Mitigation: Key messages from the IPCC 6th assessment

How knowledge from climate, engineering and social science is combined to provide insights on mitigation policies

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IPCC Working Group III Sixth Assessment Report (2022)

278 lead authors

65 countries

41 % developing countries
59 % developed countries

29% Women
71% Men

More than
18,000 scientific articles

59,212 comments

Content

https://www.ipcc.ch/report/sixth-assessment-report-working-group-3/

Summary for policymakers

https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_SummaryForPolicymakers.pdf

Technical Summary

https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_TechnicalSummary.pdf

Full Report

https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_FullReport.pdf

1: Introduction and Framing
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4: Mitigation and development pathways in the near- to mid-term
5: Demand, services and social aspects of transformation
6: Energy systems
7: AFOLU
8: Urban systems and other settlements
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10: Transport
11: Industry
12: Responses across and beyond sectors
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14: International cooperation
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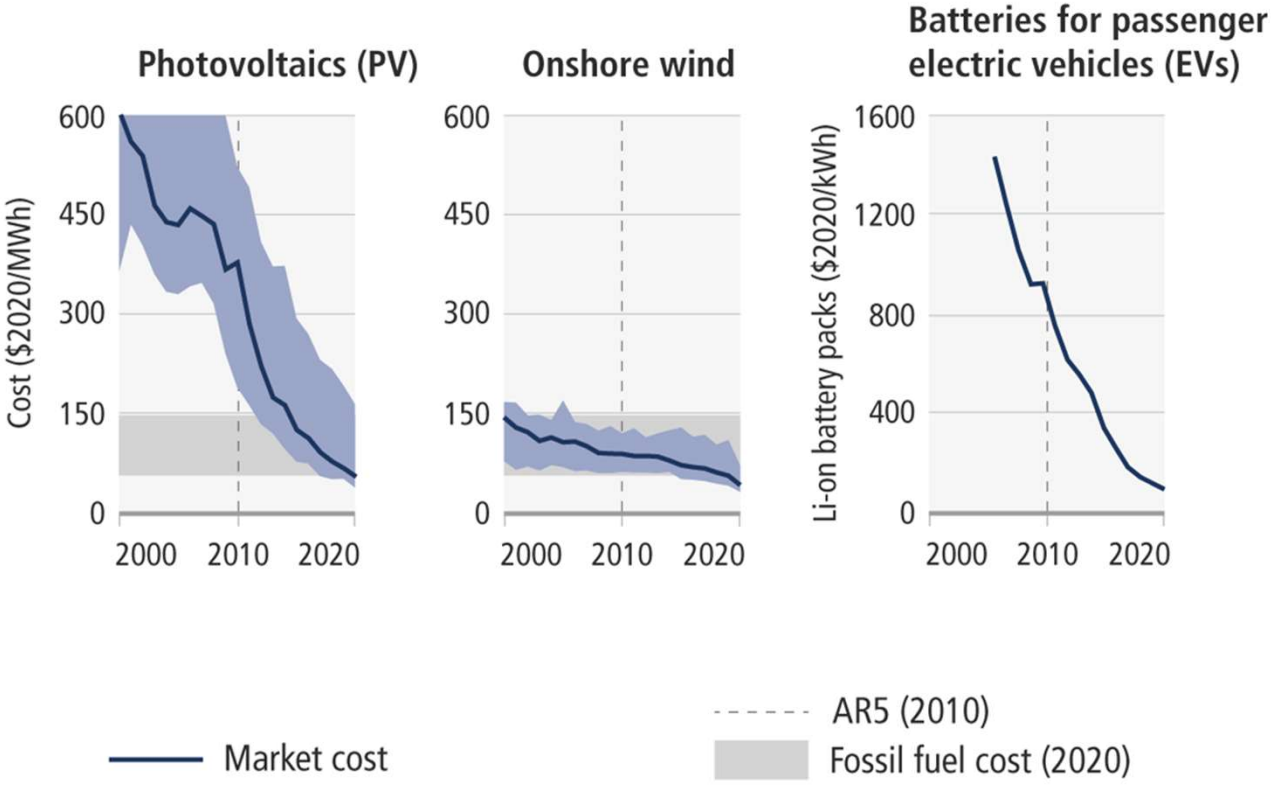
16: Innovation, technology development and technology transfer
17: Accelerating the transition in the context of sustainable development

