Sixth Assessment Report
WORKING GROUP III – MITIGATION OF CLIMATE CHANGE

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Climate Change 2022

IPCC's Mitigation Assessment: Conclusions from AR6 and Future Challenges

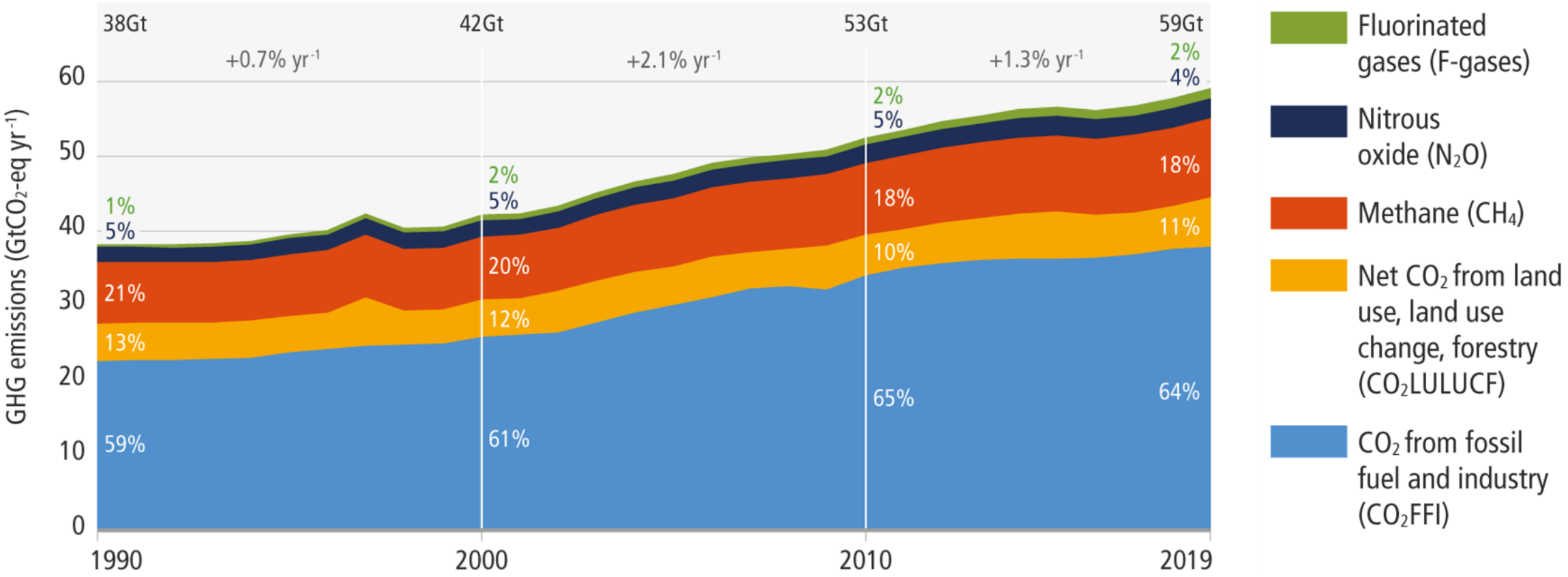
IPCC Symposium
Tokyo, 19 May 2022

Jim Skea, IPCC WG III Co-Chair

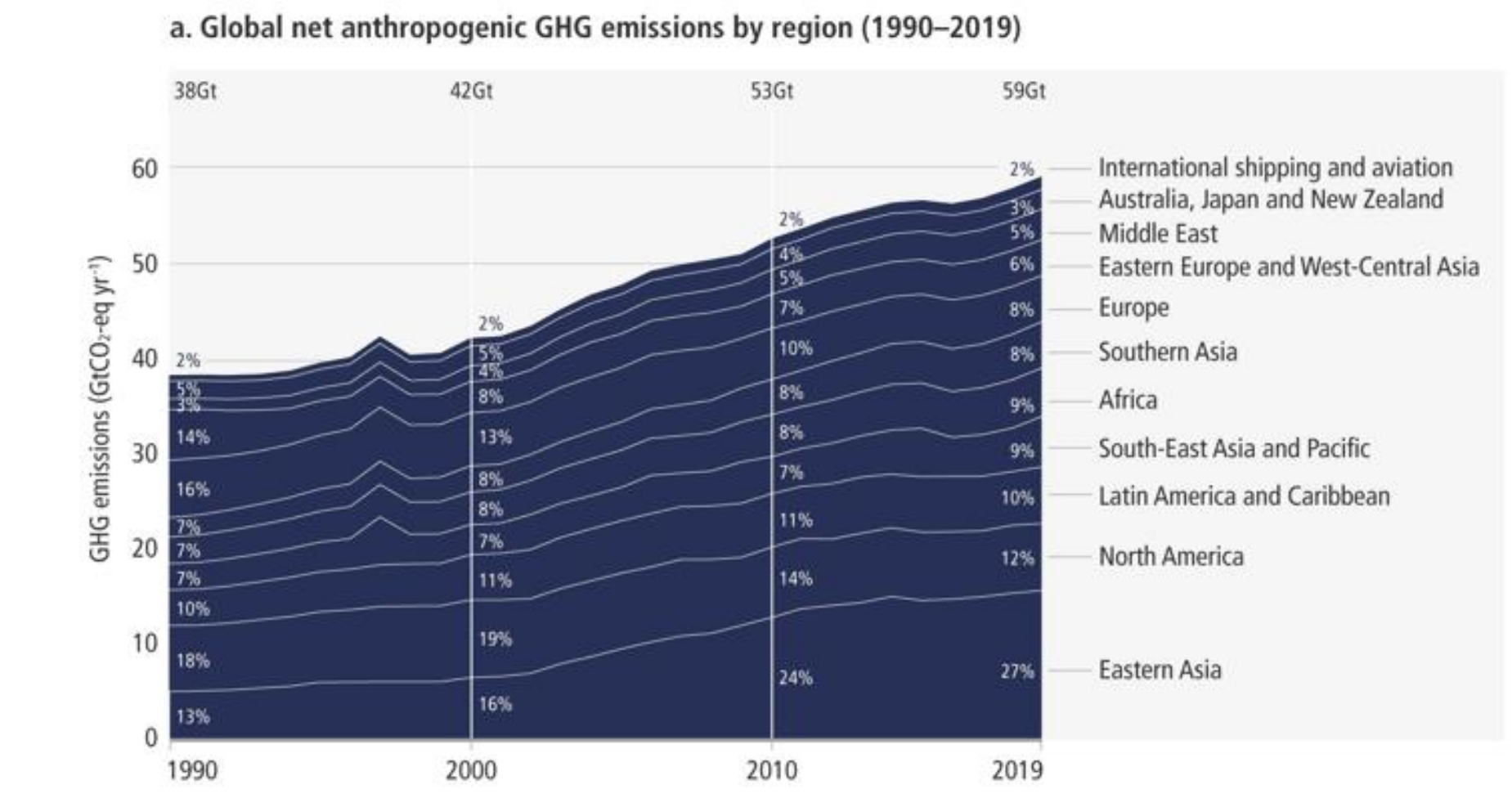
[Matt Bridgestock, Director and Architect at John Gilbert Architects]

We are not on track to limit warming to 1.5°C

Average annual GHG emissions during 2010–19 were the highest in human history..

