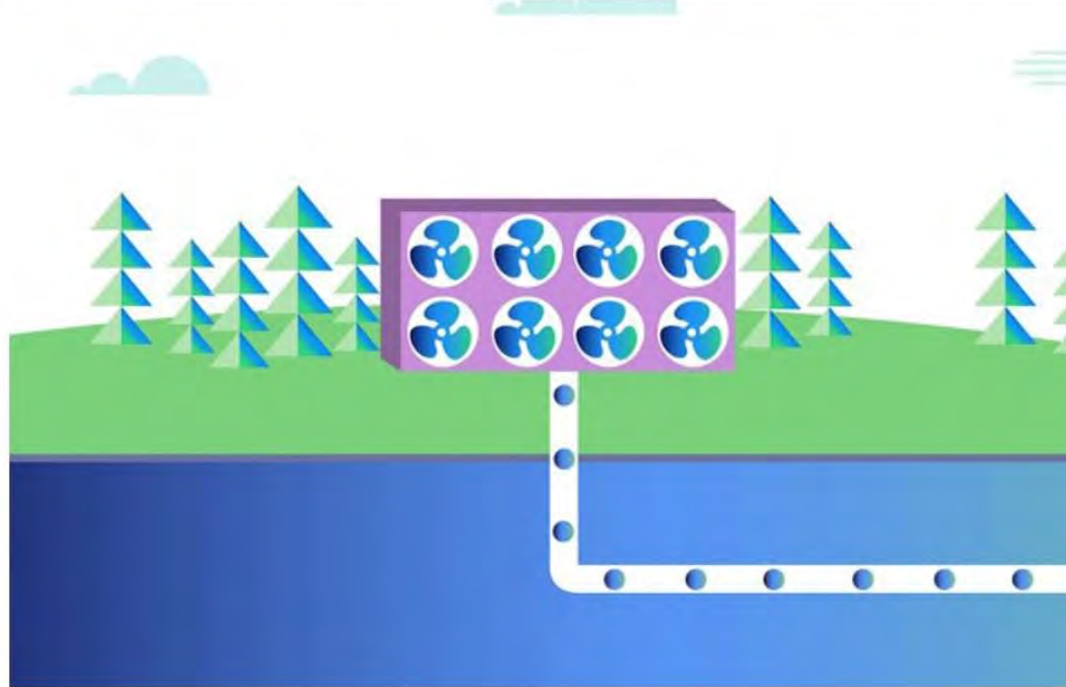
- Bio-char
- Ocean liming
- Direct Air Carbon Capture (DACC)
- Biomass Carbon Capture and Storage (BECCS)

Also important: Demand Side Management

Graphics: EPFL

Technological readiness in net-zero scenarios?

<https://globalchange.mit.edu/news-media/jp-news-outreach/affordable-direct-air-capture-myth-or-reality>



Jun 08, 2022

Affordable direct air capture: myth or reality?

MIT seminar explores economic feasibility of technology that could play a key role in the energy transition

By Mark Dwortzan | MIT Joint Program on the Science and Policy of Global Change



<https://globalchange.mit.edu/news-media/jp-news-outreach/affordable-direct-air-capture-myth-or-reality>

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The economics of bioenergy with carbon capture and storage (BECCS) deployment in a 1.5 °C or 2 °C world