Looking backward, we see increased evidence of climate action

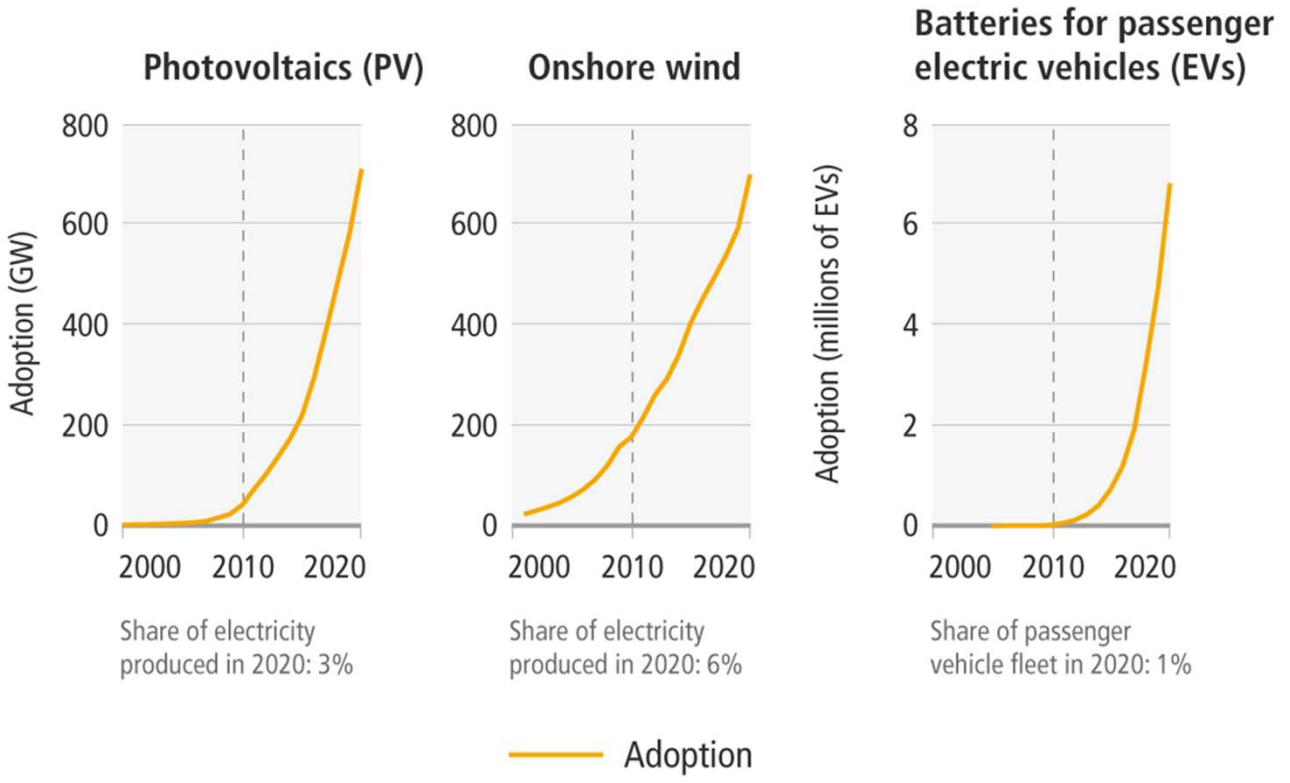
30+ countries have achieved a steady decrease in emissions consistent with limiting warming to 2°C.