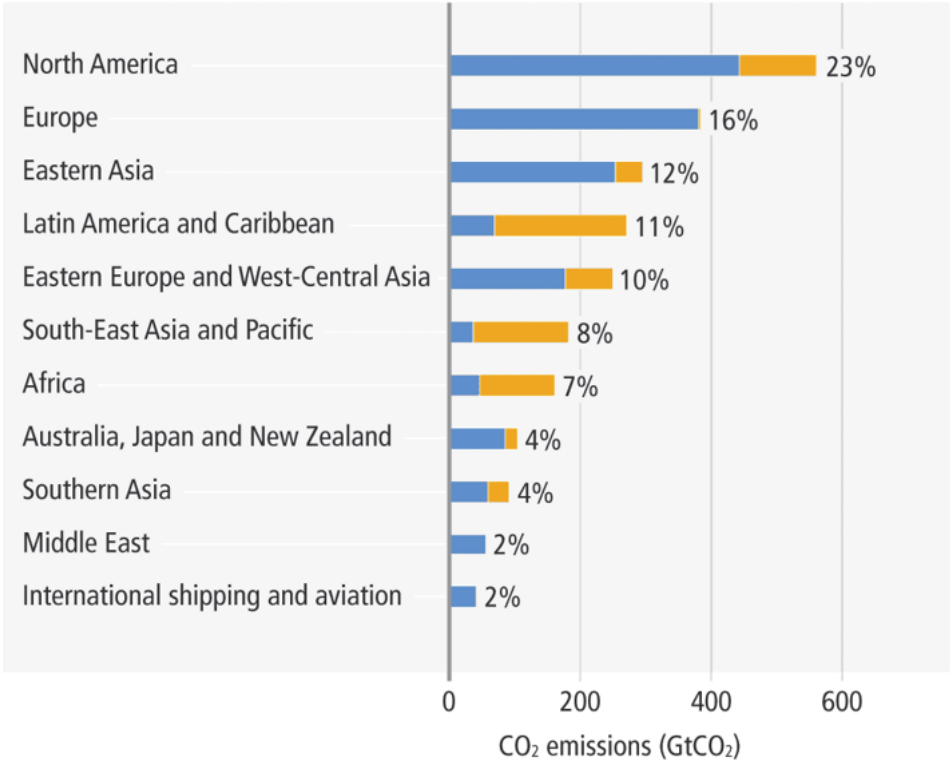


Emissions are growing in most regions

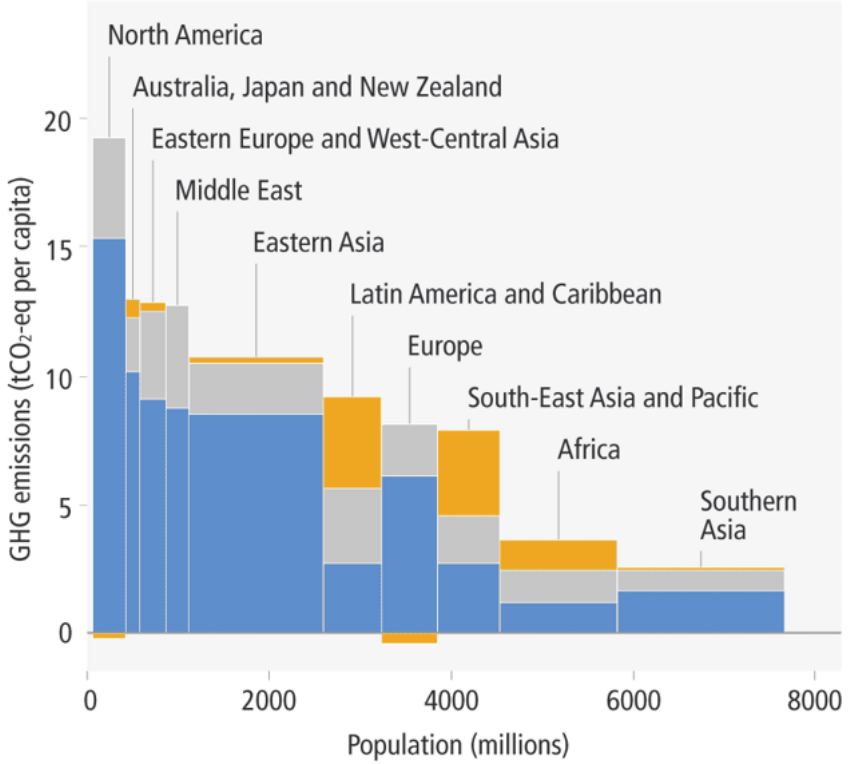


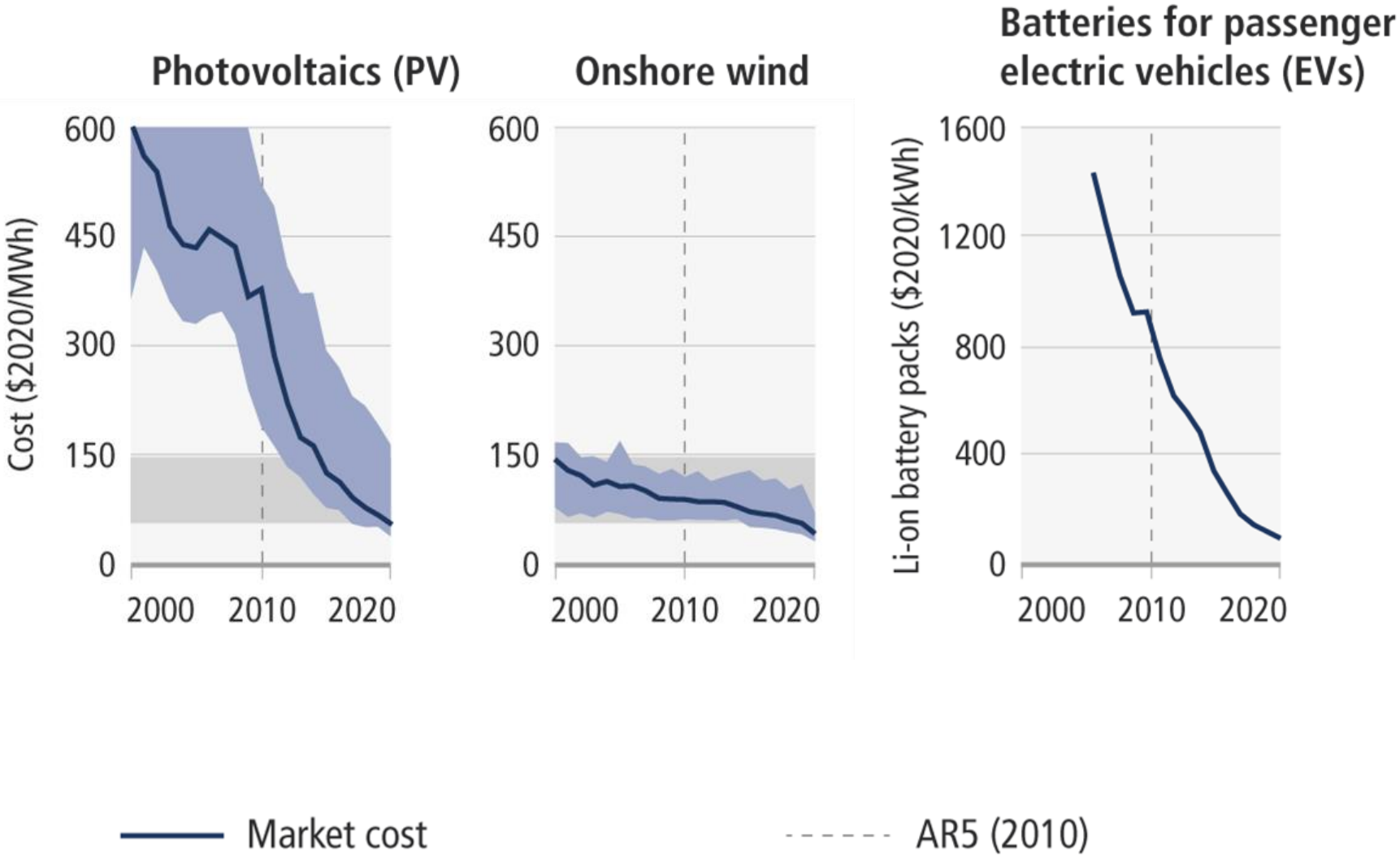
Emissions are distributed unevenly, both in the present day and cumulatively since 1850

b. Historical cumulative net anthropogenic CO_2 emissions per region (1850–2019)

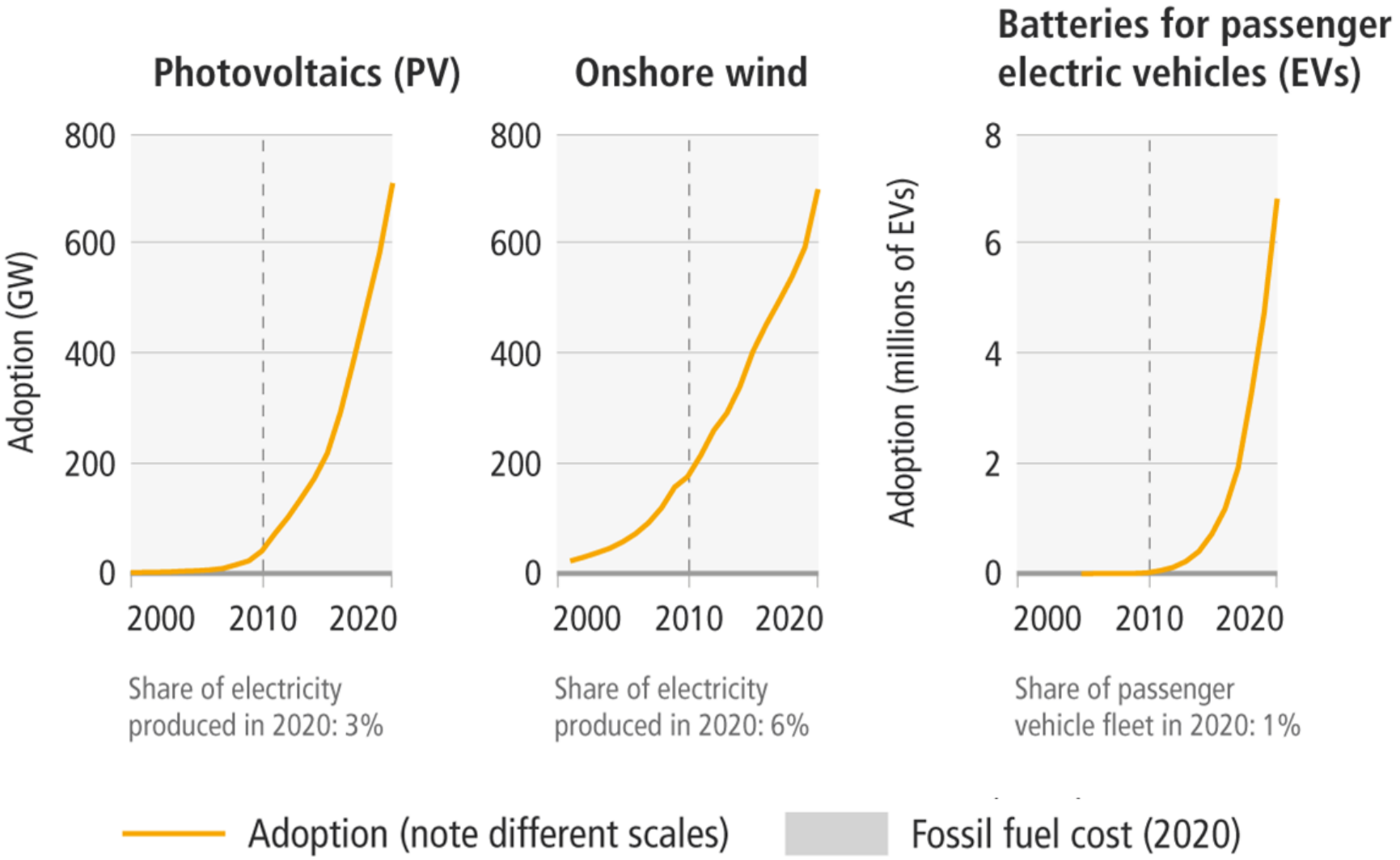


c. Net anthropogenic GHG emissions per capita and for total population, per region (2019)

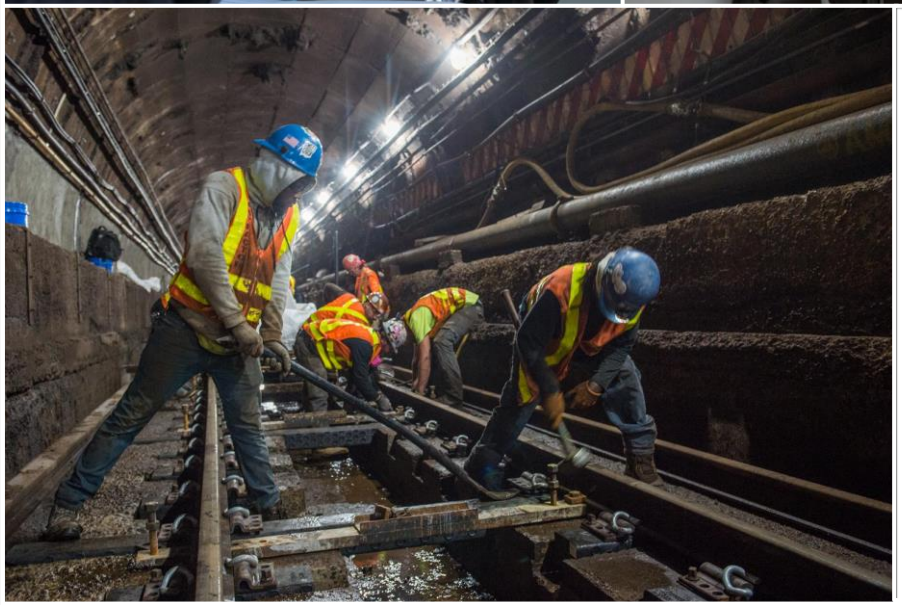


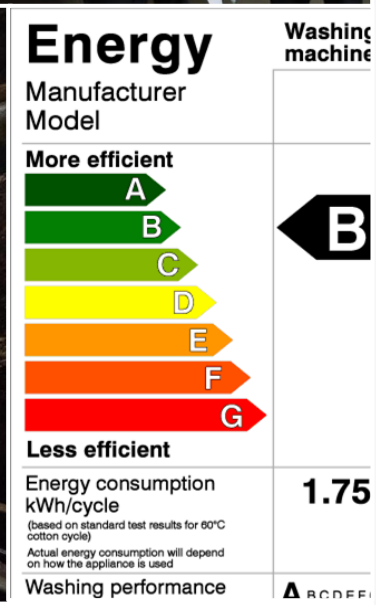


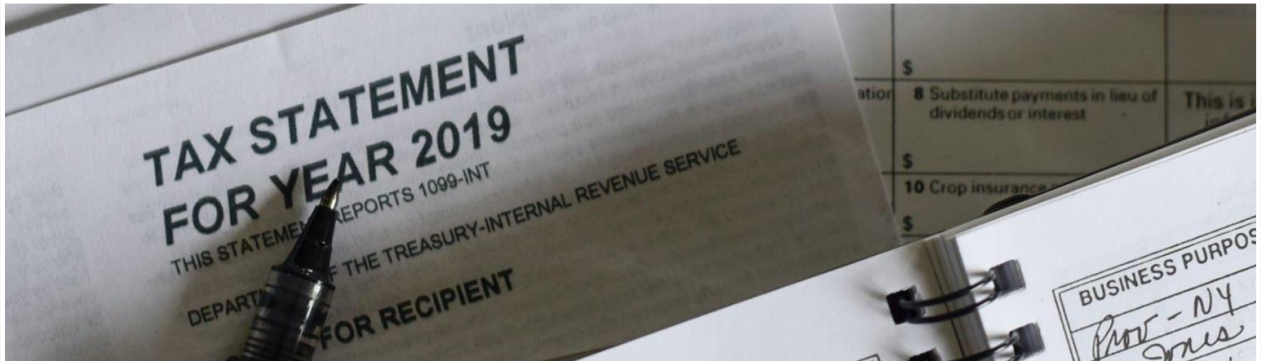
Since 2010, there have been sustained decreases of up to 85% in the costs of solar and wind energy In some cases, costs for renewables have fallen below those of fossil fuels.



