Sixth Assessment Report
WORKING GROUP III – MITIGATION OF CLIMATE CHANGE

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INTERGOVERNMENTAL PANEL ON climate change

Climate Change 2022

Mitigation of Climate Change

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

Report by numbers

278 Authors

65 Countries

41 % Developing countries
59 % Developed countries

354 Contributing authors

29 % Women / 71 % Men

More than 18,000 scientific papers

59,212 Review comments

3+ years later …..

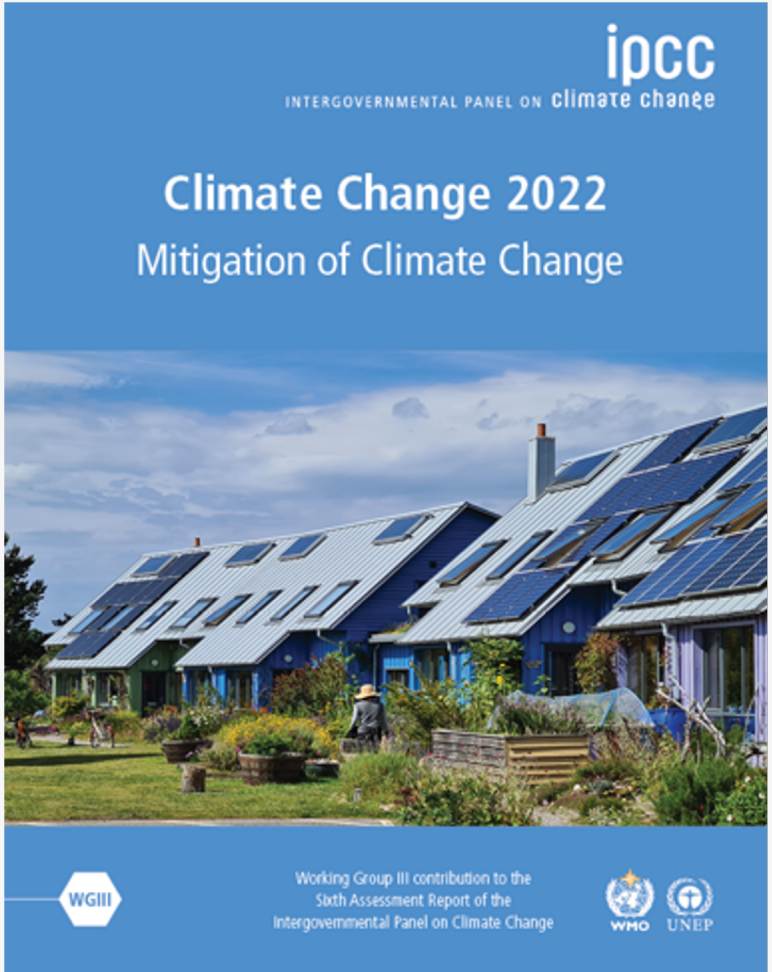
Global Research

meets

Global Review

with

National Perspectives



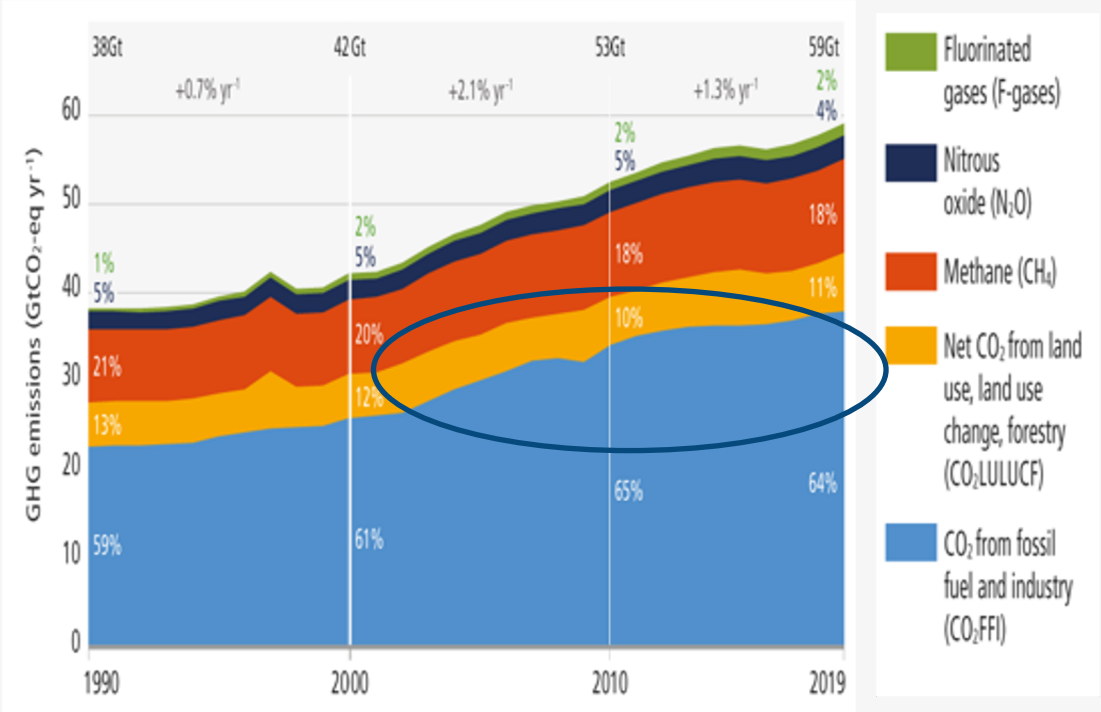
17 Chapters,
c. 2000pp

Technical Summary
142pp

Summary for Policymakers,
63pp

‘Mitigation glass more than half empty, but filling?’

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



2010-2019:

- Average annual greenhouse gas emissions at highest levels in human history
- Increase from previous decade largest ever seen

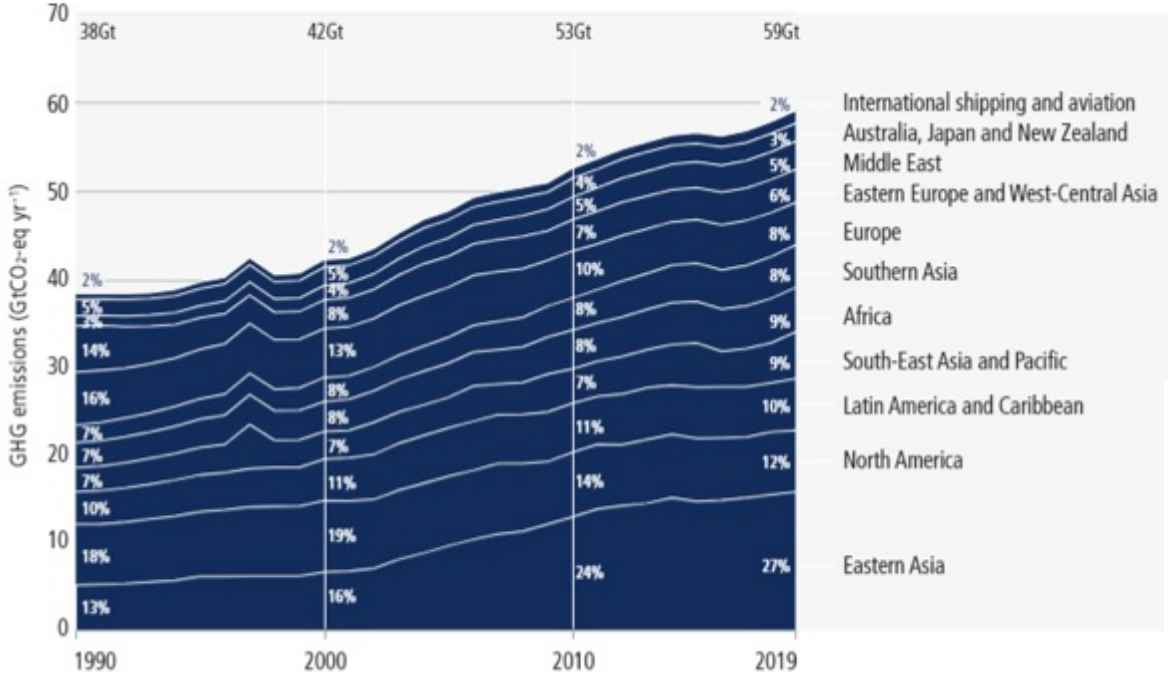
YET:

- Average annual rate of growth during decade, slowed from 2.1%/yr to 1.3%/yr (+sectoral info)
- Average growth since 2014 (for all GHGs) around 0.8%% yr-1*
- Slow-down notably in CO2-FFI ?
- Global per-capita emissions since 2014 unchanged

To describe contributions by sector is complex,* by region *inevitably* involves 'political' choices

Emissions have grown in most regions but are distributed unevenly, both in the present day and cumulatively since 1850.

a. Global net anthropogenic GHG emissions by region (1990–2019)

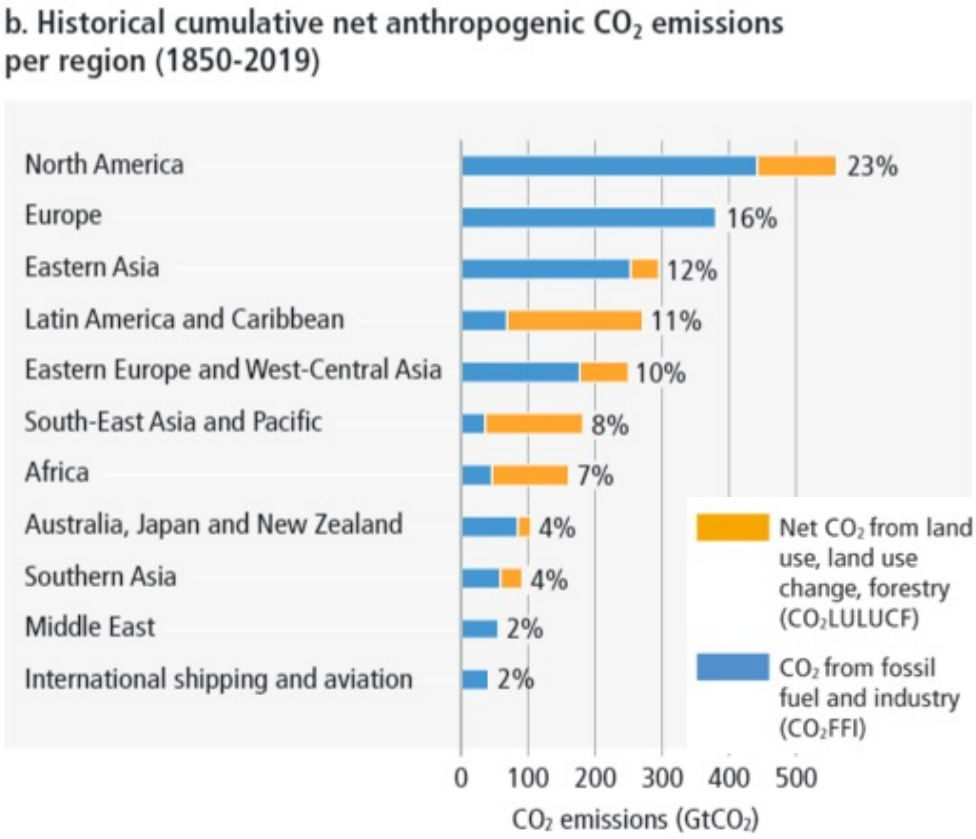


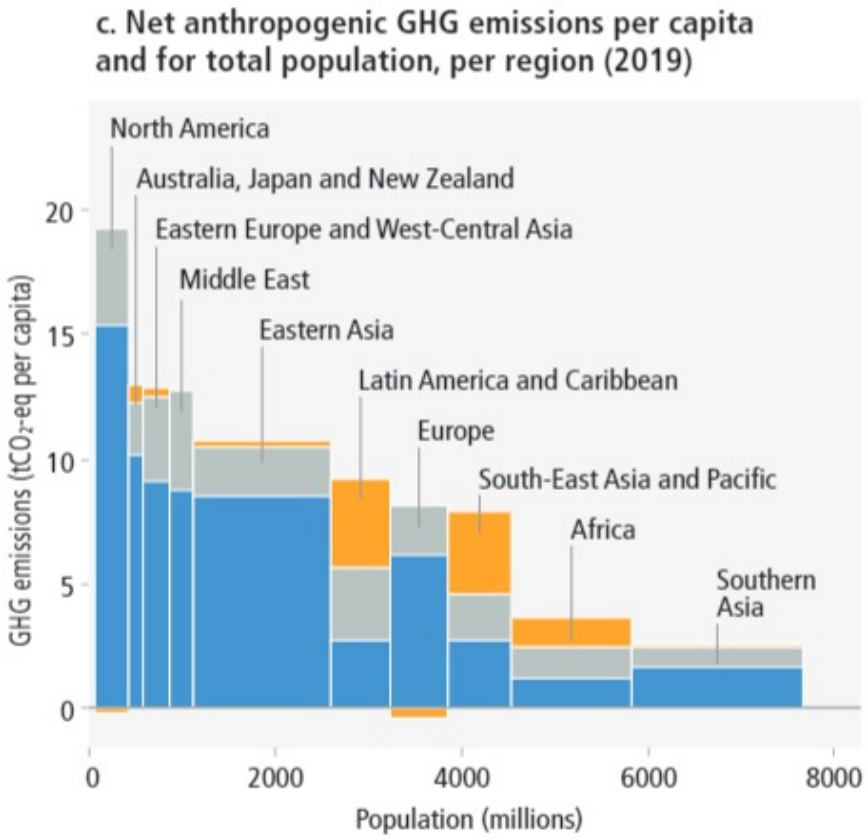
- Sectoral complexity – electricity attribution, LULUCF uncertainties, Urban systems, and more … see SPM sectoral sections, Figure TS.6

Regional emissions:

- % or absolute contributions
- Growth by region?
- Trends & contributions since … when?

… What about cumulative contributions, data uncertainties, and different indices ..?