Zero emissions targets have been adopted by at least 826 cities and 103 regions

More than half of the World's GHG emissions in the scope of a regulation



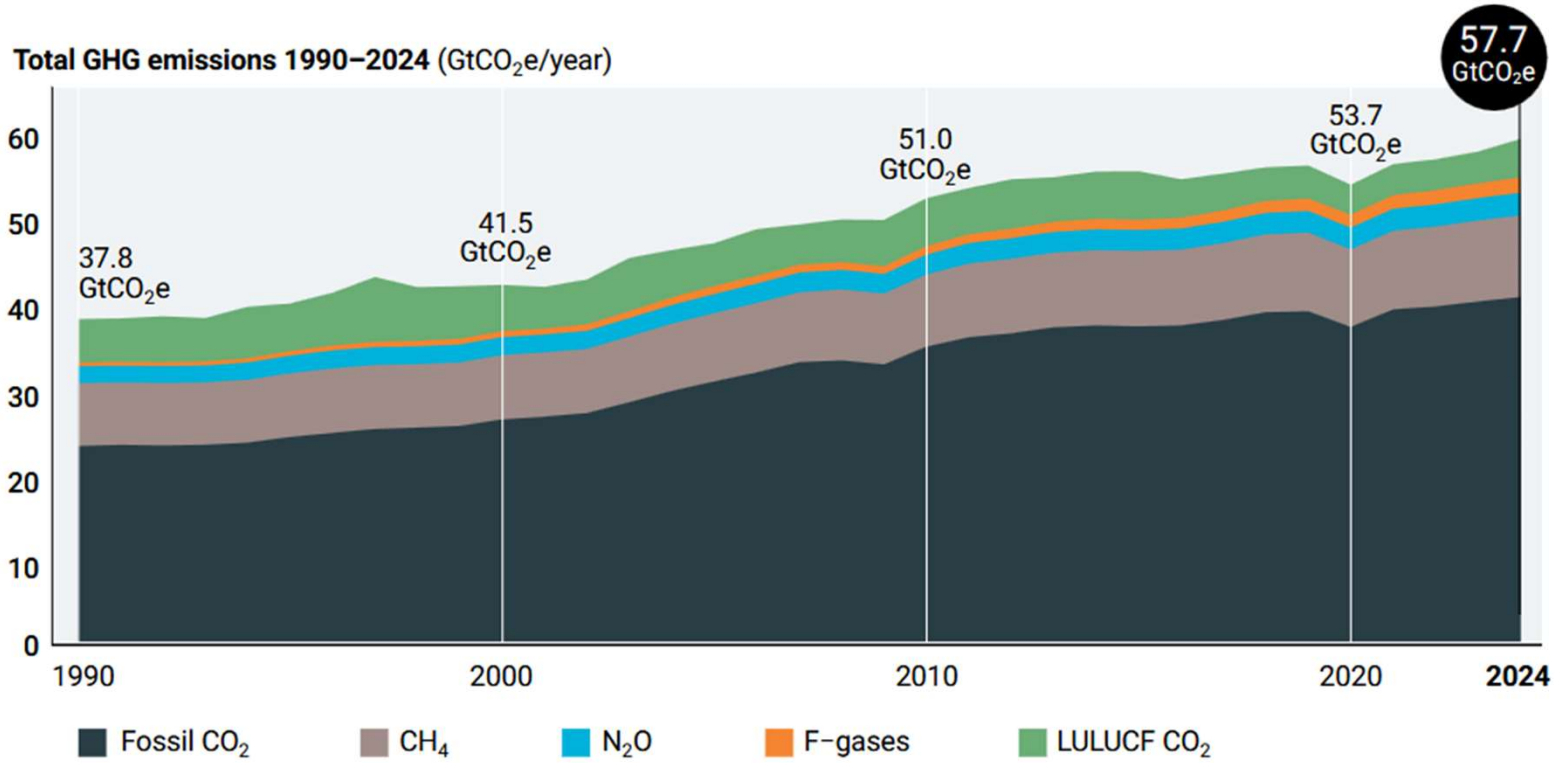
In some cases, costs for renewables have fallen below those of fossil fuels.



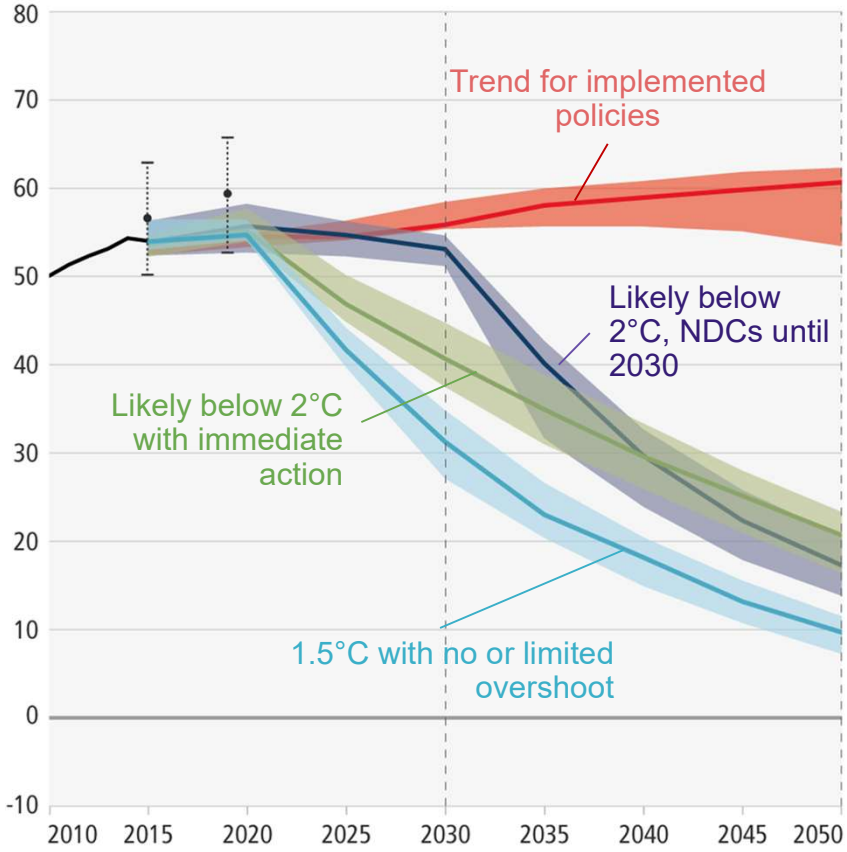
Electricity systems in some countries and regions are already predominantly powered by renewables.