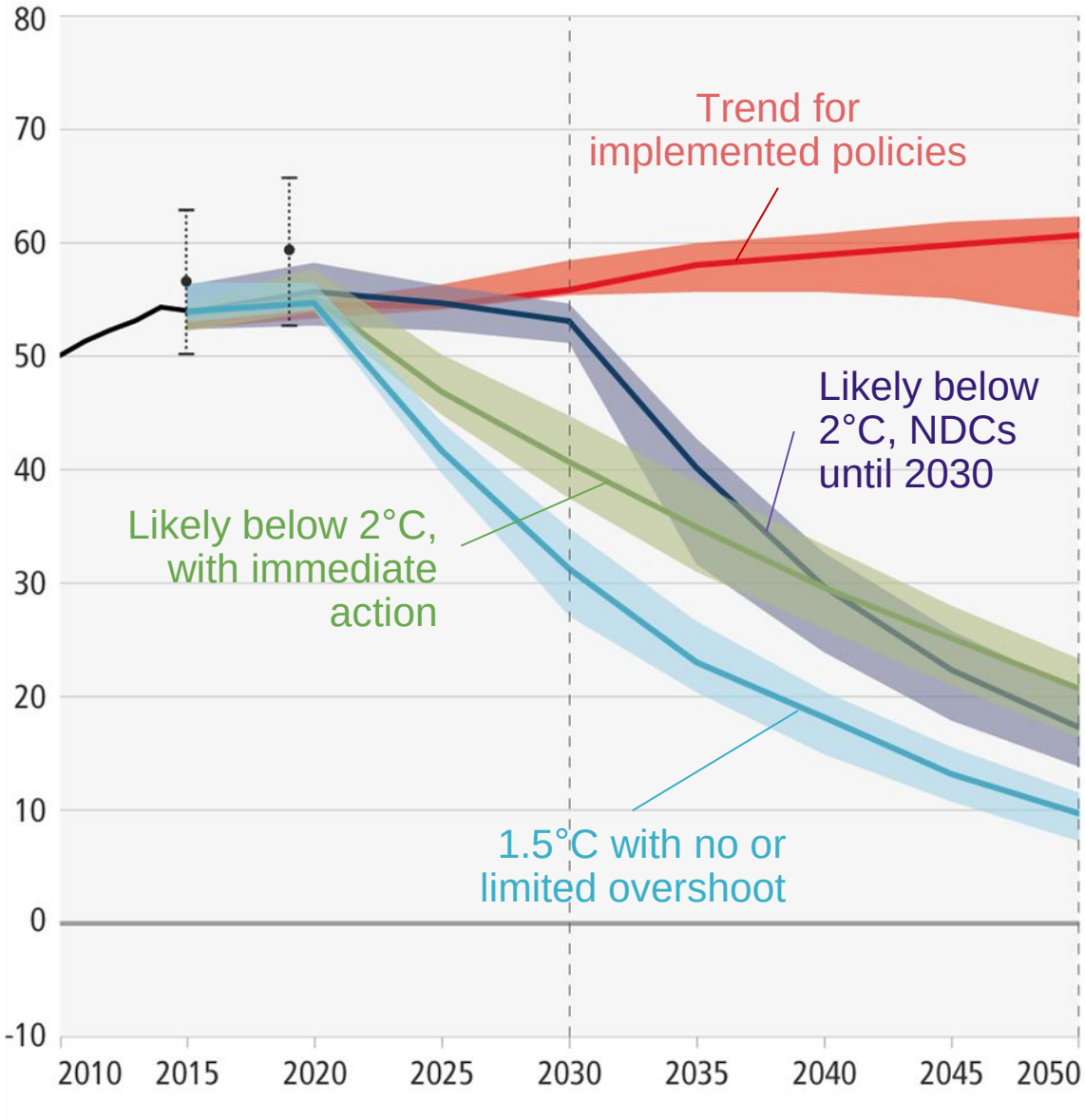
There have been large increases in capacity installed. Electricity systems in some countries and regions are already predominantly powered by renewables.







- Regulatory and economic instruments have **already proven effective** in reducing emissions;
- Climate laws cover **53% of global emissions**;
- 20% of emissions are covered by **carbon taxes or trading systems**



Limiting warming to 1.5 °C

- Global GHG emissions peak before 2025, reduced by 43% by 2030.
- Methane reduced by 34% by 2030

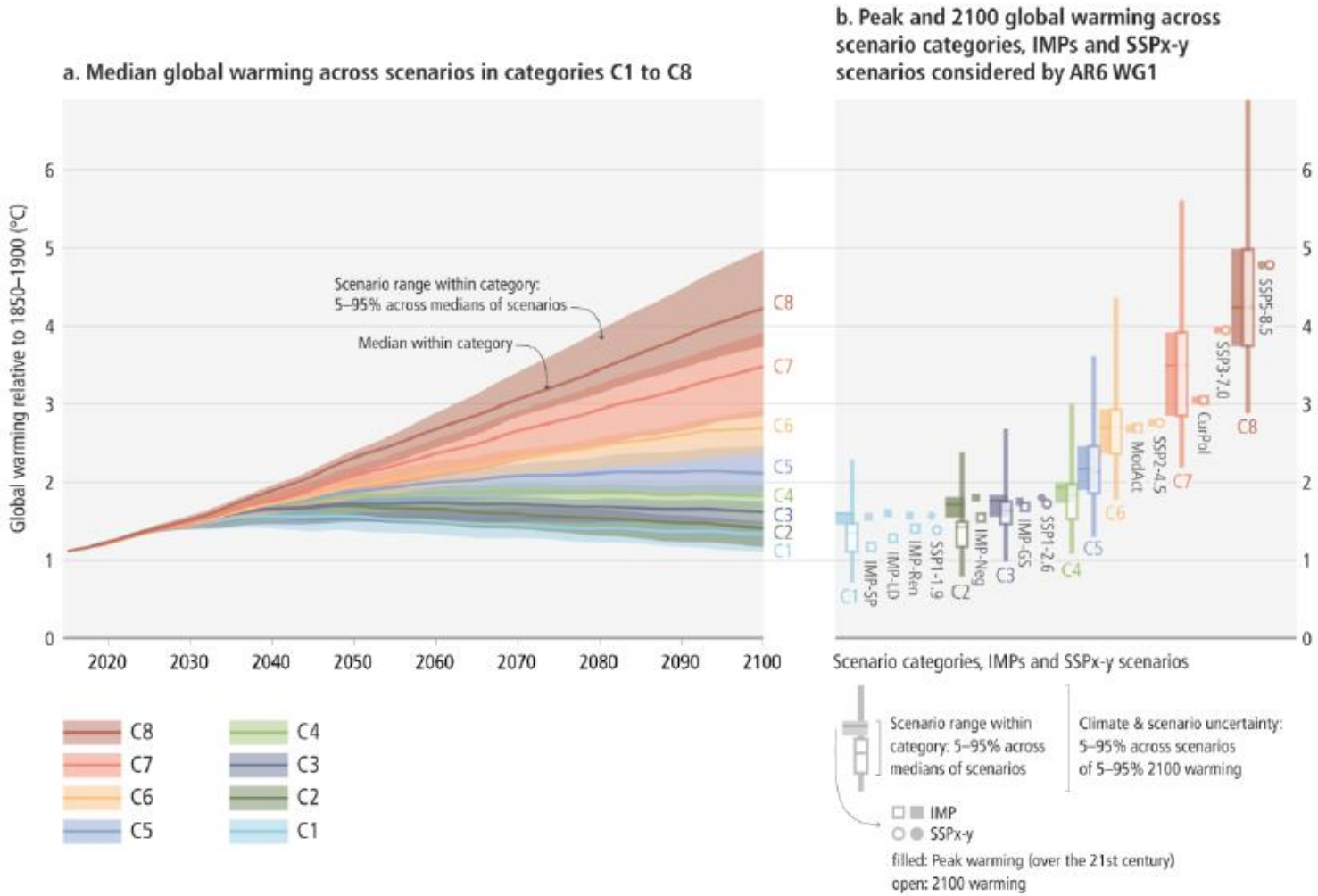
Limiting warming to around 2°C

- Global GHG emissions peak before 2025, reduced by 27% by 2030.

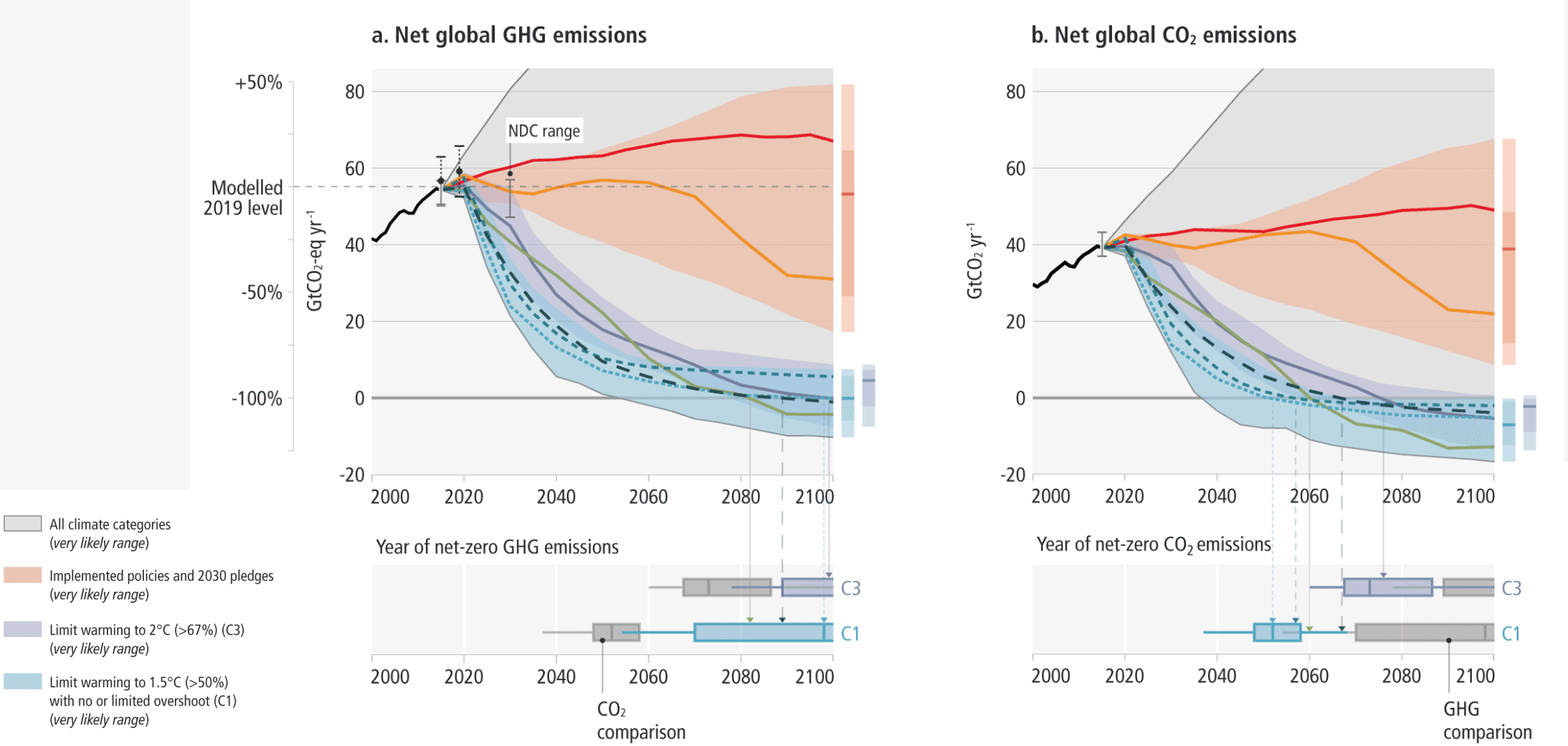
(based on IPCC-assessed scenarios)

C1 [97]	limit warming to 1.5°C (>50%) with no or limited overshoot	
C1a [50]	… with net-zero GHGs	SSP1-1.9, SP LD
C1b [47]	… without net-zero GHGs	Ren
C2 [133]	return warming to 1.5°C (>50%) after a high overshoot	Neg
C3 [311]	*limit warming to 2°C (>67%)*	
C3a [204]	… with action starting in 2020	SSP1-2.6
C3b [97]	… NDCs until 2030	GS
C4 [159]	limit warming to 2°C (>50%)	
C5 [212]	limit warming to 2.5°C (>50%)	
C6 [97]	limit warming to 3°C (>50%)	SSP2-4.5 Mod-Act
C7 [164]	limit warming to 4°C (>50%)	SSP3-7.0 Cur-Pol
C8 [29]	exceed warming of 4°C (>=50%)	SSP5-8.5

The range of assessed scenarios results in a range of 21st century projected global warming.