* Figure SPM.2. With table of specific indices, including intensity, and consumption-based accounting data

Analytic approaches – a broad landscape

Some characterisations

"The biggest market failure in history"
(Nicolas Stern, 2005)

"The perfect moral storm"
(Steve Gardiner, 2011)

A "Super-Wicked" problem
(Lazarus, 2009; Kelly Levin et al, 2012)

"'Psychological distance' - our brains are hard wired to ignore climate change"
(Marshall, 2014; also Weber 2018, 2020; Spence et al 2012)

Four Analytic Frameworks

Aggregate Efficiency

Ethics and Equity

Innovation & transition dynamics

Psychology and politics

Cited and outlined in IPCC Mitigation Report Chapter 1 Section 7, "Four Analytic Frameworks …

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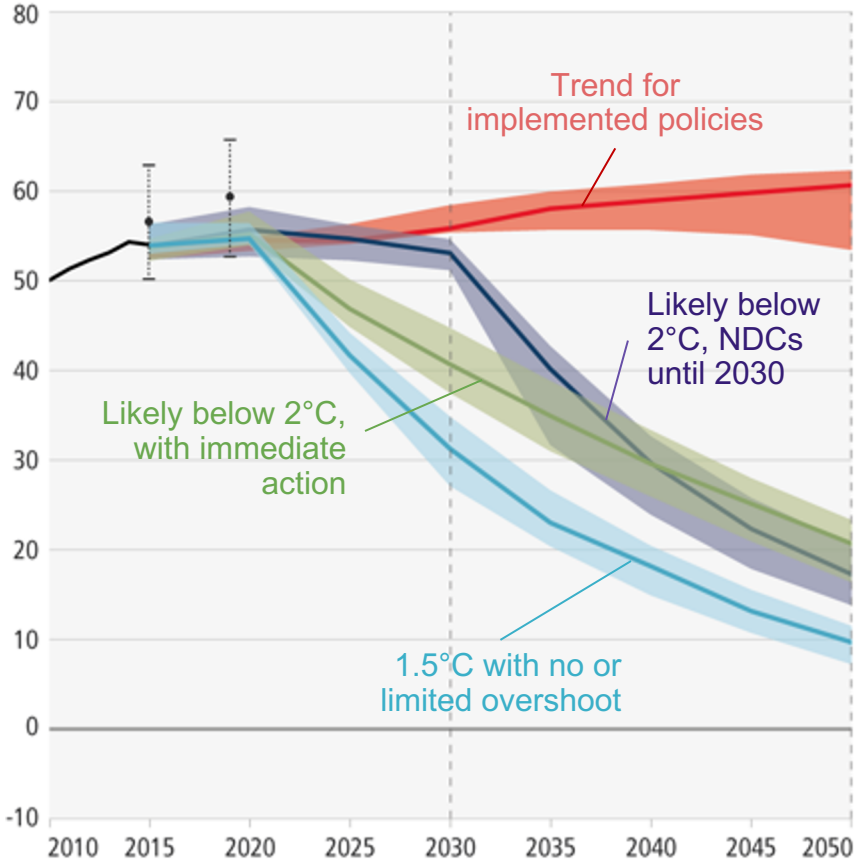
“

Unless there are immediate and deep emissions reductions across all sectors, 1.5°C is beyond reach.



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)