Global emissions keep growing, albeit less rapidly

Figure 2.1 Total net anthropogenic GHG emissions by gas, 1990–2024 (UNEP Gap Report 2025)



Sources: Crippa *et al.* (2025) for non-LULUCF emissions, Friedlingstein *et al.* (2025) for LULUCF emissions



Looking forward, limiting warming to 1.5 °C entails

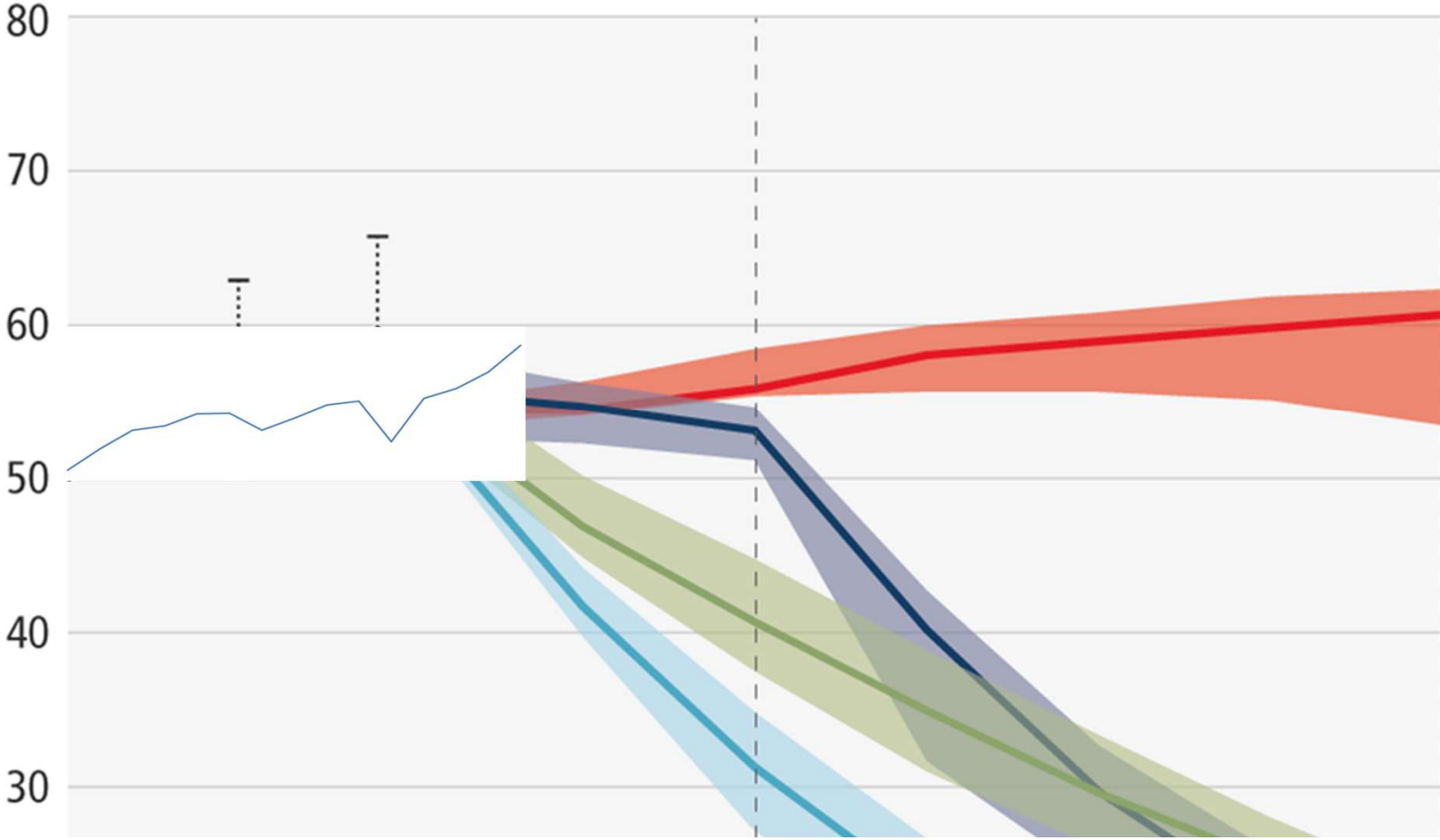
- Global GHG reduced by 43% by 2030.
- Methane reduced by 34% by 2030