Modelled mitigation pathways that limit warming to 1.5ºC, and 2ºC, involve deep, rapid and sustained emissions reductions



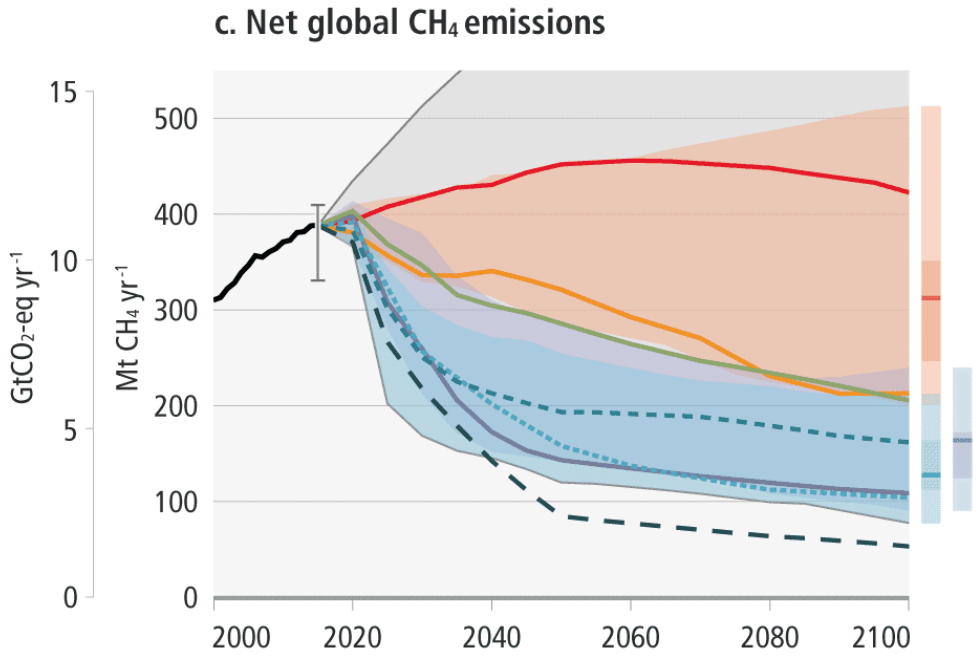
Modelled mitigation pathways that limit warming to 1.5ºC, and 2ºC, involve deep, rapid and sustained emissions reductions

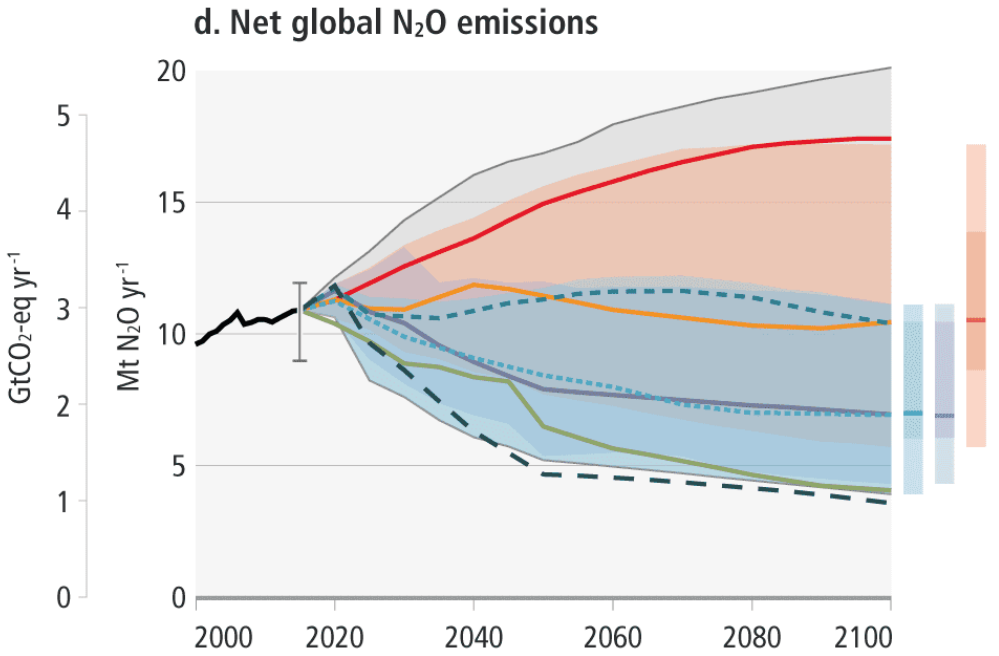
All climate categories (*very likely range*)

Implemented policies and 2030 pledges (*very likely range*)

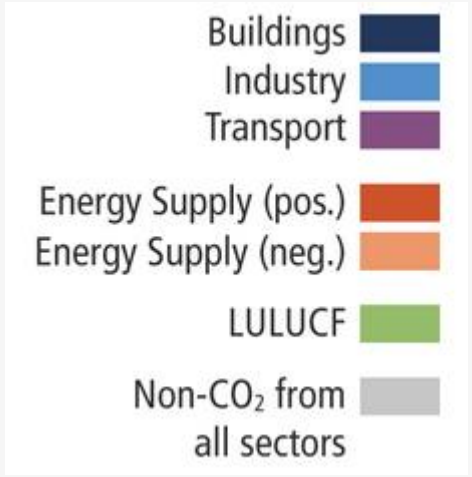
Limit warming to 2°C (>67%) (C3) (*very likely range*)

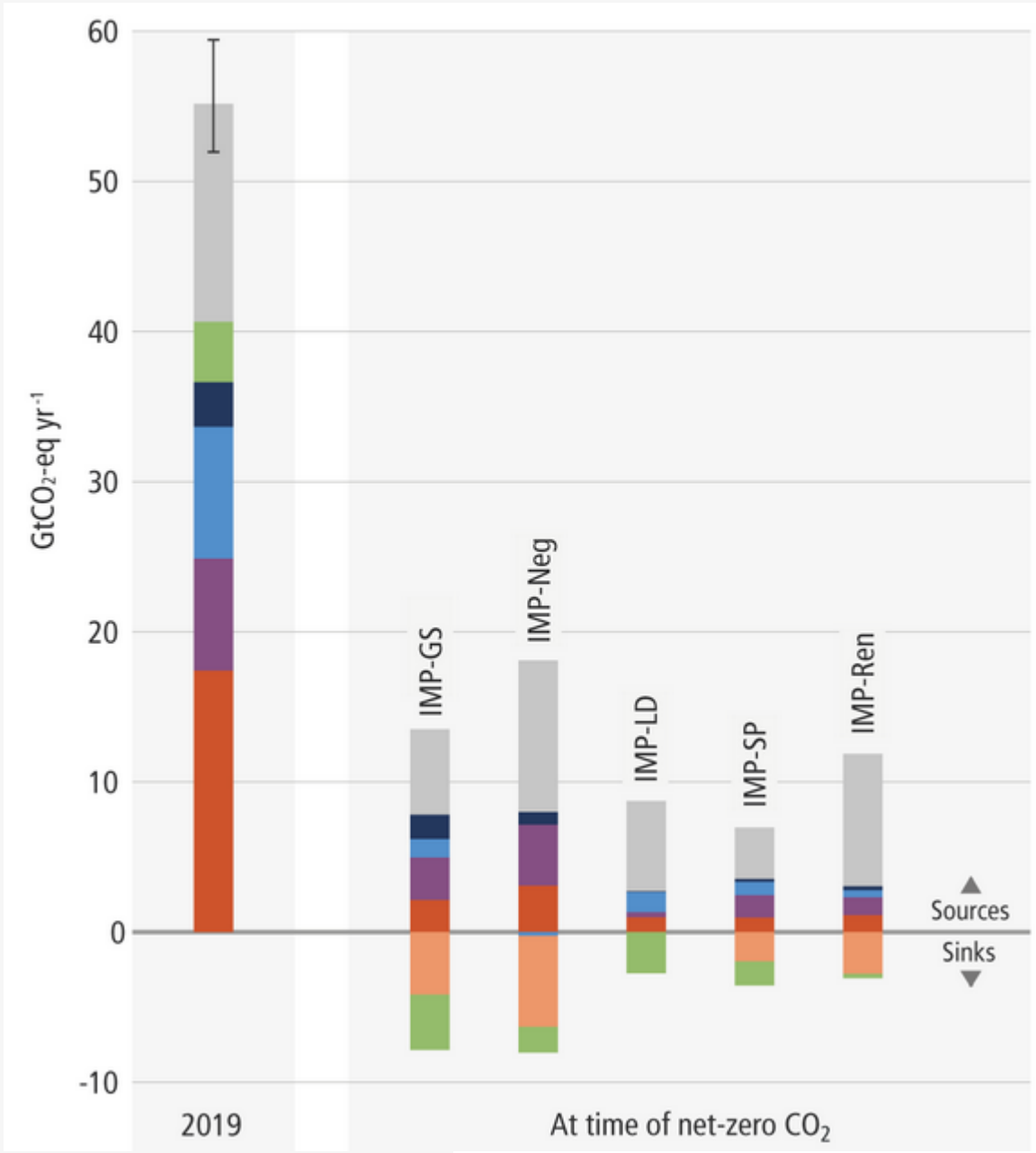
Limit warming to 1.5°C (>50%) with no or limited overshoot (C1) (*very likely range*)





Net zero CO_2 and net zero GHG emissions are possible through different modelled mitigation pathways





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There are options available **now** in every sector that can at least **halve** emissions by 2030

Demand and services

Energy

Land use

Industry

Urban

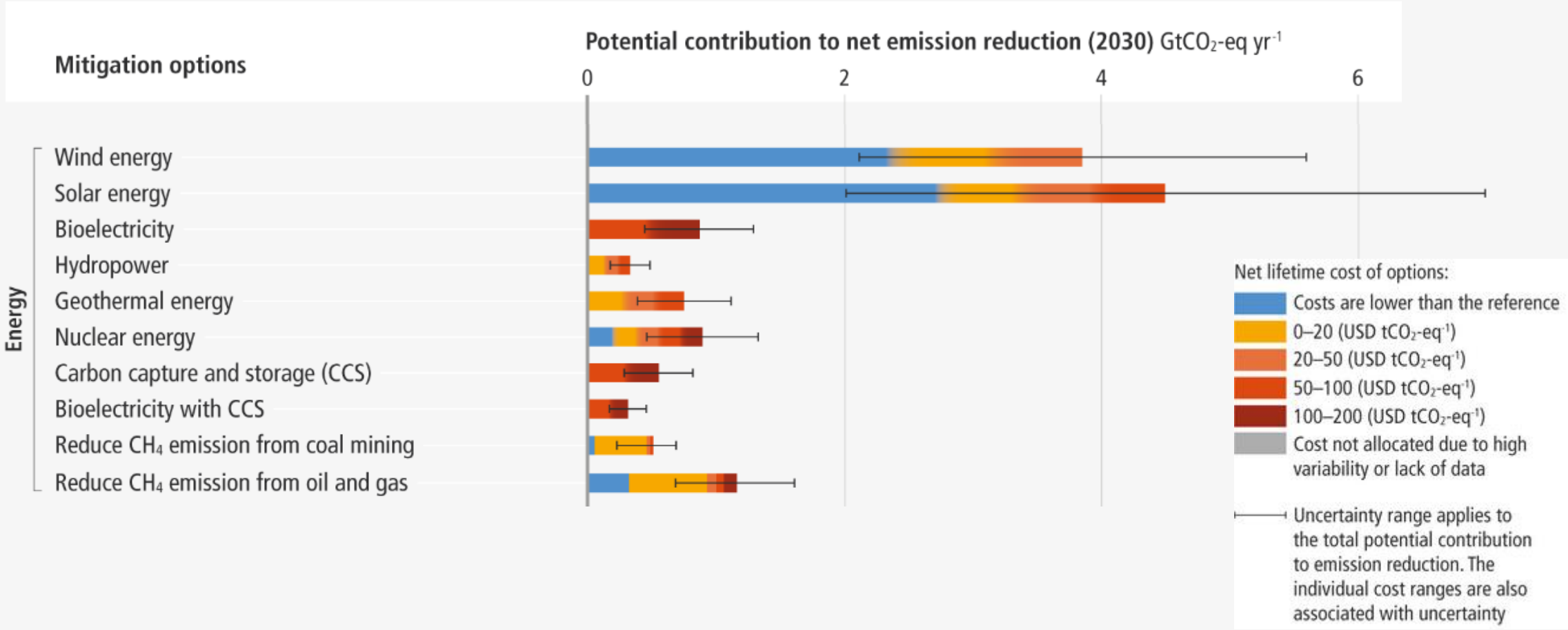
Buildings

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

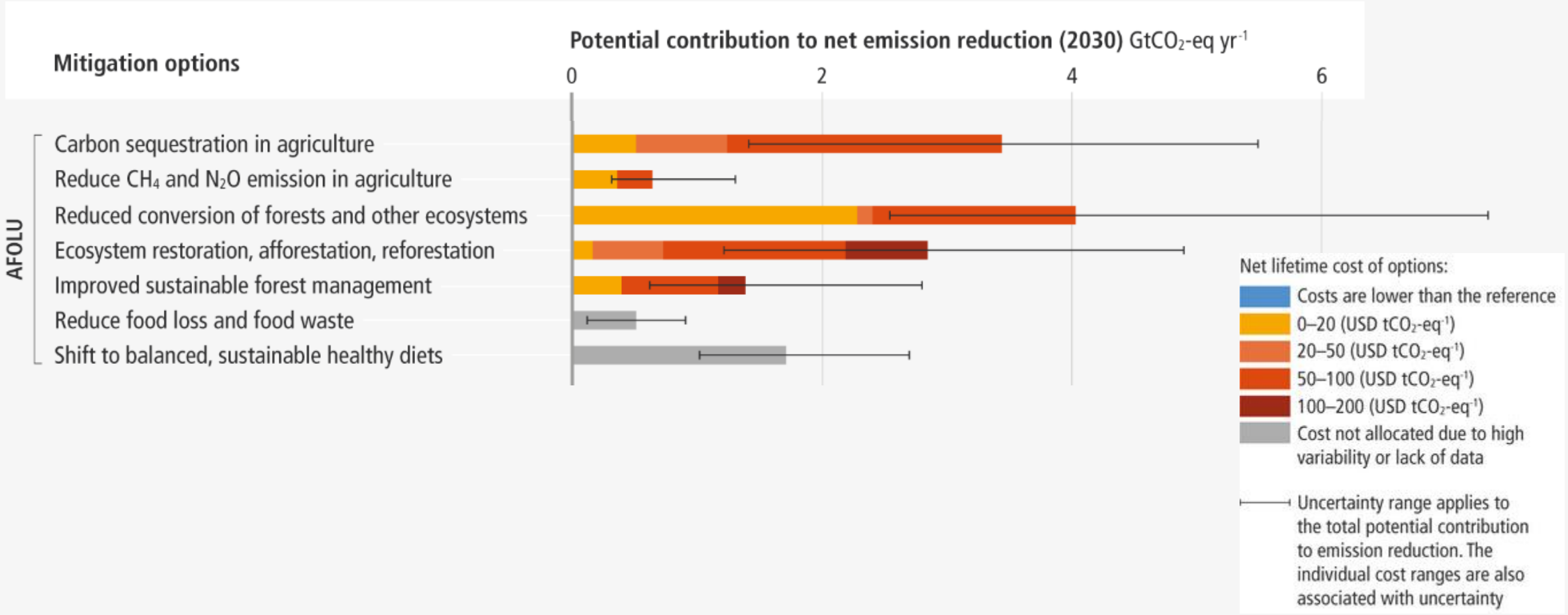
Many options available now in all sectors are estimate to offer substantial potential to reduce net emissions by 2030 : Energy