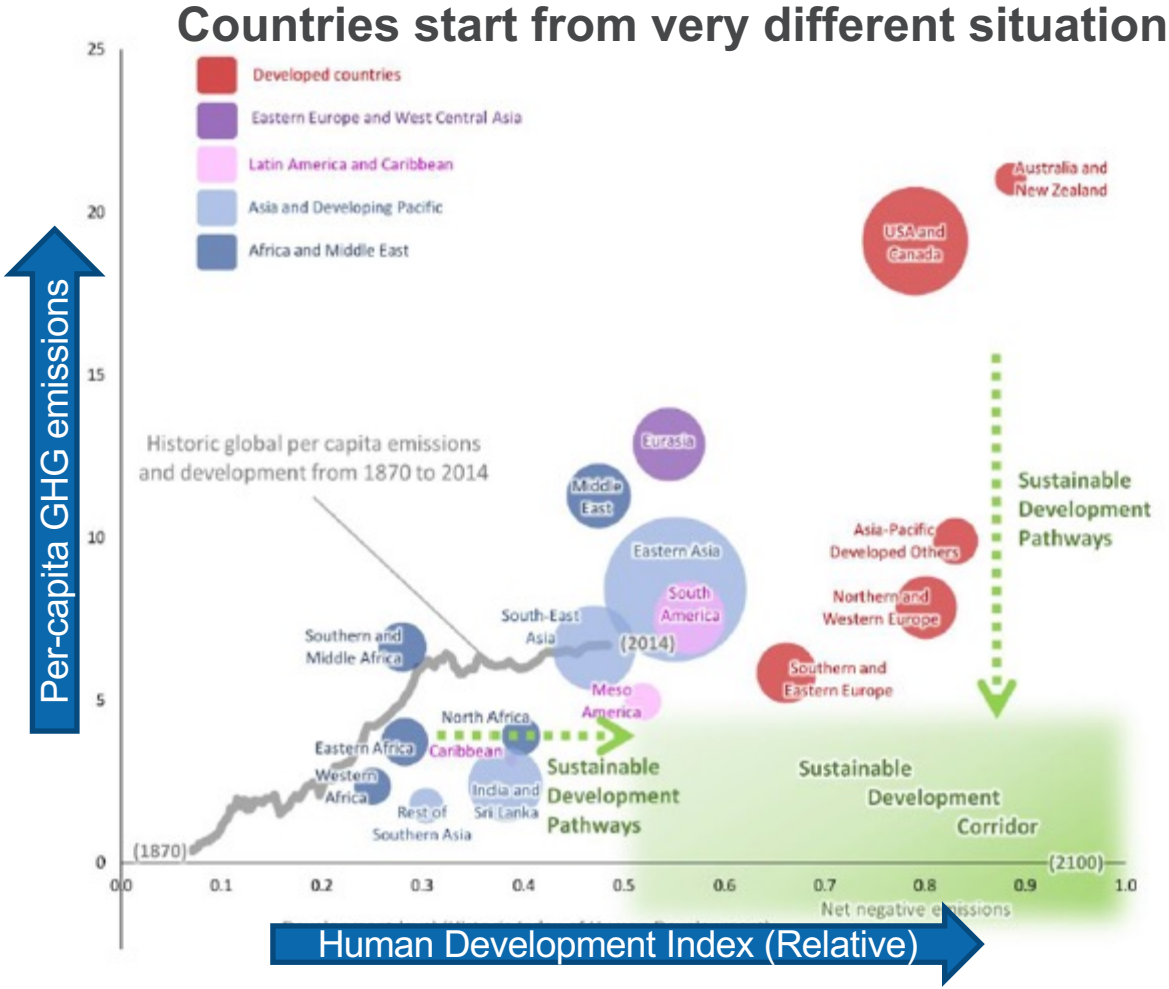


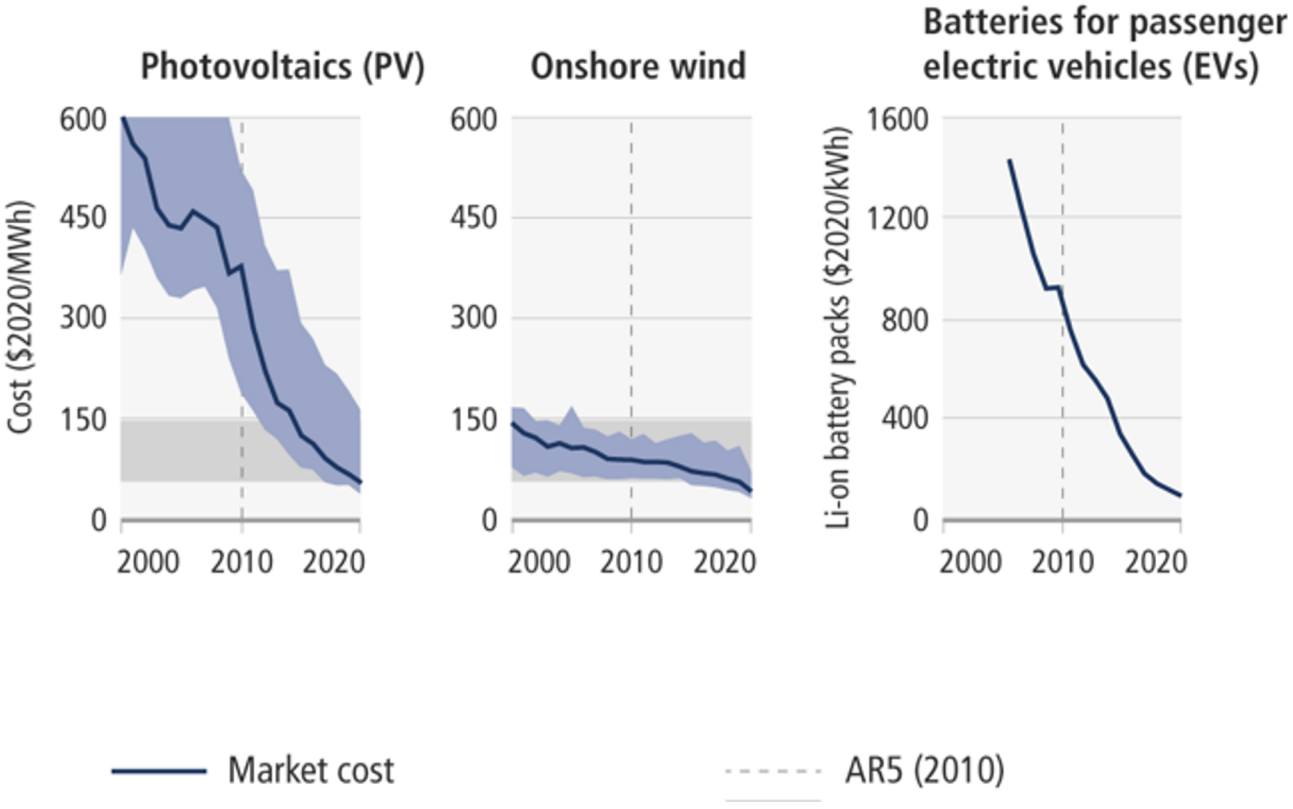
Figure TS.1: Sustainable development pathways towards fulfilling the Sustainable Development Goals

Ethics and equity, inc culture and capacity

- Synergies and trade-offs depend on the development context including inequalities
- Development pathways taken by countries at all stages of economic development impact GHG emissions and hence shape mitigation challenges and opportunities, which vary across countries and regions

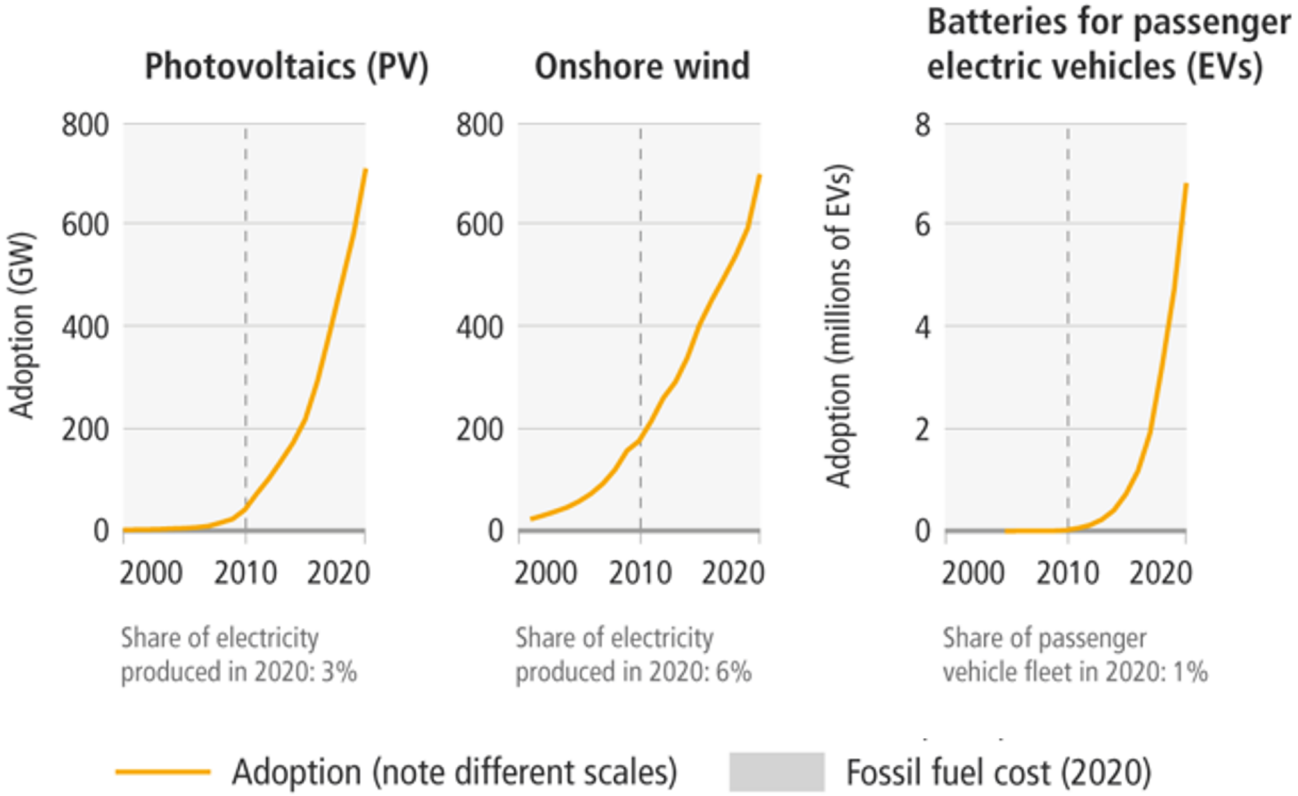
Signs of Progress?

[Charlie Chesvick/IStock.com]



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

Also see Technical Summary, and Chapters 2 and 6



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

Also see Technical Summary, and Chapters 2 and 6

Policy trends and impacts

SPM B5.2 Policy Trends

- Over 20% of global GHG emissions covered by carbon taxes or emissions trading systems, although coverage and prices insufficient ..
- 'Direct' climate laws in 56 countries covering 53% of global
- Remain limited for emissions from agriculture and production of industrial materials and feedstocks
- Annual tracked total financial flows [heavily focused on mitigation] increased by up to 60% 2013/14 to 19/20)
    - are uneven, developed heterogeneously across regions and sectors, and average growth has slowed since 2018.

SPM B5.3 Policy Impacts

- In many countries, policies have enhanced energy efficiency, reduced rates of deforestation and accelerated tech deployment
- At least 18 countries have sustained production-based GHG and consumption-based CO2 emission reductions for longer than 10 years [most having Kyoto targets, exc EITs]
- Mitigation policies have led to avoided global emissions of several Gt CO2-eq/yr:
    - At least 1.8 Gt CO2-eq/yr accounted for by aggregating separate estimates for the effects of economic and regulatory instruments.
    - Growing numbers of laws and executive orders, were estimated to result in 5.9 Gt CO2-eq/yr less in 2016 than otherwise would have been.

Increased evidence of climate action

Some 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**

Glass half empty or half full?