Limiting warming to around 2°C

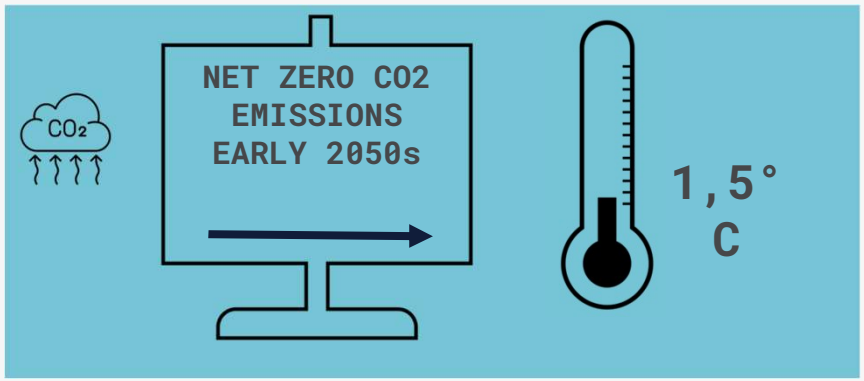
- Global GHG emissions reduced by 27% by 2030

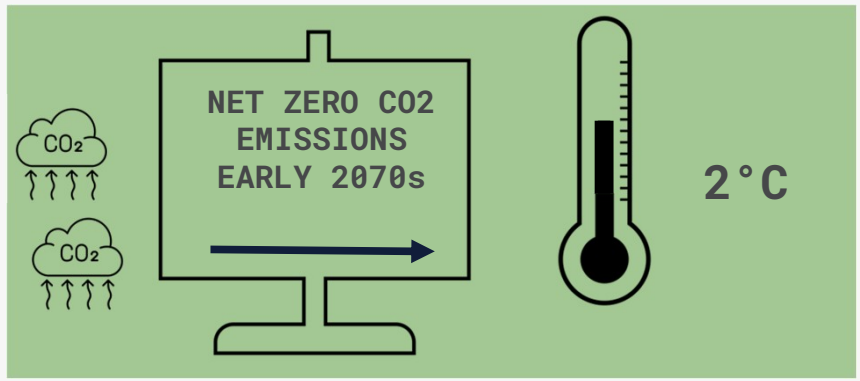
(based on IPCC assessed scenarios)

Current emissions are on the higher end of the range



Temperature will stabilize when net zero carbon dioxide emissions is reached





(based on IPCC-assessed scenarios)

Method: Combining knowledge to produce scenarios

WG3 community asks questions such as: If we adopt policy x, how will emissions respond? At what cost? The answer depends on parametric and structural assumptions about e.g., economic and social dynamics, technical change, demography, policies, etc.

We develop scenarios to **assess robustness** → large ensembles, completeness

Scenarios also **provide consistency** across WGs → small set, translation

And scenarios also help **explore specific worlds** → small set, specifics

Scenarios are useful to **communicate** (e.g., in IPCC summary for policymakers), and they are **used outside of academia** (e.g. stress tests for banks).