Land use

- can provide large-scale emissions reductions **and** remove and store CO_2 at scale
- protecting and restoring **natural ecosystems** to remove carbon: forests, peatlands, coastal wetlands, savannas and grasslands
- competing demands have to be **carefully managed**
- **cannot compensate** for **delayed** emission **reductions** in other sectors

Many options available now in all sectors are estimate to offer substantial potential to reduce net emissions by 2030 : AFOLU



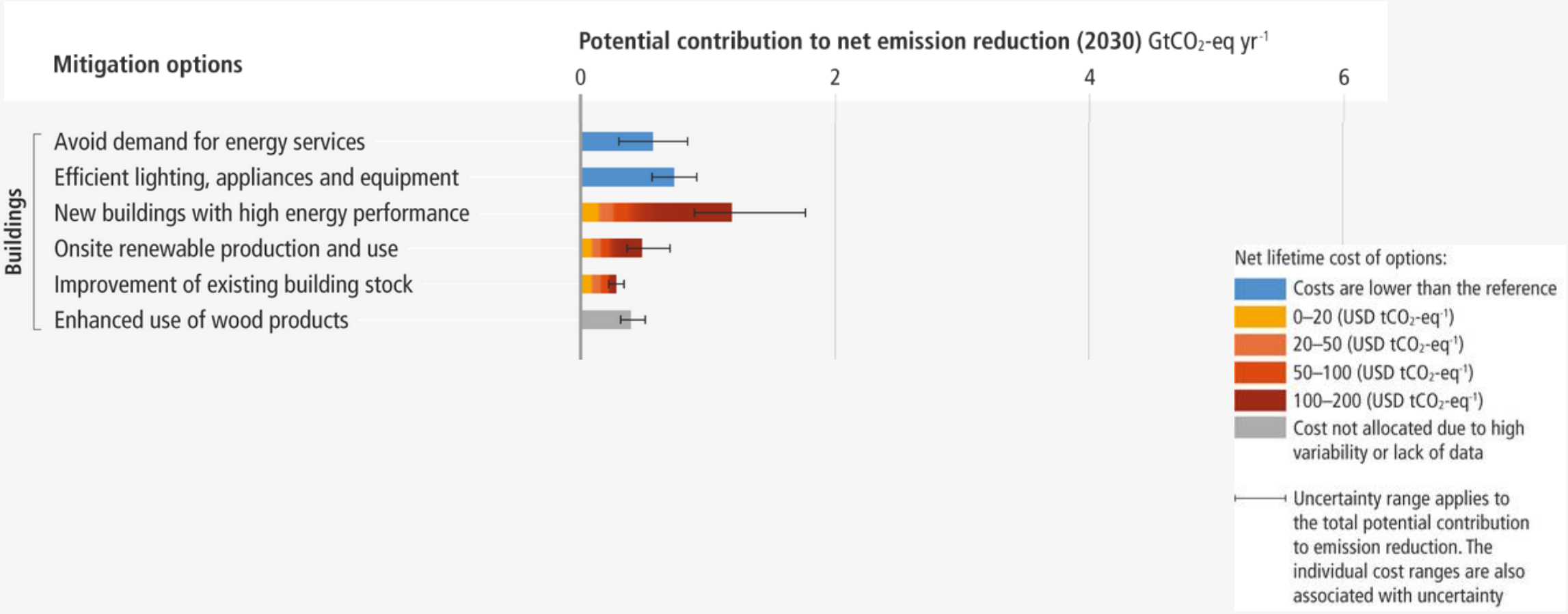
Cities and urban areas

- better urban planning, as well as:
- sustainable production and consumption of goods and services,
- **electrification** (low-emission energy),
- enhancing **carbon uptake and storage** (e.g. green spaces, ponds, trees)

There are options for existing, rapidly growing *and* new cities.

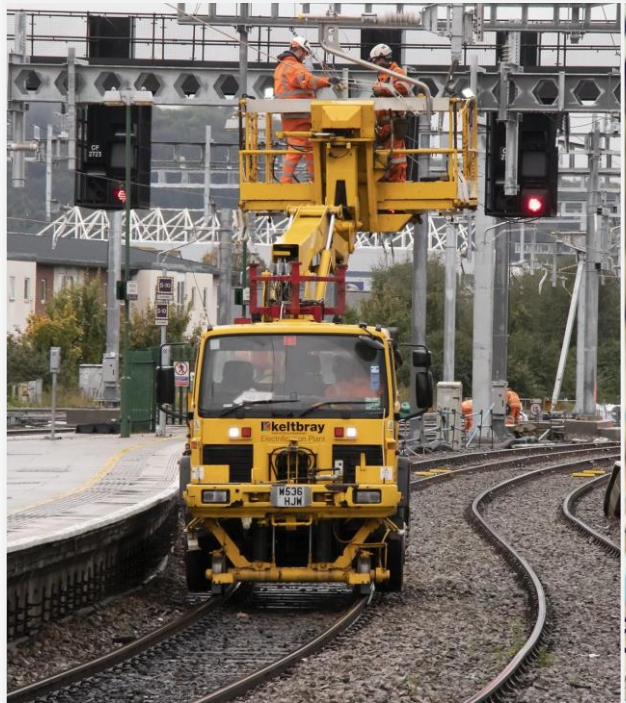
[Pelargoniums for Europe/Unsplash, City of St Pete CC BY-ND 2.0, Victor/Unsplash, EThekwini Municipality, Arne Müseler/arne-mueseler.com, CC BY-SA 3.0 de]

Many options available now in all sectors are estimate to offer substantial potential to reduce net emissions by 2030 : Buildings



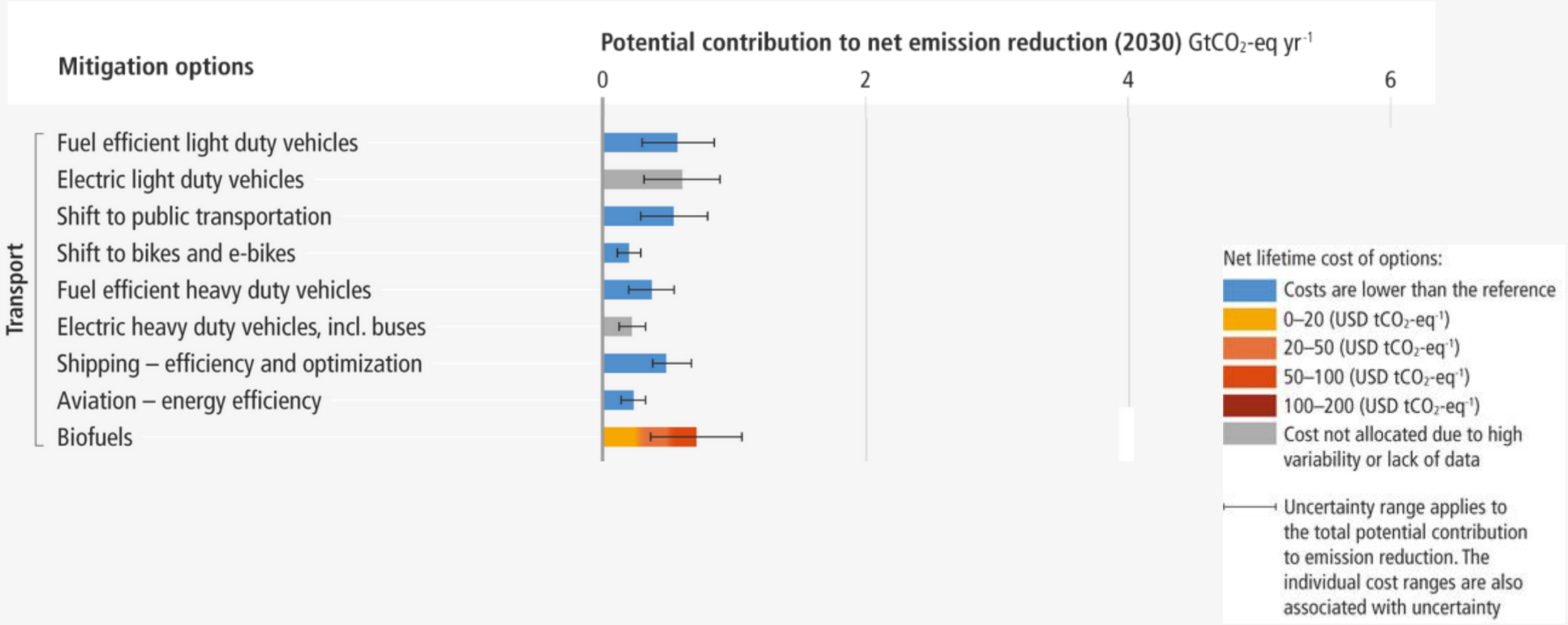
Transport

- **reducing demand** and **low-carbon** technologies are key to reducing emissions
- **electric vehicles**: greatest potential
- **battery technology**: advances could assist electric rail, trucks
- **aviation** and **shipping**: alternative fuels (low-emission **hydrogen** and **biofuels**) needed
- Overall, substantial potential but depends on **decarbonising the power sector**.

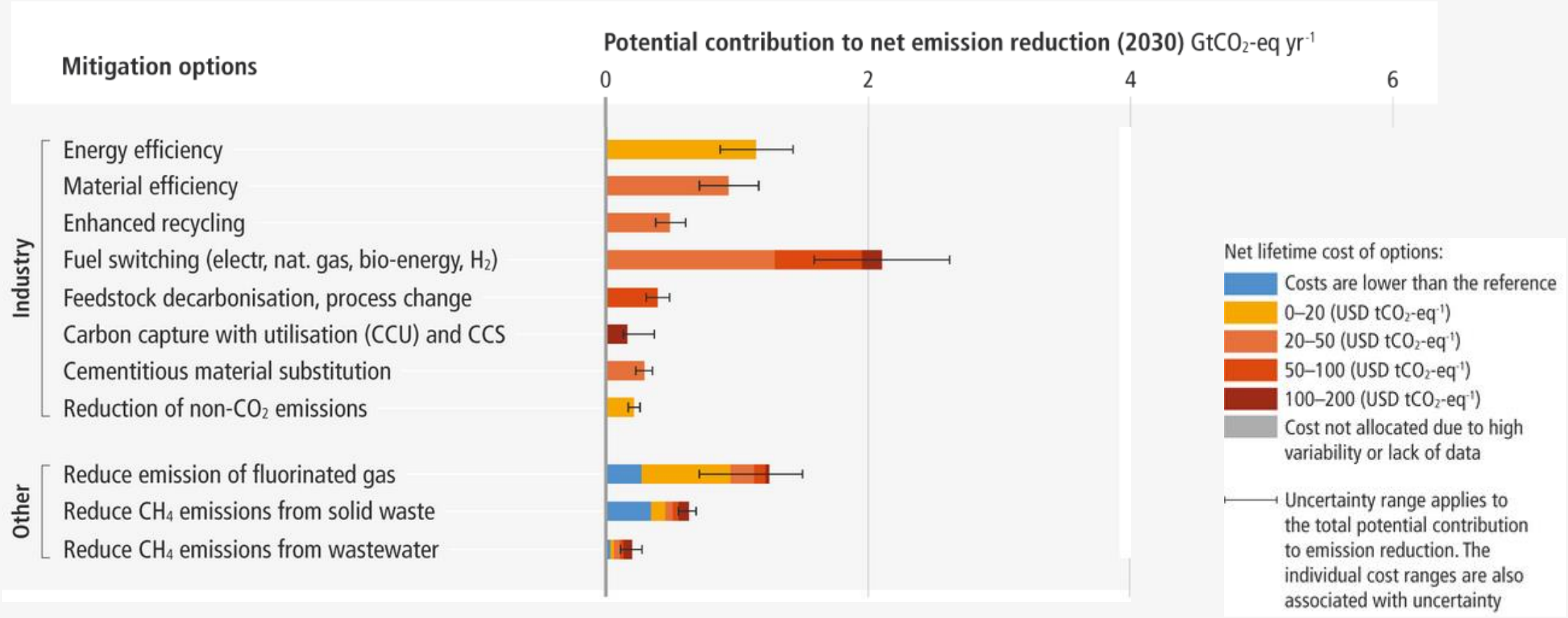


[United Airlines, Jeremy Segrott CC BY 2.0, Andreas160578/Pixabay]