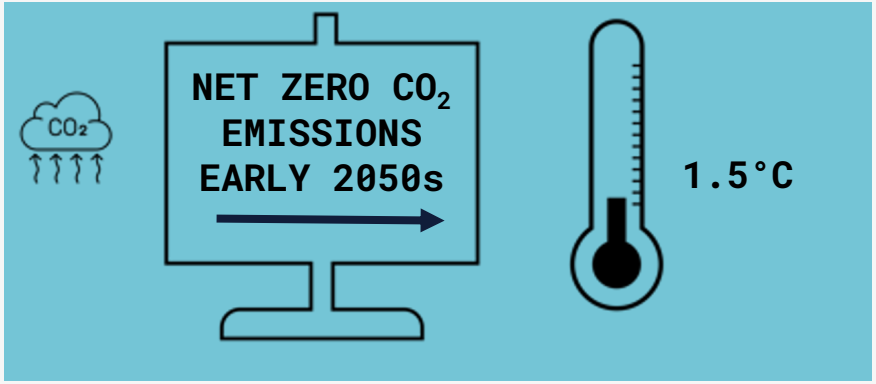
Technical Summary, Table TS.1 Signs of Progress and Continuing Challenges

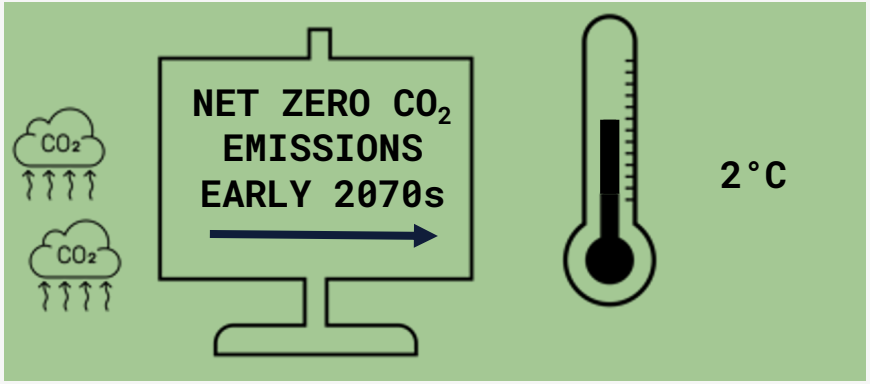
Table TS.1: Signs of Progress and Continuing Challenges

Signs of progress	Continuing challenges
Emissions trends	

- Emission Trends (3)
- Sectors (6)
- Policies and investment (4)

The longer term: temperature will stabilise when we reach net zero carbon dioxide emissions





(based on IPCC-assessed scenarios, indicating prompt and deep emission reduction scenarios to be the most cost-effective path towards the Paris temperature range)

‘Stranded Assets’ and carbon budgets

Projected cumulative future CO2 emissions over the lifetime of existing and currently planned fossil fuel infrastructure without additional abatement are approximately equal to total cumulative net CO2 emissions in pathways that limit warming to 2°C (>67%) [and exceed those in pathways for 1.5°C (>50%) with no or limited overshoot. (*high confidence*)

B7.1 Historical operating patterns of existing infrastructure … without additional abatement

- future CO2, the majority in the power sector, amount to 660 [460–890] $GtCO_2$
- Or 850 [600–1100] $GtCO_2$ when unabated emissions from currently planned infrastructure in power sector included

Compares to 580 [460–890] $GtCO_2$ for 1.5 (>50%), and 890 [640–1160] for 2C(>67%)

B7.3 Most remaining fossil fuel CO2 emissions projected to occur *outside* power sector, mainly in industry and transport

- ***Alignment in power sector:*** Decommissioning and reduced utilisation of existing fossil fuel based power sector infrastructure, retrofitting existing installations with CCS switches to low carbon fuels, and cancellation of new coal installations without CCS are major options

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WMO UNEP

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

See IPCC WGIII Official Launch Presentation for overview of Sector options; SPM also extensive info on modelled / illustrative pathways

Demand and services

Energy

Land use

Industry

Urban

Buildings

Transport

- [6 Sectoral slides from official IPCC launch presentation, separate file]

Accelerated climate action – cross-sectoral costs, actions, benefits?

[Duy Pham/Unsplash]

Emissions mitigation and SD
- Aggregate global economics

C.12.2 The aggregate effects of [CC] mitigation on global GDP are **small compared to global projected growth**

- Global GDP projected to at least double by 2050
- Neglecting CC damages, pathways <2°C (>67%):
  - Global GDP 1.3–2.7% below such "reference" projections
  - Annual global GDP growth rate 0.04–0.09 percentage points lower
- But **large variations at country levels** depending on national circumstances, level of mitigation and how achieved ..

C.12.3 Global cost of limiting warming to 2°C over 21st century is lower than the global economic benefits of reducing warming, unless:

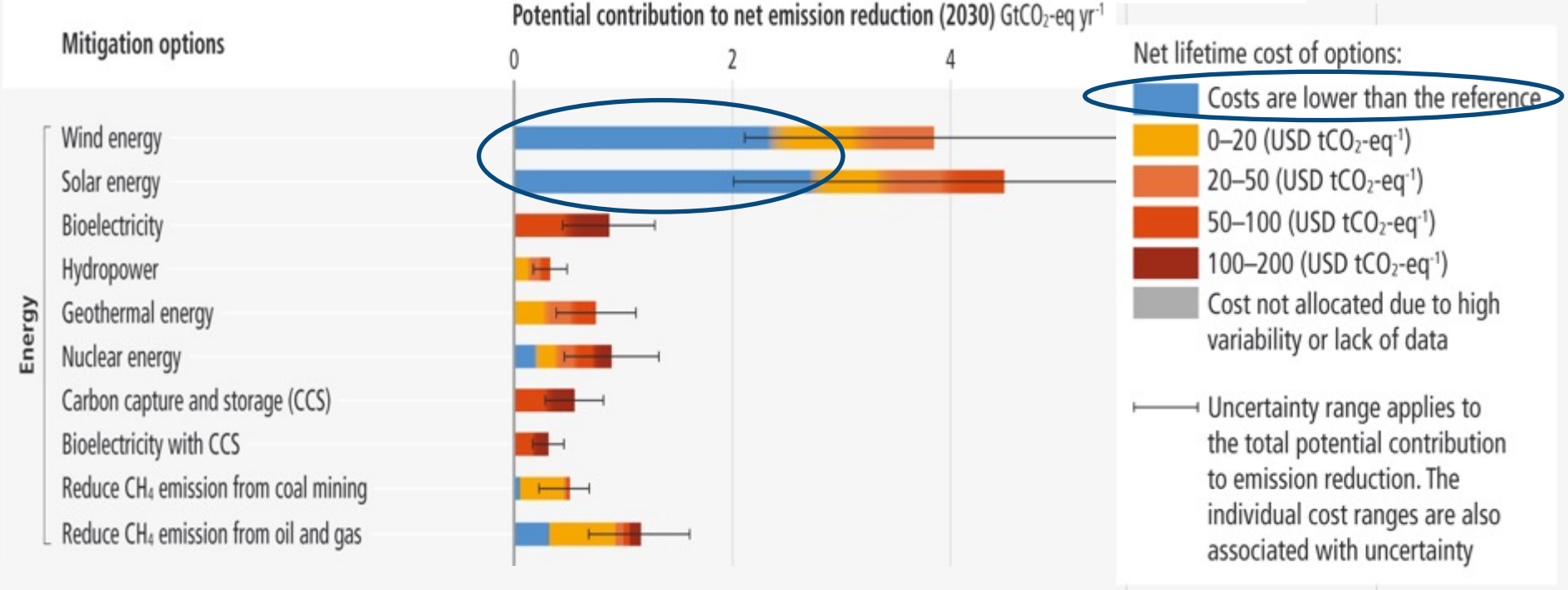
- i) climate damages are towards the low end of the range; or,
- ii) future damages are discounted at high rates

- [FN 69]. Peaking global emissions by 2025 entails **more rapid near-term transitions and higher up-front investments, but brings long-term economic gains**, as well as earlier benefits of avoided climate change impacts. Precise magnitude is difficult to quantify.

