Sixth Assessment Report
WORKING GROUP III – MITIGATION OF CLIMATE CHANGE

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

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

Messaging across the Working Groups

WG I	It is indisputable that human activities are causing climate change, making extreme climate events, including heat waves, heavy rainfall, and droughts, more frequent and severe.
WG II	Climate change is a grave and mounting threat to our wellbeing and a healthy planet. Our actions today will shape how people adapt and nature responds to increasing climate risks.
WG III	There is increased evidence of climate action. There are options available now in every sector that can at least halve emissions by 2030.

The WG III Summary for Policymakers tells a story

Recent developments and current trends	Emissions Technology Policy Emissions and implementation gaps
System transformations to limit global warming	Global emission and mitigation pathways Mitigation options by sector Integration: Costs and potentials; costs and benefits
Mitigation, adaptation and sustainable development	Linkages Just transition
Strengthening the response	Feasibility Governance and policy Finance Technology International cooperation

Novel elements

- Mitigation and development (“shifting development pathways towards sustainability”)
- Demand, services and social aspects of mitigation (new chapter)
- Innovation, technology development and transfer (new chapter)
- More extensive treatment of carbon dioxide removal (CDR)
- Characteristics of modelled global emissions pathways in the literature

WG III topics to be explored further at SB56

Structured Expert Dialogue for PR2

- Information and knowledge gaps filled since AR5, and remaining to be filled
- Aggregate effect of steps taken by Parties
- Progress in establishing enabling conditions
- Historical perspectives
- Dynamics of long-term scenarios
- Sources/means of finance

Research dialogue

- Carbon dioxide removal

Technical dialogue for GST

- Emissions and pathways
- Technology
- Finance

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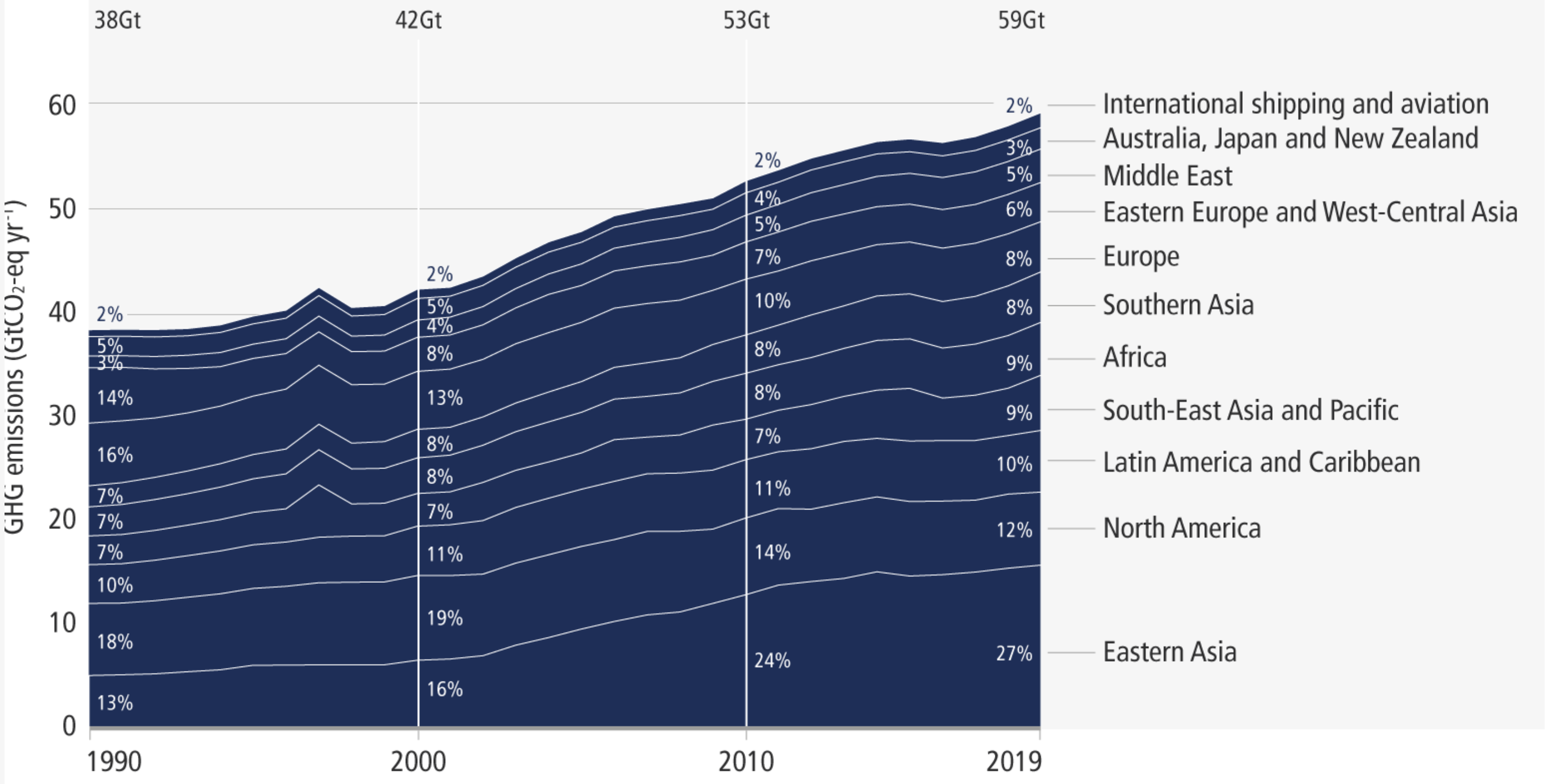
Emissions are continuing to rise