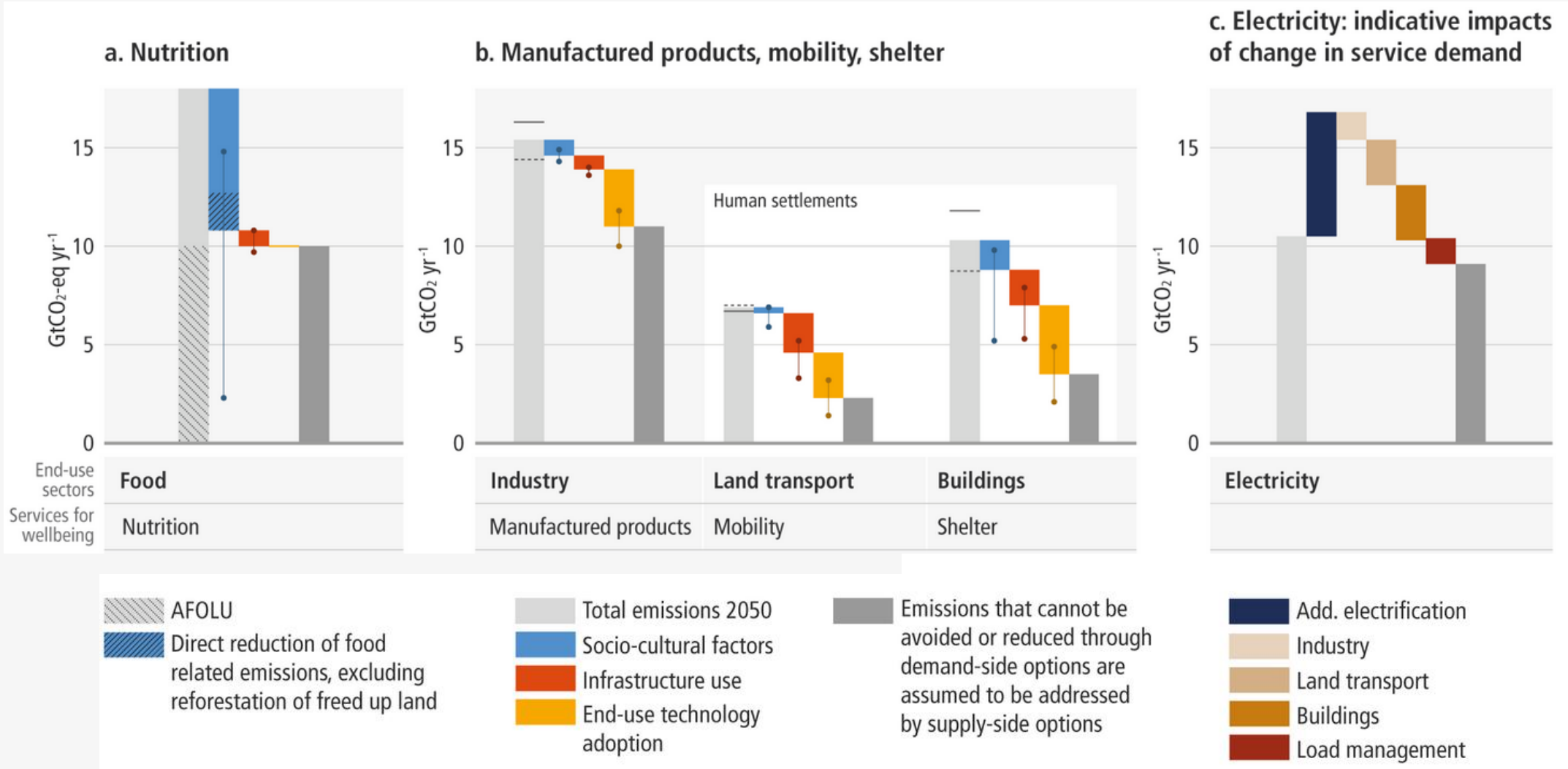
Many options available now in all sectors are estimate to offer substantial potential to reduce net emissions by 2030 : Transport



Many options available now in all sectors are estimate to offer substantial potential to reduce net emissions by 2030 : Industry



Demand side mitigation can be achieved by changes in socio-cultural factors, infrastructure design and use, and end use technology adoption by 2050



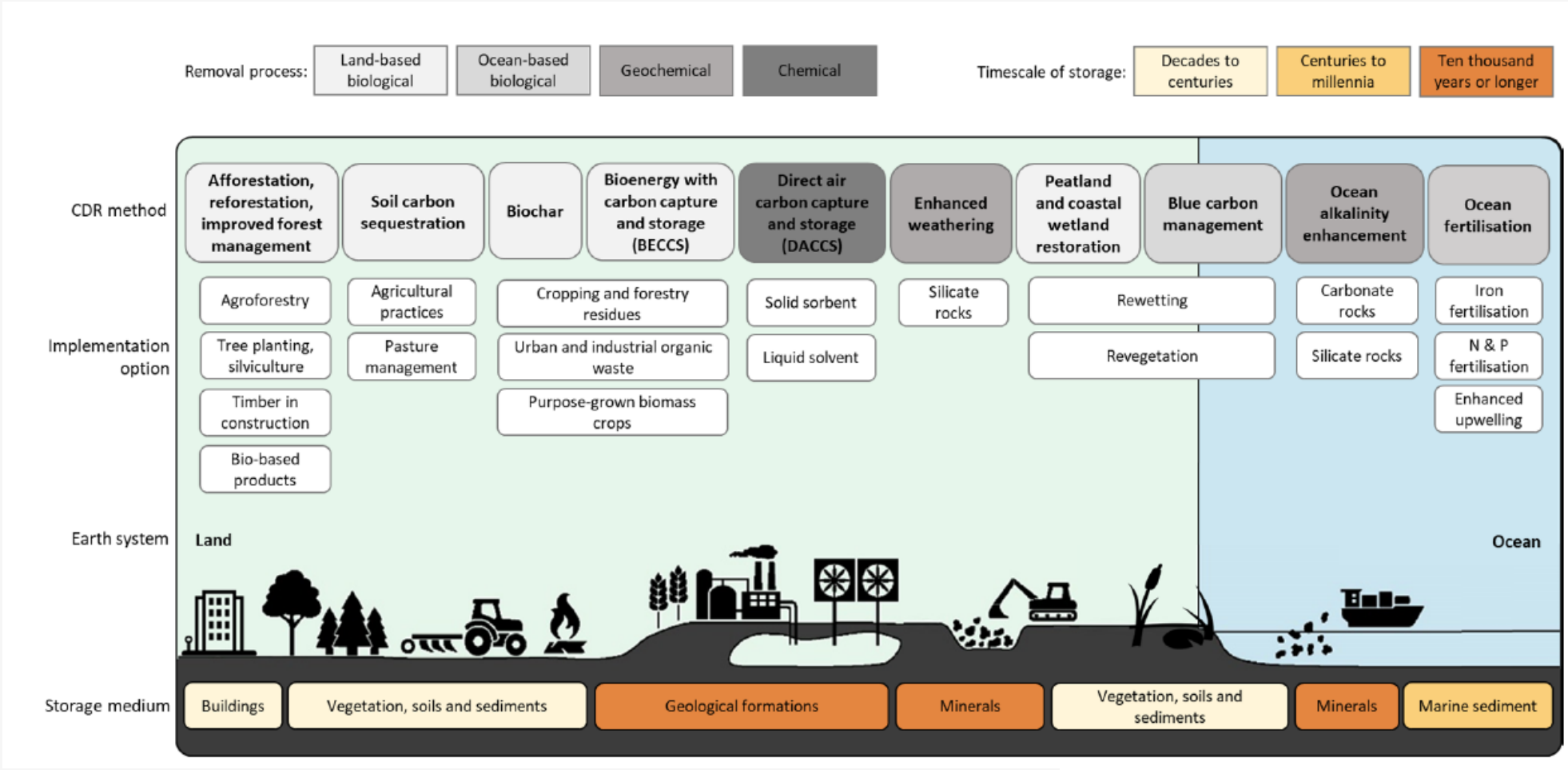
Carbon Dioxide Removal

- 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]