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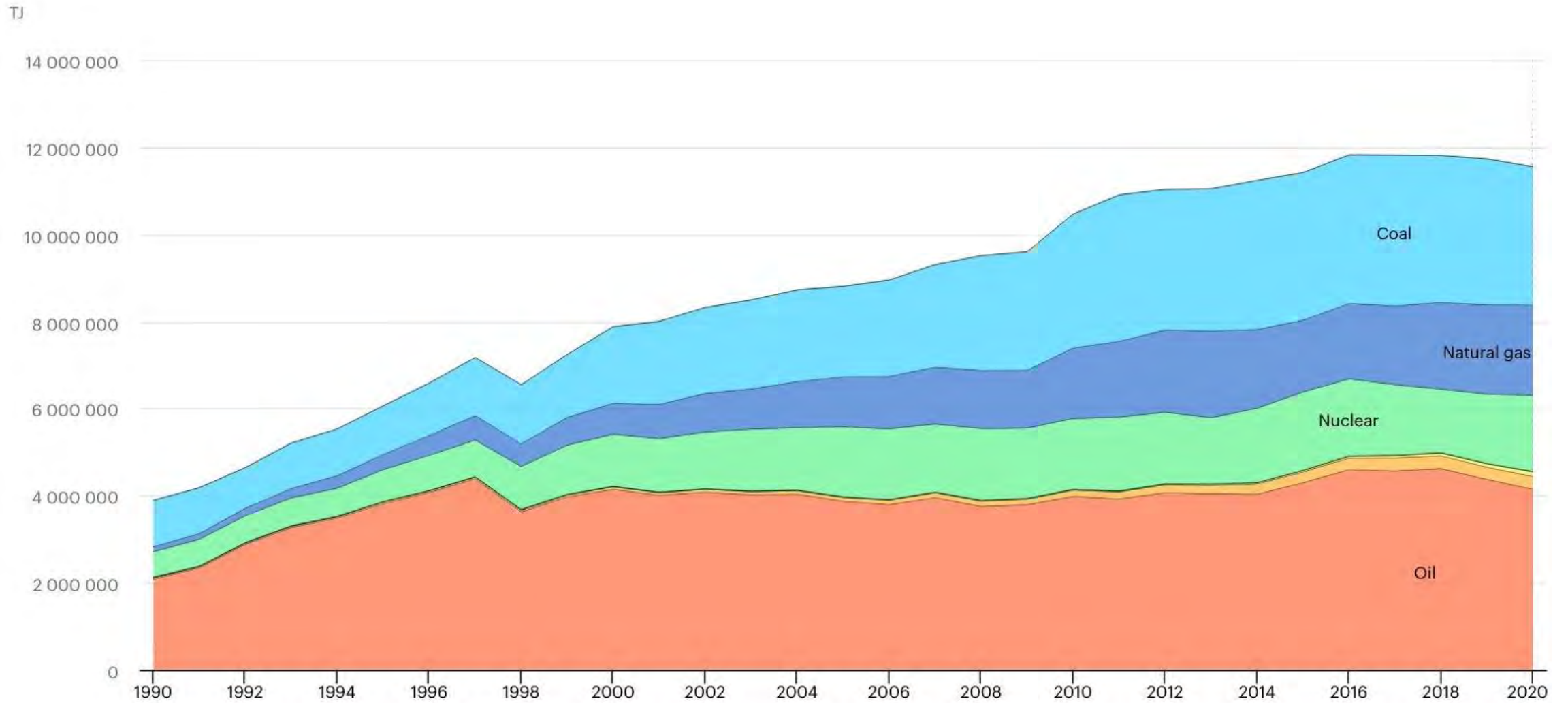
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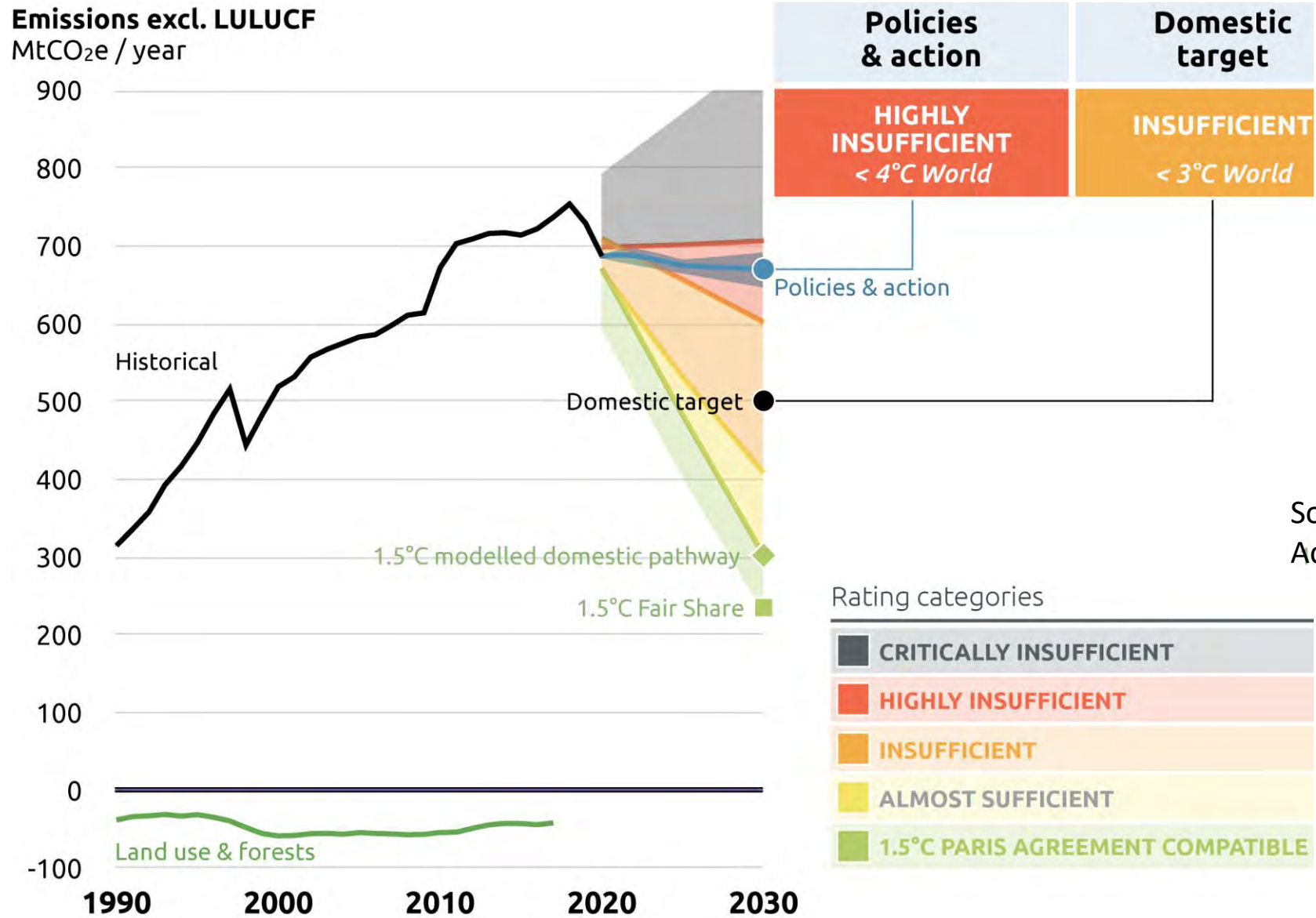
Korea's primary energy (1990-2020)