Emissions mitigation and SD

Technology, innovation and transitions

Technology progress has potentially alleviated trade-offs for some countries in key sectors: "..synergies between SD and energy efficiency and renewable energy, urban planning with more green spaces, reduced air pollution, and demand side .."



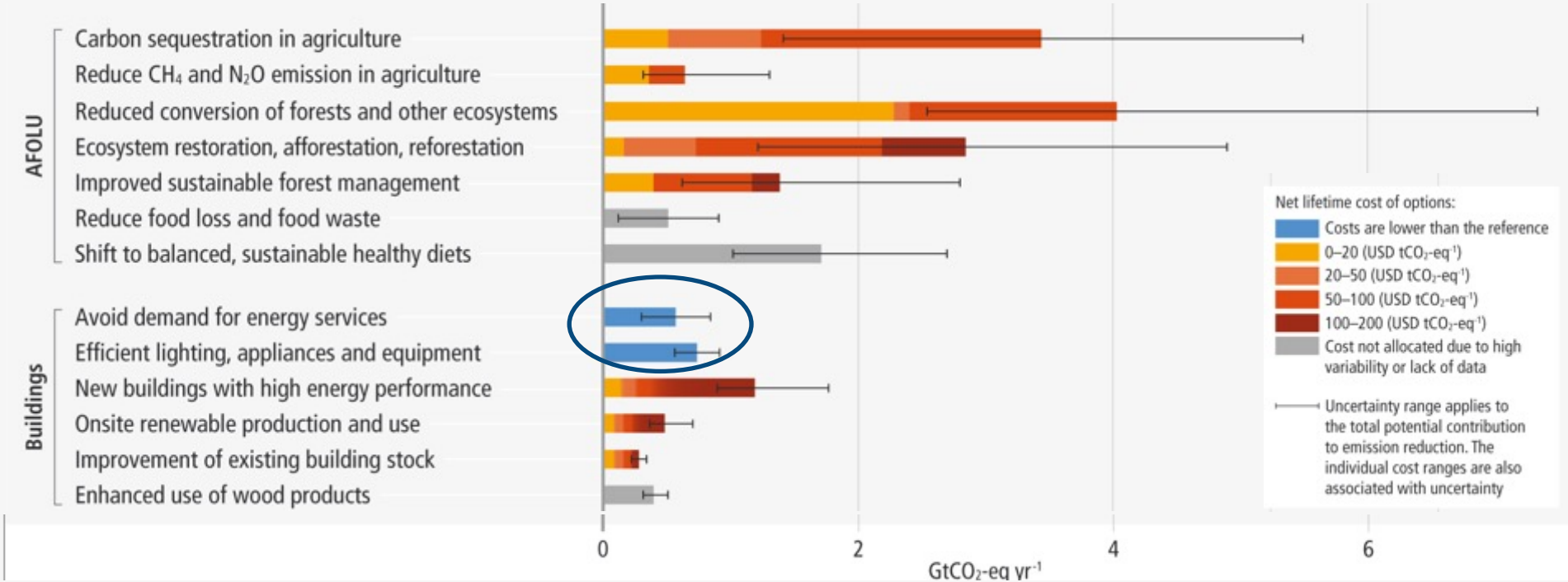


Figure SPM.7 (panels AFOLU, Buildings)