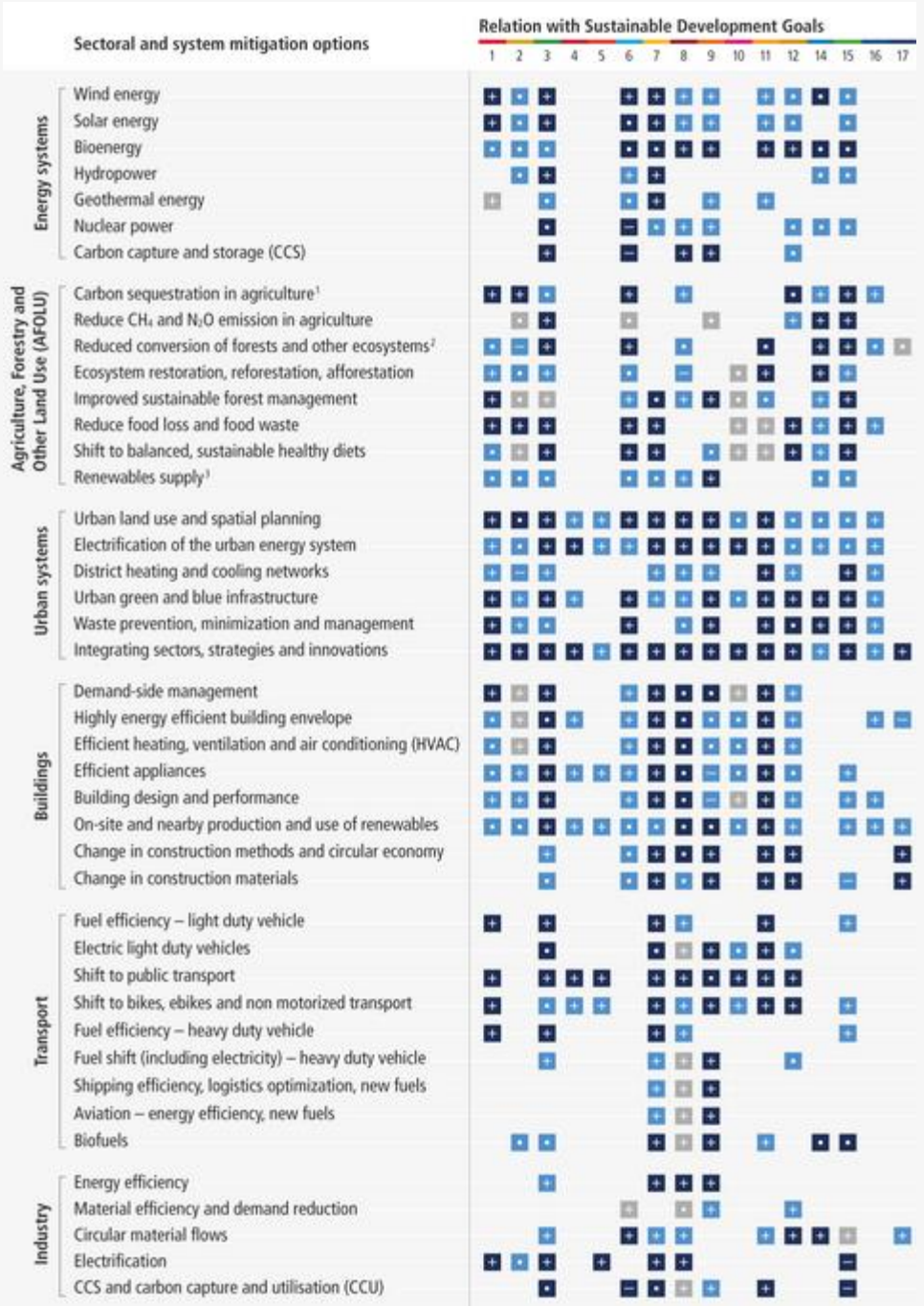


Carbon Dioxide Removal (CDR): Taxonomy of Methods

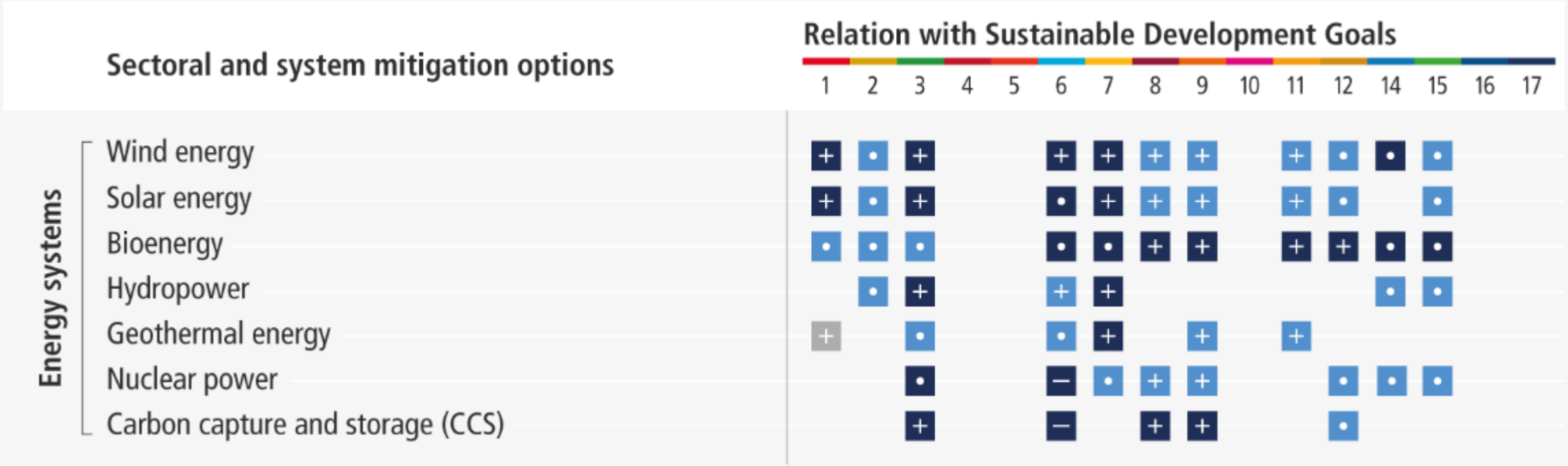


Mitigation options have many synergies with the Sustainable Development Goals, but some options can also have trade-offs.

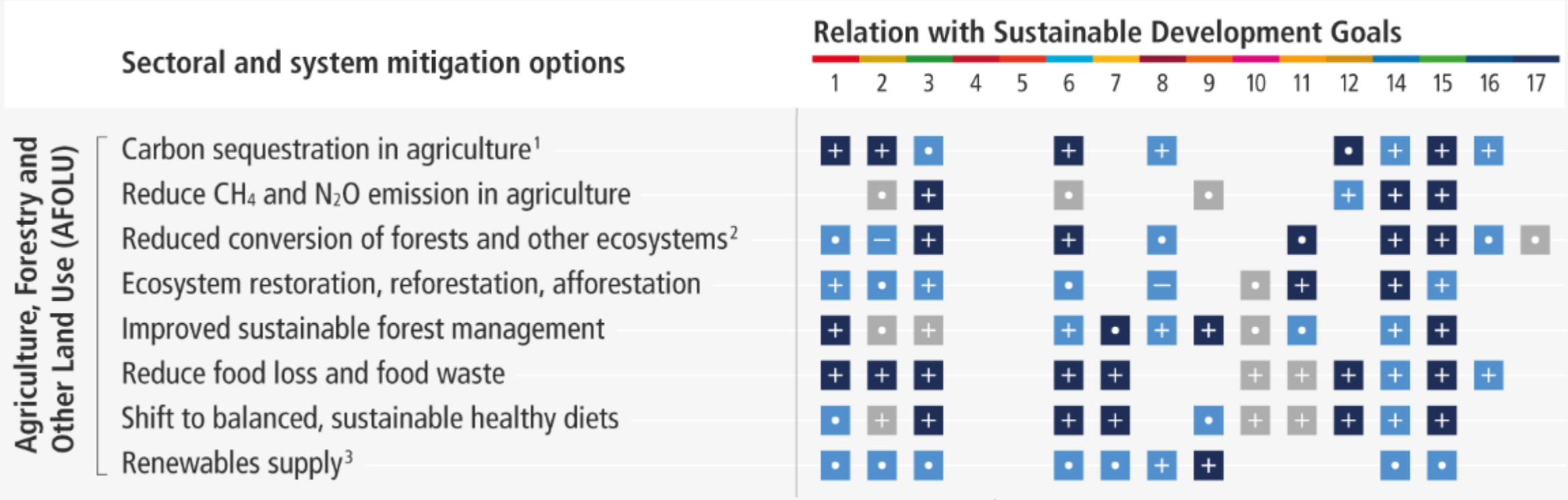
The synergies and trade-offs vary dependent on context and scale



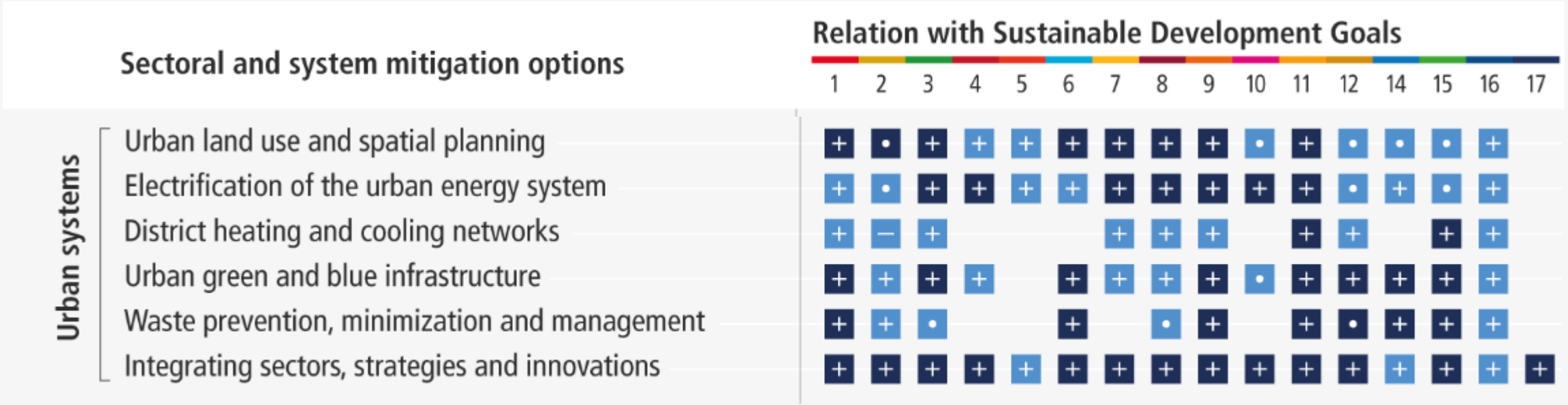
Mitigation options and the SDGs: Energy



Mitigation options and the SDGs: AFOLU



Mitigation options and the SDGs: Urban Systems



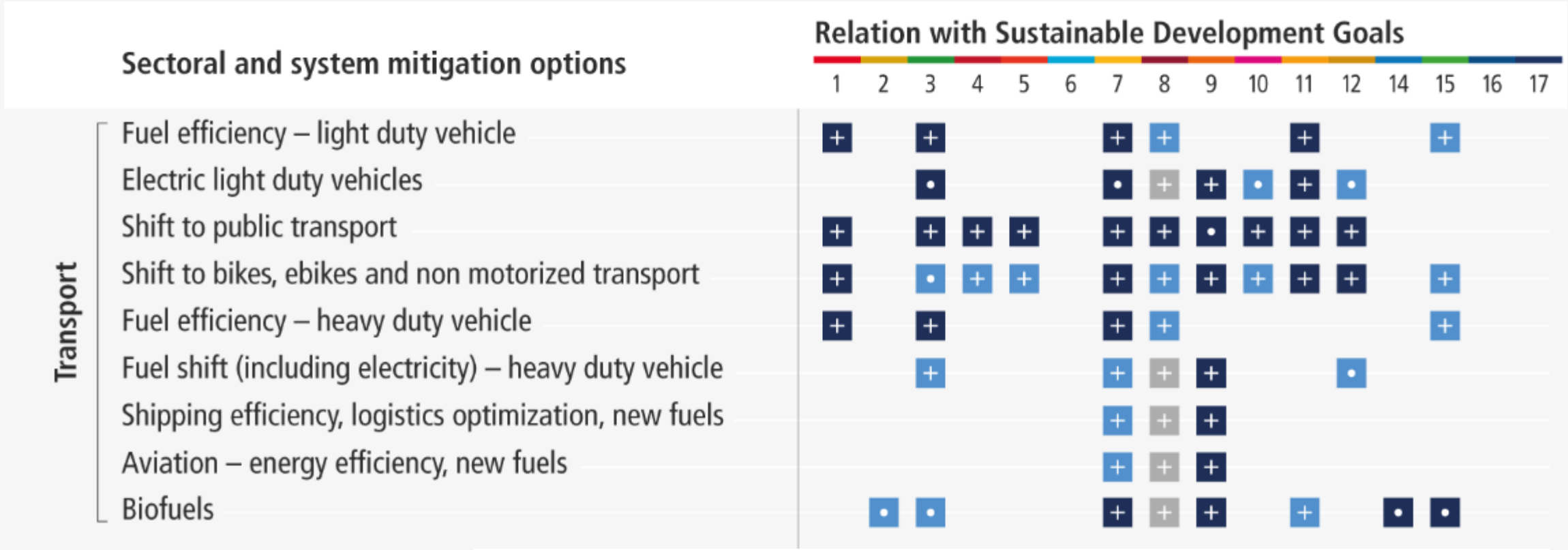
Type of relations:
- + Synergies
- – Trade-offs
- • Both synergies and trade-offs[4]

Blanks represent no assessment[5]

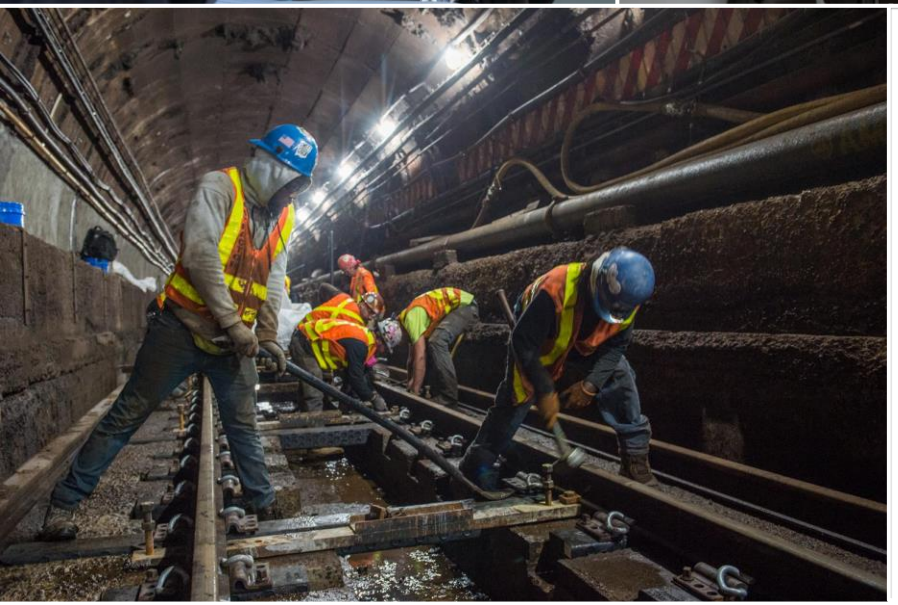
Confidence level:
- High confidence
- Medium confidence
- Low confidence

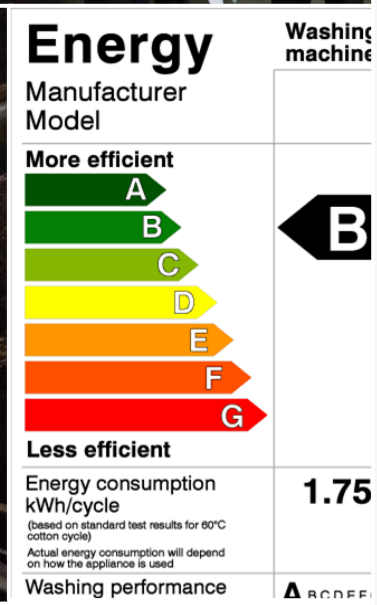
Related Sustainable Development Goals:
- 1 No poverty
- 2 Zero hunger
- 3 Good health and wellbeing
- 4 Quality education
- 5 Gender equality
- 6 Clean water and sanitation
- 7 Affordable and clean energy
- 8 Decent work and economic growth
- 9 Industry, innovation and infrastructure
- 10 Reduced inequalities
- 11 Sustainable cities and communities
- 12 Responsible consumption and production
- 13 Climate action
- 14 Life below water
- 15 Life on land
- 16 Peace, justice and strong institutions
- 17 Partnership for the goals