Source: IEA (2022)



Coal Natural gas Nuclear Hydro Wind, solar, etc. Biofuels and waste Oil

Korea's targets: 2030 - 40% below 2018 levels; 2050 – net zero



Source: Climate Action Tracker (2022)



<https://globalchange.mit.edu/publication/17279>

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THE ECONOMIC, ENERGY, AND EMISSIONS IMPACTS OF CLIMATE POLICY IN SOUTH KOREA

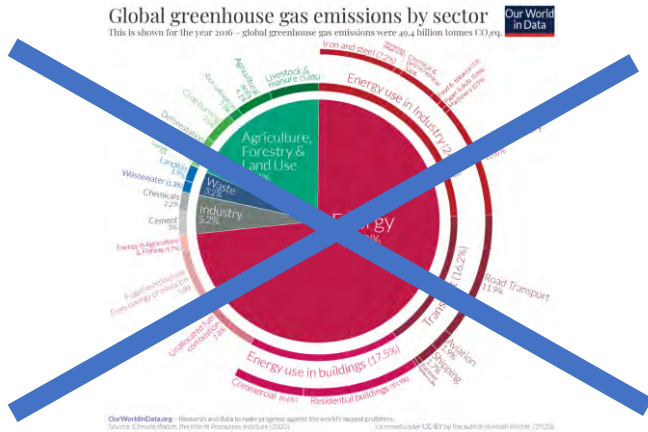
While focusing on the previous Korea's NDC targets for 2030, the paper finds that:

“From the perspective of the GHG price required, the South Korean NDC is among the most ambitious.”



How do we get to net-zero emissions? How quickly?

Pledges by numerous governments and companies to reach **net-zero** greenhouse gas (GHG) emissions, **but Action Plans are needed**



Opportunities and challenges for **scalable** low-carbon energy options

Economic: Do we have technologies? Are they economically competitive? Do we have policies to support them? Lifestyle changes?

Geopolitical: Impacts of de-carbonization on other goals? COVID implications for a rise of protectionism? Stability of energy exporters? Impacts of Russia-Ukraine war?

Environmental: Physical risks from climate change will be there regardless of emission reduction. Impacts from low-carbon options (e.g., car battery recycling). Minerals for clean energy transition.

Thank you

Questions or comments?

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