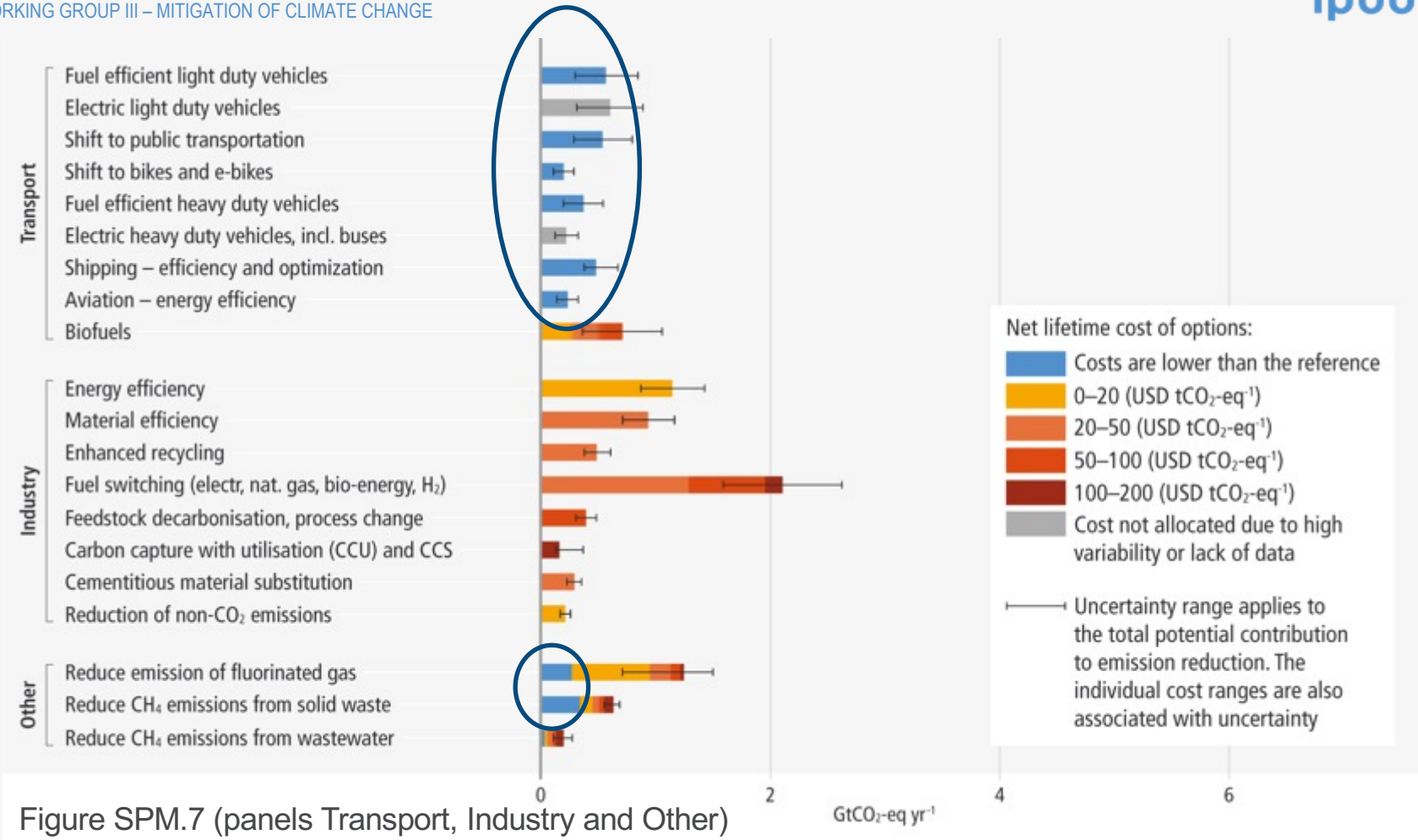


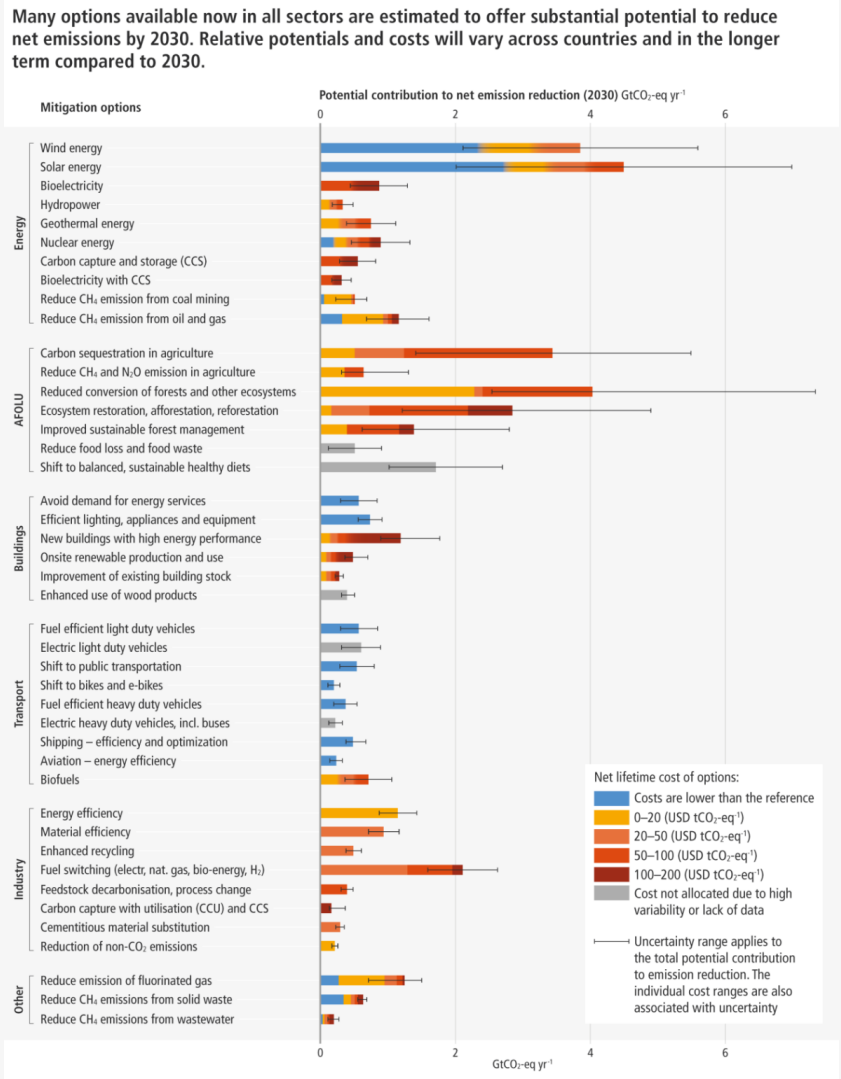
Figure SPM.7 (panels Transport, Industry and Other)

Costs and Potentials - overview

Figure SPM.7: Overview of mitigation options and their estimated ranges of costs ad potentials in 2030.

Mitigation options costing USD100 tCO2-eq-1 or less could reduce global GHG emissions by at least half the 2019 level by 2030

- (options costing less than USD20 tCO2-eq-1 are estimated to make up more than half of this potential)
- For a smaller part of potential, deployment leads to larger net cost
- Large contributions with costs less than USD20 from solar and wind energy, energy efficiency improvements, reduced conversion of natural ecosystems, and CH4 emissions reductions (coal mining, oil and gas, waste)
- The mitigation potentials and mitigation costs of individual technologies in a specific context or region may differ greatly from the provided estimates.



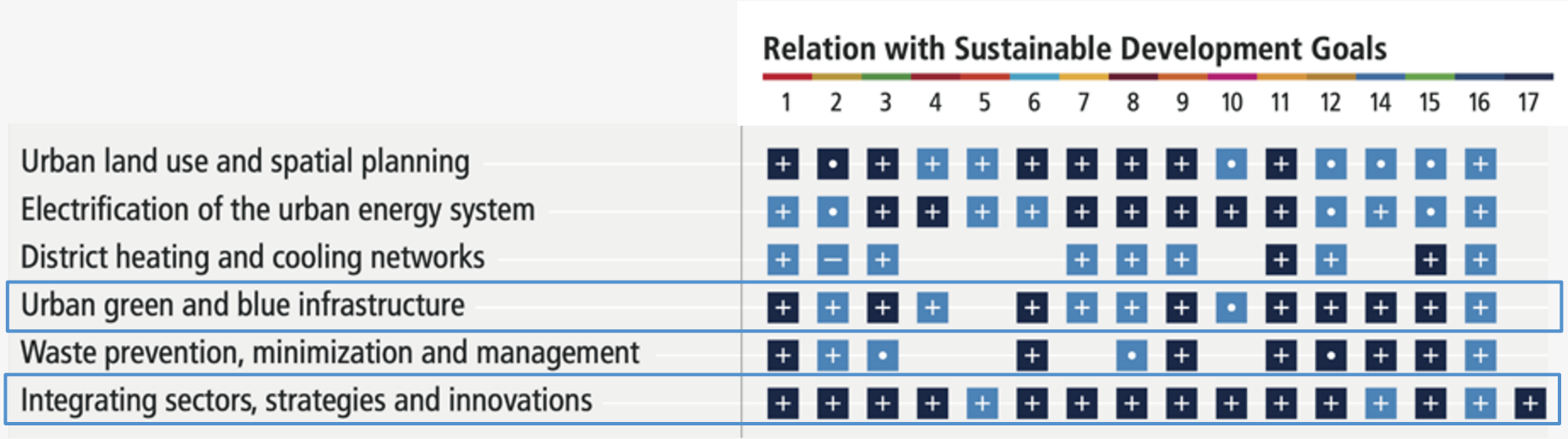
[Tobias/Unsplash, Rwanda Green Fund /CC BY-SA 2.0]

Accelerated climate action is critical to sustainable development

[Duy Pham/Unsplash]


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
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 PARTNERSHIPS FOR THE GOALS

Mitigation options in urban areas



See IPCC SPM for other sectors

Progress on the alignment of financial flows towards the goals of the Paris Agreement remains slow

- Access to finance at adequate terms represents a critical enabling factor for the low carbon transition
- Tracked climate finance flows increased by approx. 60% between 2013/14 and 2019/2020 remaining heavily focused on mitigation
- Fundamental inequities in access to finance as well as its terms and conditions, and countries exposure to physical impacts of climate change overall result in a worsening outlook for a global just transition
- The relatively slow implementation of commitments by countries and stakeholders in the financial system to scale up climate finance reflects neither the urgent need for ambitious climate action, nor the economic rationale for ambitious climate action

Seven Urgent Options> Scaling Up Climate Finance to Developing Regions

Accelerated financial support *from developed to developing countries* ***is critical enabler*** of low-GHG and just transitions: address high costs, terms and conditions of finance, and vulnerability

Scaled up public grants for mitigation and adaptation funding for vulnerable countries; cost-effective and high social returns in access to basic energy and related SDG goals

Increased levels of public and publicly mobilized private finance in the context of unmet $100bn/yr, a 'redesigned goal' essential in scale, priorities, instruments and transparency in context of escalating gaps ('trillions, not billions') and macro-financial headwinds

Public guarantees to reduce risks, lower budgetary cost and leverage private flows at lower cost