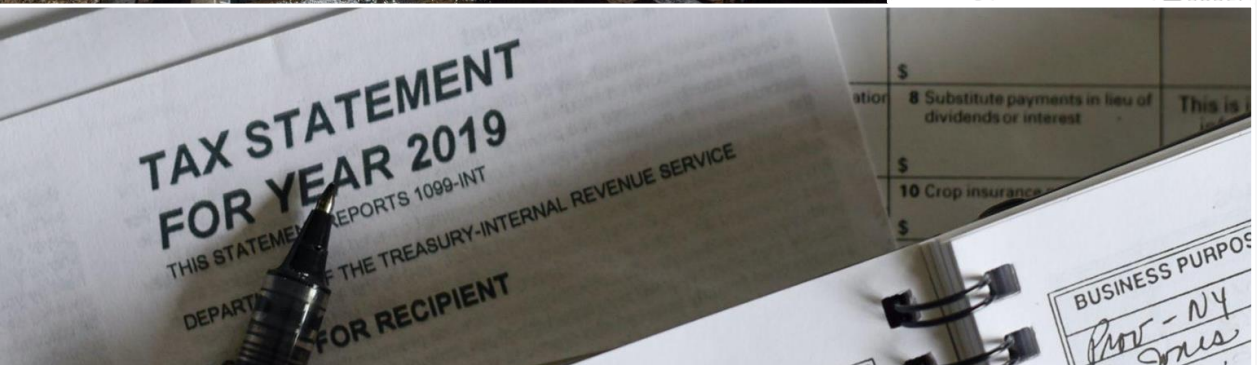
Mitigation options and the SDGs: Transport



“We have the policy tools







Policies, regulatory and economic instruments

- **policy packages** and **economy-wide packages** are able to achieve **systemic change**
- ambitious and effective mitigation requires **coordination across government** and society
- An increasing range of policies and laws have **enhanced energy efficiency**, **reduced rates of deforestation** and **accelerated the deployment of renewable energy.**

[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.]

Technology and Innovation

- investment and policies **push forward low emissions** technological **innovation**
- **effective decision making** requires assessing potential benefits, barriers and risks
- **some options** are technically **viable**, rapidly becoming **cost-effective**, and have relatively **high public support**. Other options face barriers

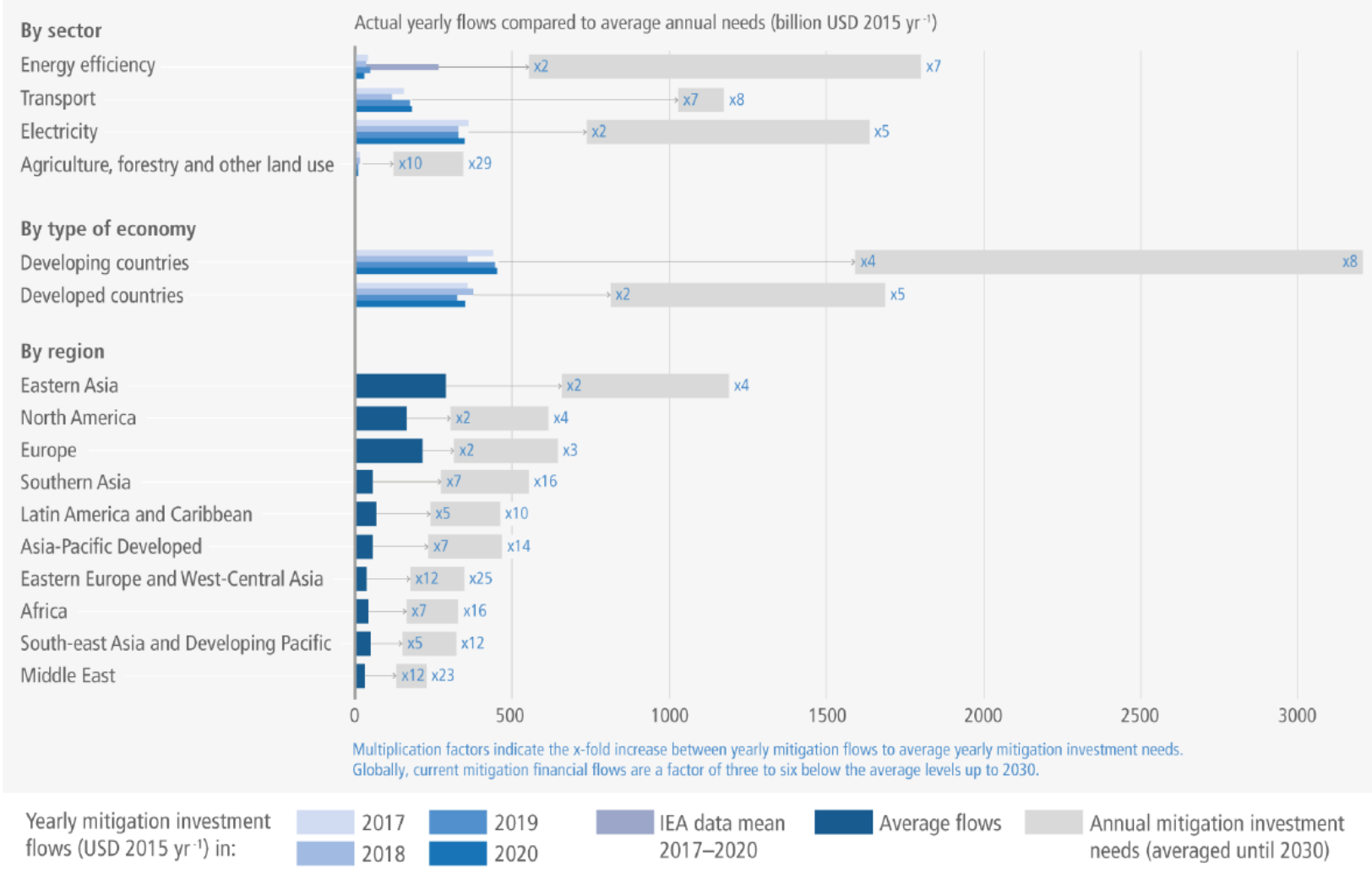
Adoption of low-emission technologies is slower in most developing countries, particularly the least developed ones.

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

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

Mitigation investment flows fall short of investment needs across all sectors and types of economy, particularly in developing countries



Note: from Technical Summary

New Scientific Challenges

- Scenarios
- Inventories, sources and sinks, and mitigation
- Adaptation and mitigation
- The impacts of the implementation of response measures
- Engaging with social science
- Coherent science and assessment

Scenarios (or is it pathways?)

Global warming levels (GWLs)

Illustrative scenarios

Scenario categories

Illustrative mitigation pathways

Shared socio-economic pathways (SSPs)

Shared policy assumptions (SPAs)

Representative concentration pathways (RCPs)

Scenarios (2)

- Lack of attention to pathways that are off the “middle of the road” (97% of new scenarios in the AR6 database are based on SSP2)
- Lack of valuation of co-benefits in models
- More policy-relevant transparency about key assumptions
- More explicit attention to “who pays” to complement “what actions are taken where”
- Do Integrated Assessment Models have all the answers?

AR6 Scenario Explorer: secondary research opportunities

https://data.ene.iiasa.ac.at/ar6/

Inventories, sources and sinks, mitigation

- Not just three WGs – Task Force on National Greenhouse Gas Emission Inventories (TFI)
- 5.5 Gigatonne gap between CO_2-LULUCF in UNFCCC inventories and dynamic global vegetation models (DVGMs)
- Uncertainty ranges
  - CO_2-LULUCF +/- 70%
  - CH_4 +/- 30%
  - N_2O +/- 60%
- TFI Expert Meeting on use of atmospheric observation data in emission inventories (September 2022)

Adaptation and mitigation

- Areas where there are no adaptation and mitigation responses, only responses with adaptation and mitigation (and other) outcomes:
  - Settlements
  - Land use

The impacts of the implementation of response measures

- The work of the UNFCCC Katowice Committee of Experts

- Just Transition and Climate Justice

IPCC and the social sciences

- IPCC wants social science more than social scientists like IPCC
- Lack of alignment between IPCC activities and career structures

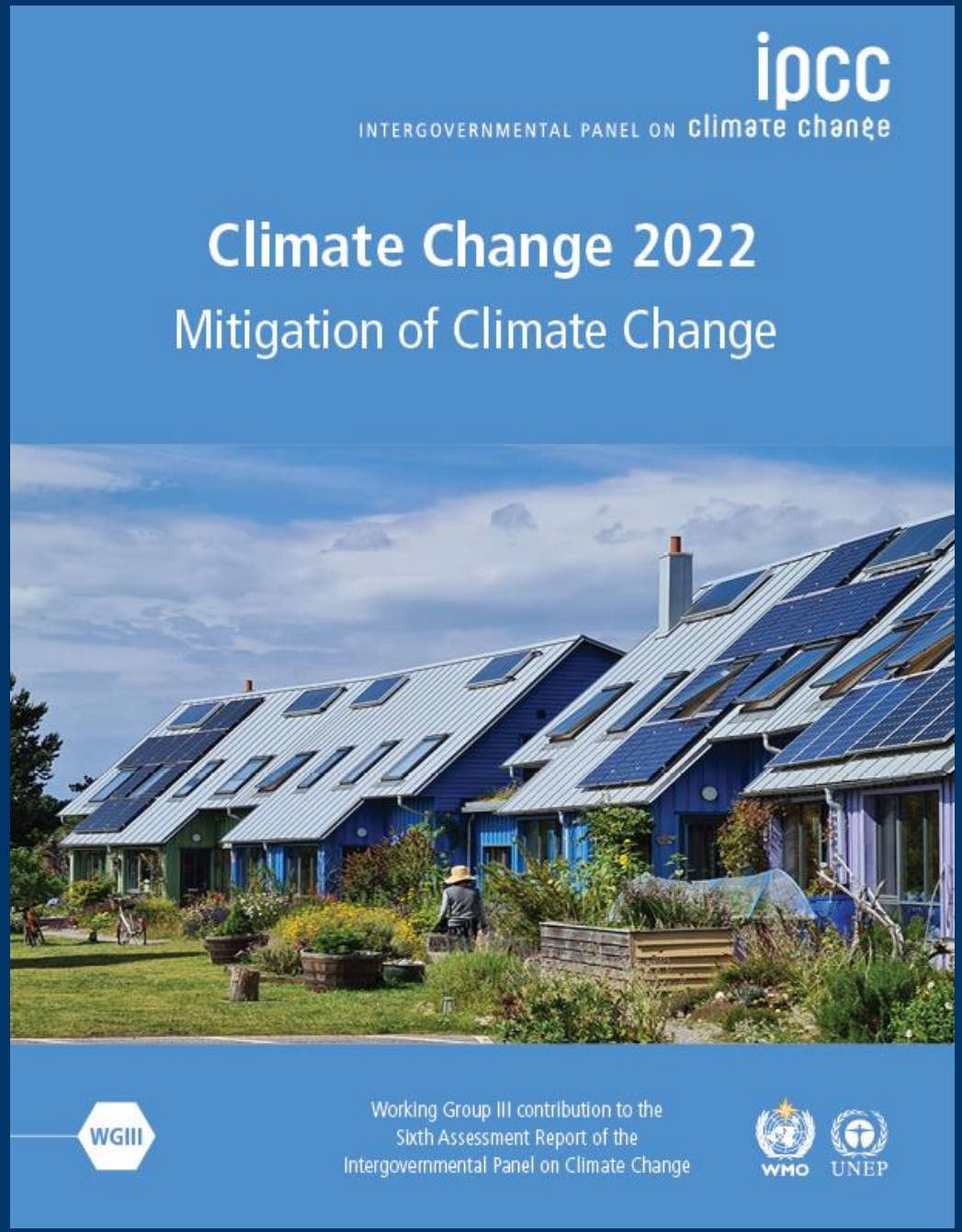
Mechanisms for coherent science and assessment

- Common glossaries
  (Note UNEP-led Ad-Hoc Global Assessment Dialogue process)
- Cross-Working Group Boxes and other activities
- Cross-chapter (cross-WG activities)
- Changed IPCC structure?

Sixth Assessment Report
WORKING GROUP III – MITIGATION OF CLIMATE CHANGE

“ **The evidence is clear:**

The time for action is now



[Matt Bridgestock, Director and Architect at John Gilbert Architects]