➔ A broad range of different scenarios to serve different purposes

A construction process combining models and expertise across disciplines

Before 2010

Socio-economy → emissions → climate → impacts

IAM **ESM** **Impact models**

Since 2010

Socio-economy ← *representative concentration pathways* → climate → impacts

IAM ↑ **ESM** **Impact models**

Shared socio-economic pathways

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

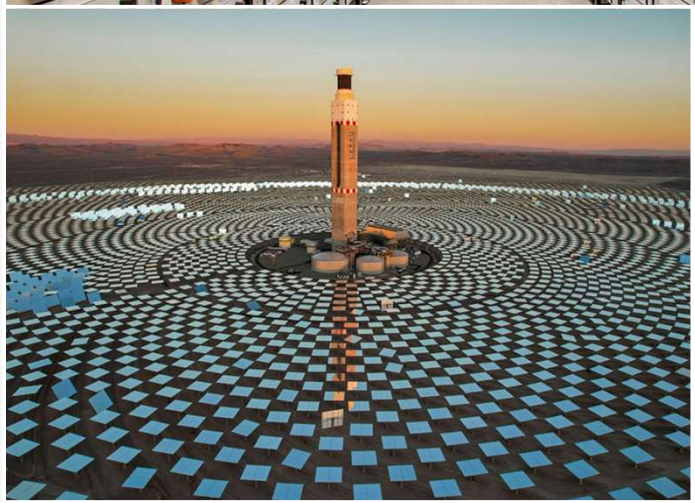
There are options available **now** in every sector that can at least **halve** emissions by 2030 at reasonable cost (< \$100/tCO_2)

Demand and services

Energy **Land use** **Industry** **Urban** **Buildings** **Transport**

Energy

- **major transitions** are required to limit global warming
- reduction in fossil fuel use and use of carbon capture and storage
- low- or **no-carbon** energy systems
- widespread **electrification** and improved energy **efficiency**
- **alternative fuels**: e.g. hydrogen and sustainable biofuels
- Key issue: existing capital stock and stranded assets


Demand and services

- potential to **bring down** global **emissions** by **40-70%** by 2050
- walking and cycling, electrified transport, reducing air travel, and adapting houses make large contributions
- **lifestyle changes** require **systemic changes** across all of society
- **some** people require additional **housing**, **energy** and **resources** for human wellbeing

[Bosch, Unsplash/Yoav Aziz, Adam Bartoszewicz, Victor Hernandez]

Carbon Dioxide Removal

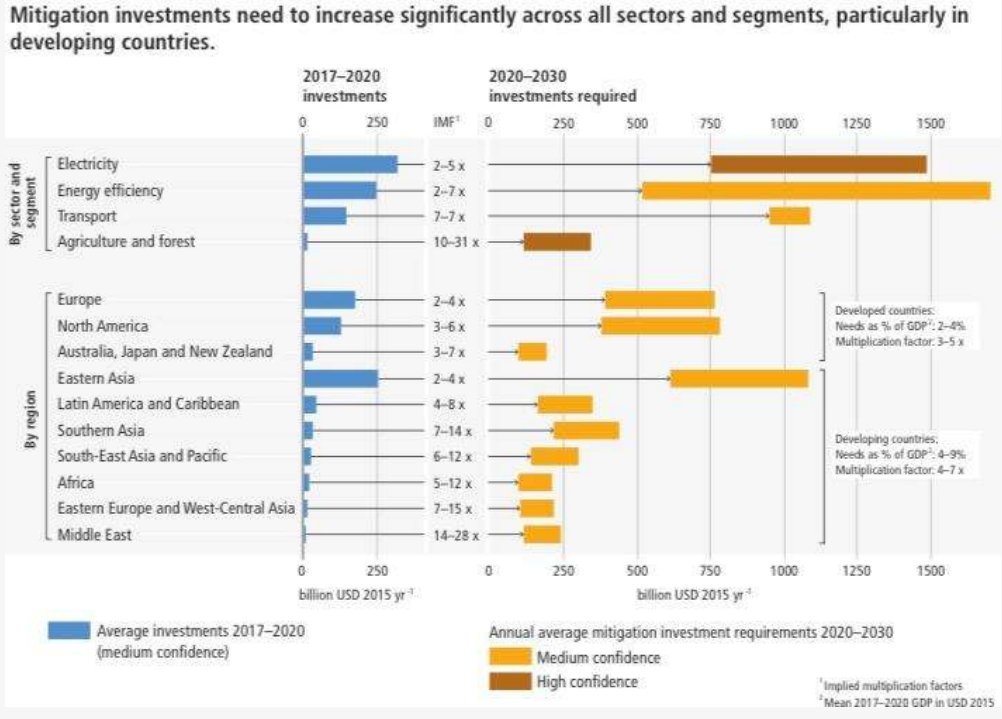
- required to **counterbalance hard-to-eliminate** emissions
- through **biological** methods: reforestation, and soil carbon sequestration
- **new technologies** require more **research**, up-front **investment**, and proof of concept at **larger scales**
- **essential** to **achieve net zero**
- **agreed methods** for measuring, reporting and verification required