Support local capital markets development

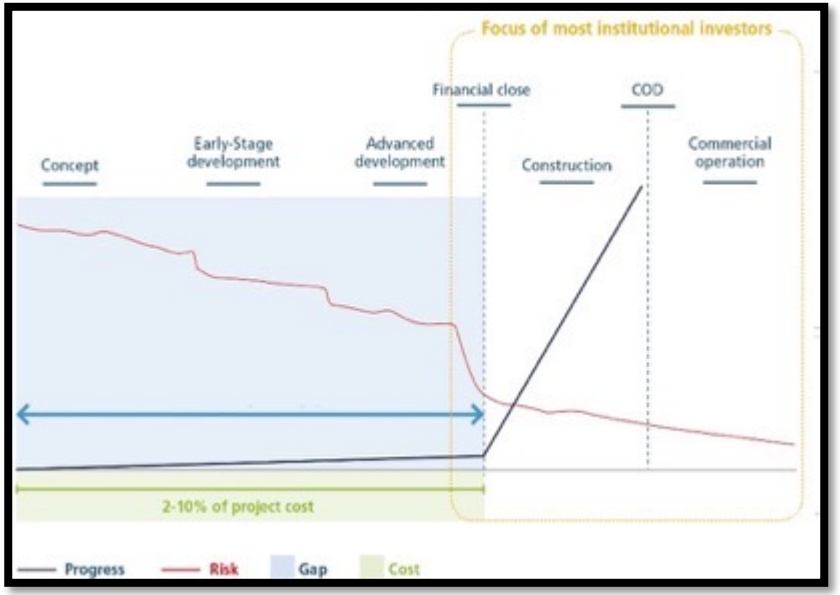
Build greater trust in international cooperation ***processes*** (definitions, information, capacity, conditions, partners)

Coordinated post-pandemic recovery with increased climate finance flows, in developing regions facing high debt costs, debt distress and macroeconomic headwinds

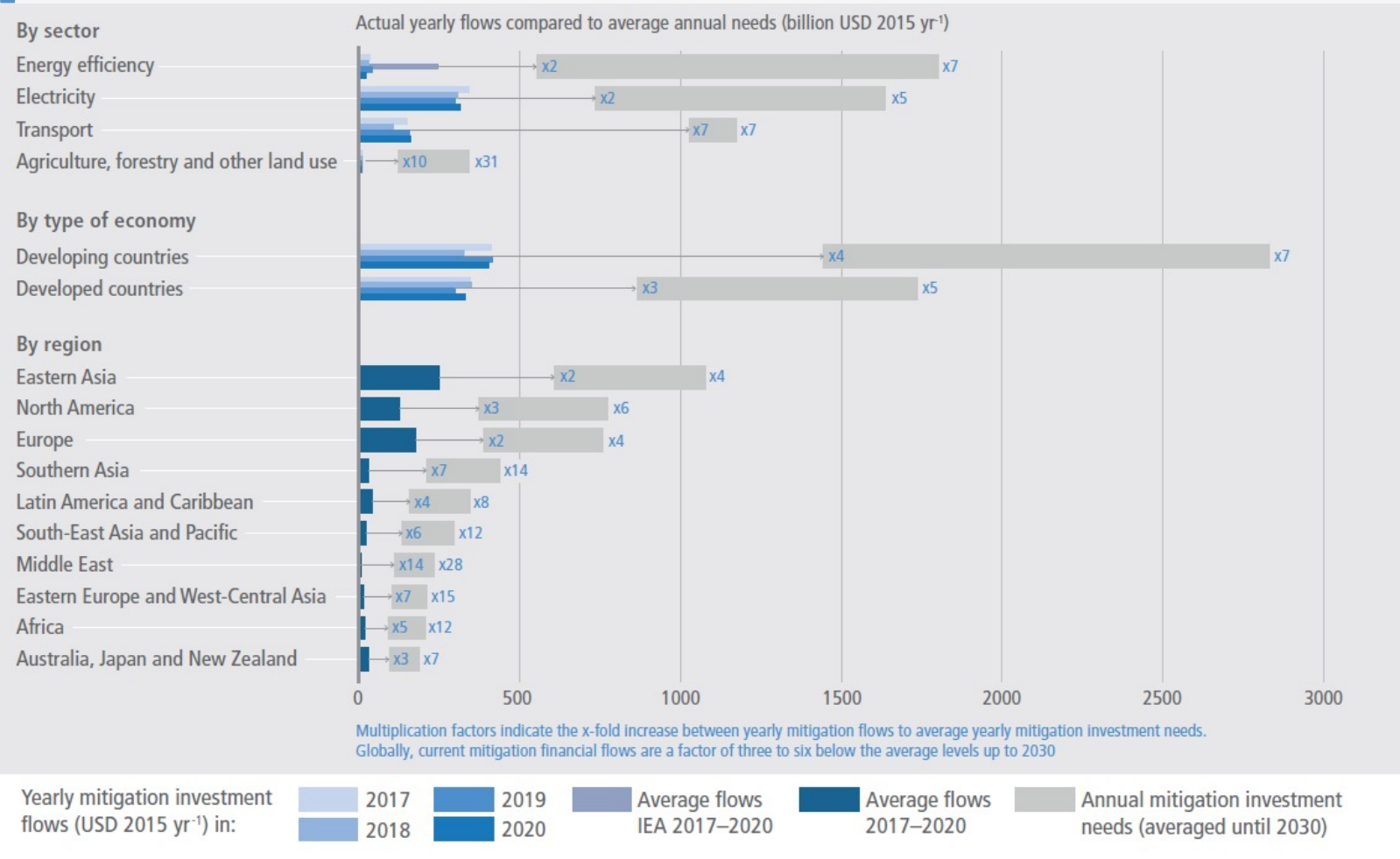
Early-Stage Risk Reduction in Capital Markets Critical

Highest risks of failure are at initial stages

- Grants and technology support can de-risk early project preparation
- Concessional finance, grants and guarantees can de-risk second stage
- Institutional investors pick-up the later and mature financing stage
- Facilitated by standardised national infrastructure style bonds, funds
- Partial credit and sovereign guarantees can play a key role
- As well as overall policy support
- Cross-Border risks are the highest, because of 'home-bias' factors



Finance needs to grow x 3-6 by 2030



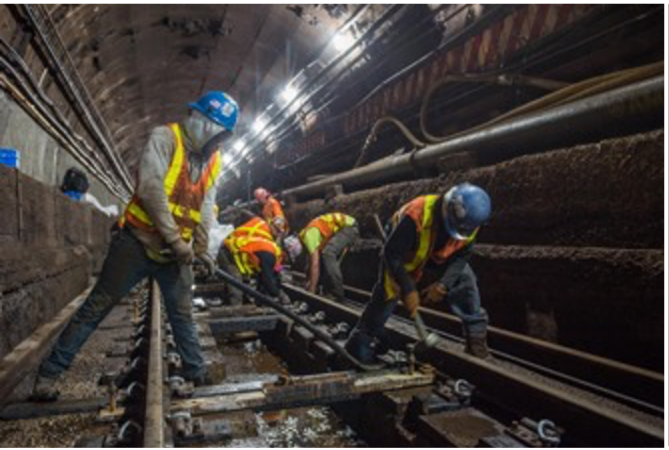
IPCC AR6 Technical Summary,

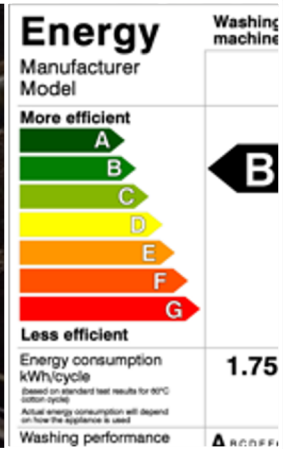
Figure TS.25: *Mitigation investment flows fall short of investment needs across all sectors and types of economy, particularly in developing countries*

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.





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

[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.]