[Forest Service Northern Region CC BY 2.0, Fiston Wasanga/CIFOR CC BY-NC-ND 2.0, Climeworks]

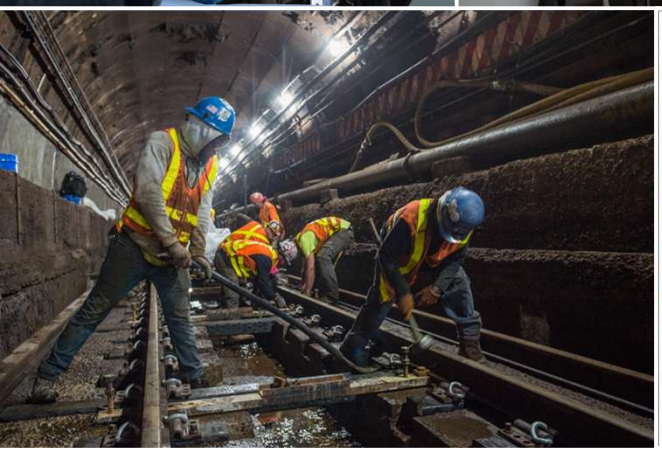


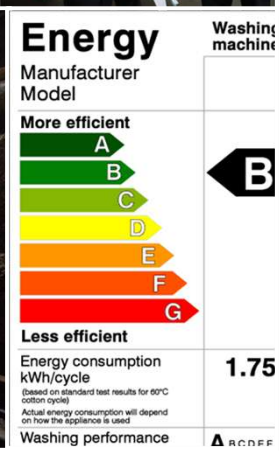
Closing investment gaps

- financial flows: **3-6x lower** than levels needed **by 2030** to limit warming to below 1.5°C or 2°C
- there is **sufficient global capital** and liquidity to close investment gaps
- challenge of closing gaps is widest for developing countries
- Resources for adaptation are also insufficient



[Tobias/Unsplash, Rwanda Green Fund /CC BY-SA 2.0]



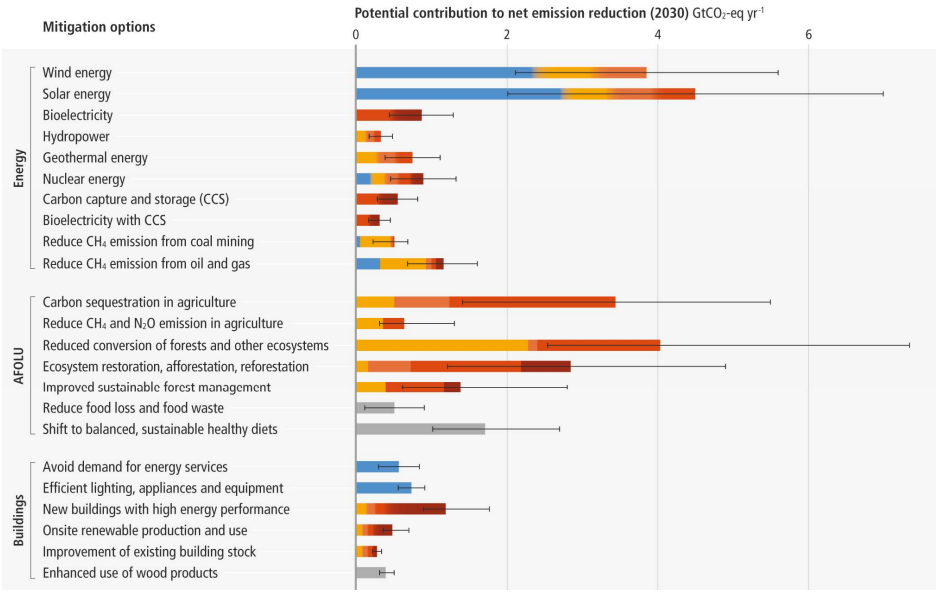


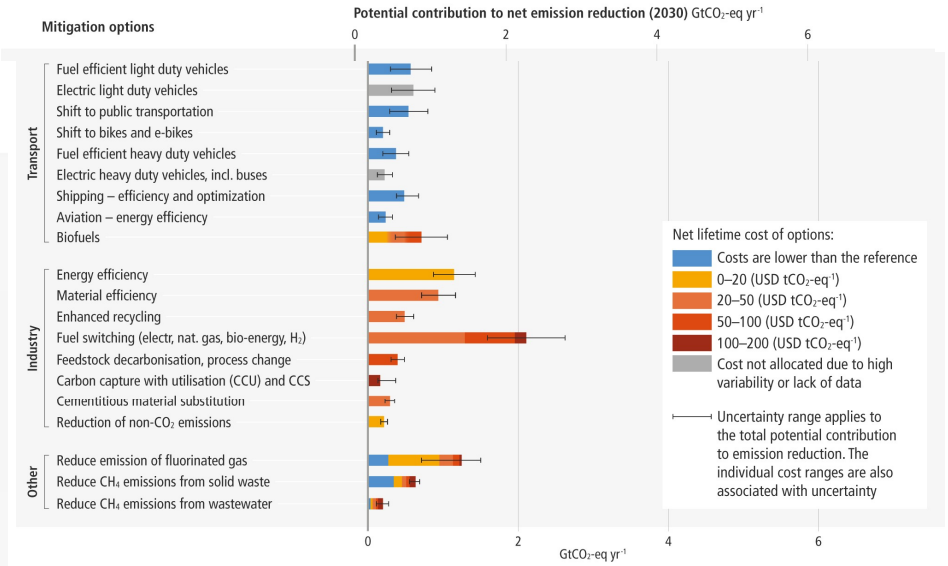
Policies, regulatory and economic instruments

- regulatory and economic instruments have **already proven effective** in reducing emissions
- **policy packages** and **economy-wide packages** are able to achieve **systemic change**
- ambitious and effective mitigation requires **coordination across government** and society
- Many institutional barriers to mitigation

[World Bank/Simone D. McCourtie, Dominic Chavez CC BY-NC-ND 2.0, Trent Reeves/MTA Construction & Development CC BY 2.0, IMF Photo/Tamara Merino CC BY-NC-ND 2.0, Olga Delawrence/Unsplash.]

Mitigation potential up to 2030 ($btCO_2$/yr)





- Based on bottom-up literature on mitigation costs
- System-wide effects are not taken into account
- Not a roadmap for action

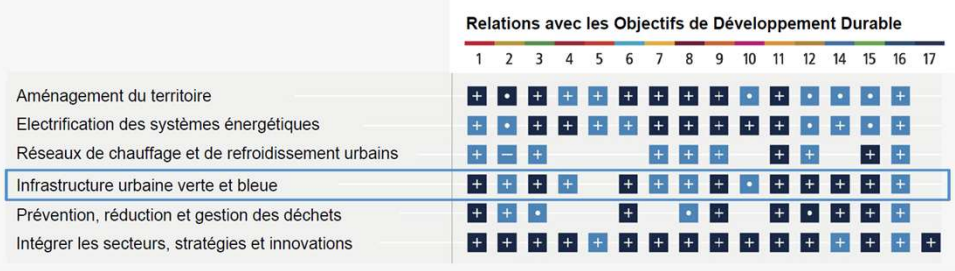
Source : Figure SPM7. IPCC, 2022: Summary for Policymakers [P.R. Shukla, J. Skea, A. Reisinger, R. Slade, R. Fradera, M. Pathak, A. Al Khourdajie, M. Belkacemi, R. van Diemen, A. Hasija, G. Lisboa, S. Luz, J. Malley, D. McCollum, S. Some, P. Vyas, (eds.)]. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.001.

On the no regret potential

- Many mitigation actions pass the cost-benefit test, but are not implemented
- Among the reasons that can explain this puzzle:
  - Implementation takes time, e.g., renewables
  - Financing constraints, e.g., upfront costs of heat pumps
  - Bounded rationality, e.g., low consumption lightbulbs
  - Transaction costs, e.g., apartment building retrofit
  - Information asymetry, e.g., wall insulation
  - Technical constraints, e.g., lack of individual energy metering
  - Split incentives, e.g., landlord – tenant dilemma
- A ‘negative’ cost (in the engineering sense) does not imply automatic adoption
- Beyond financing, one needs to identify and overcome barriers to action

Mitigation impacts on other development goals

- Accelerating mitigation is required to meet other SD goals
- **Macroeconomic impact of mitigation is in general modest** relative to baseline GDP trends
- Net impact of mitigation on employment is in general limited, or even slightly positive, but with wide disparities across sectors and regions. Ensuring a just transition is critical.
- Mitigation and adaptation have positive co-benefits for other SDGs.
- **Conversely, advancing towards the achievement of other SDGs can yield mitigation benefits**



Thank you for your attention