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



2010-2019: Average annual greenhouse gas emissions at highest levels in human history

CO2 emissions have already rebounded from the COVID-19 related temporary drop

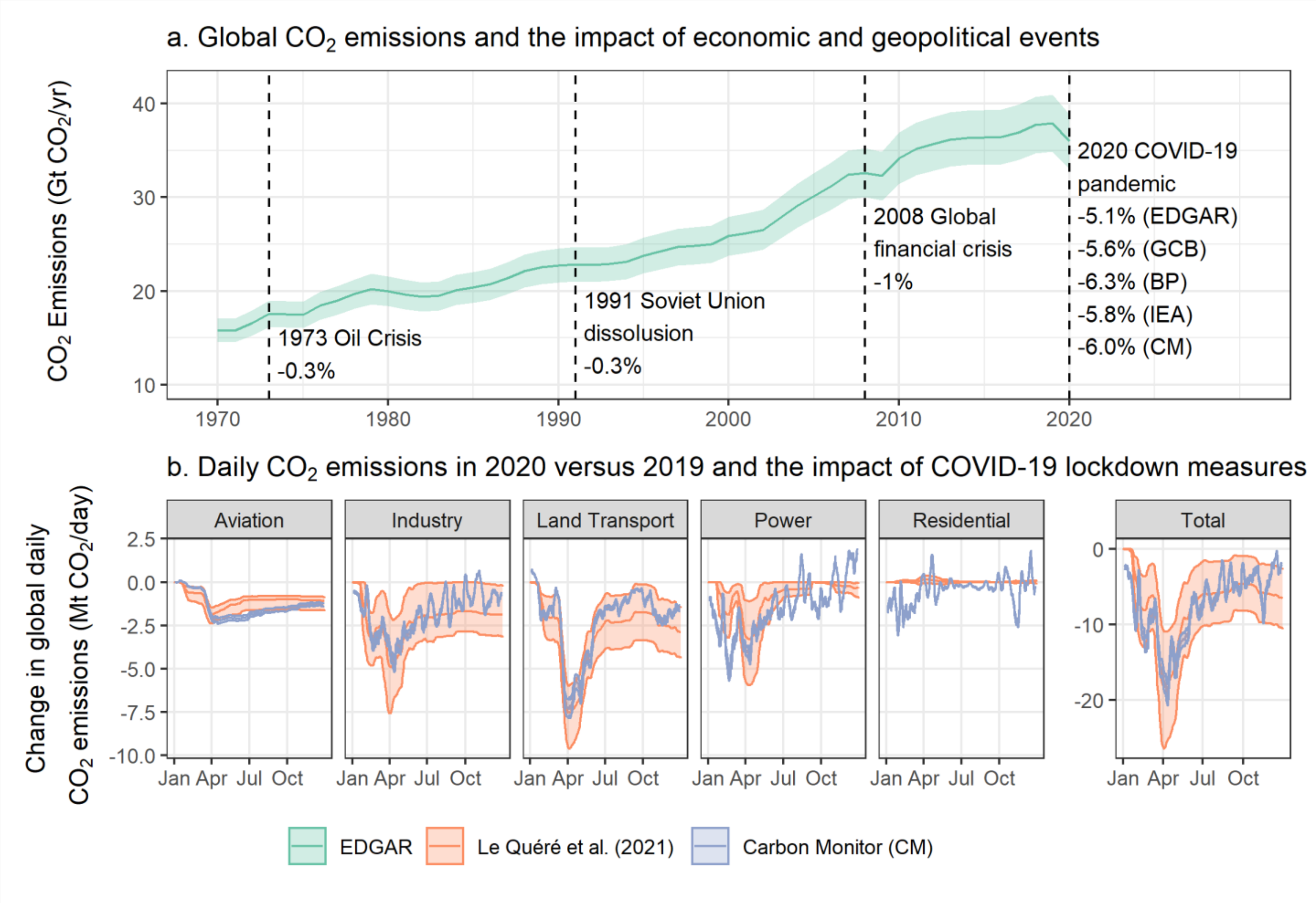
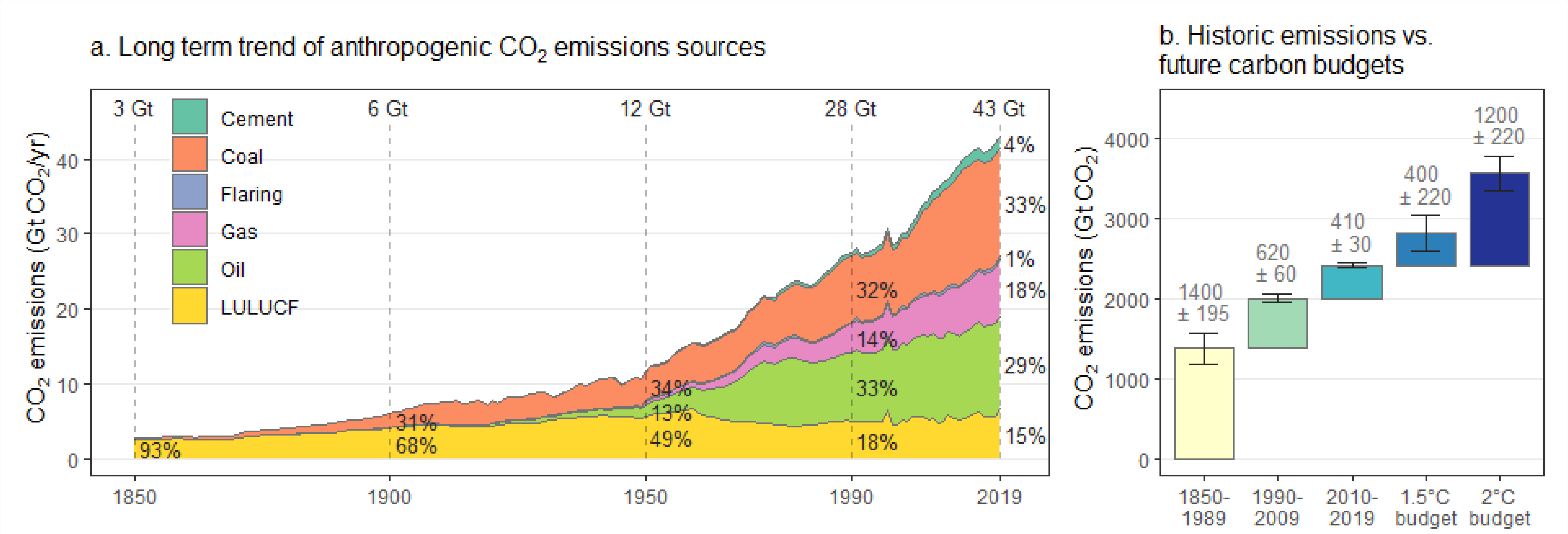


FIGURE 2.6; SUMMARY FOR POLICY MAKERS B.1.4

- Emissions of CO_2–FFI dropped temporarily in the first half of 2020 due to responses to the COVID-19 pandemic
- The annual average CO_2-FFI emissions reduction in 2020 relative to 2019 was about 5.8% [5.1-6.3%], or 2.2 [1.9-2.4] $GtCO_2$.
- However, more granular data shows that emissions had already rebounded the end of the year.

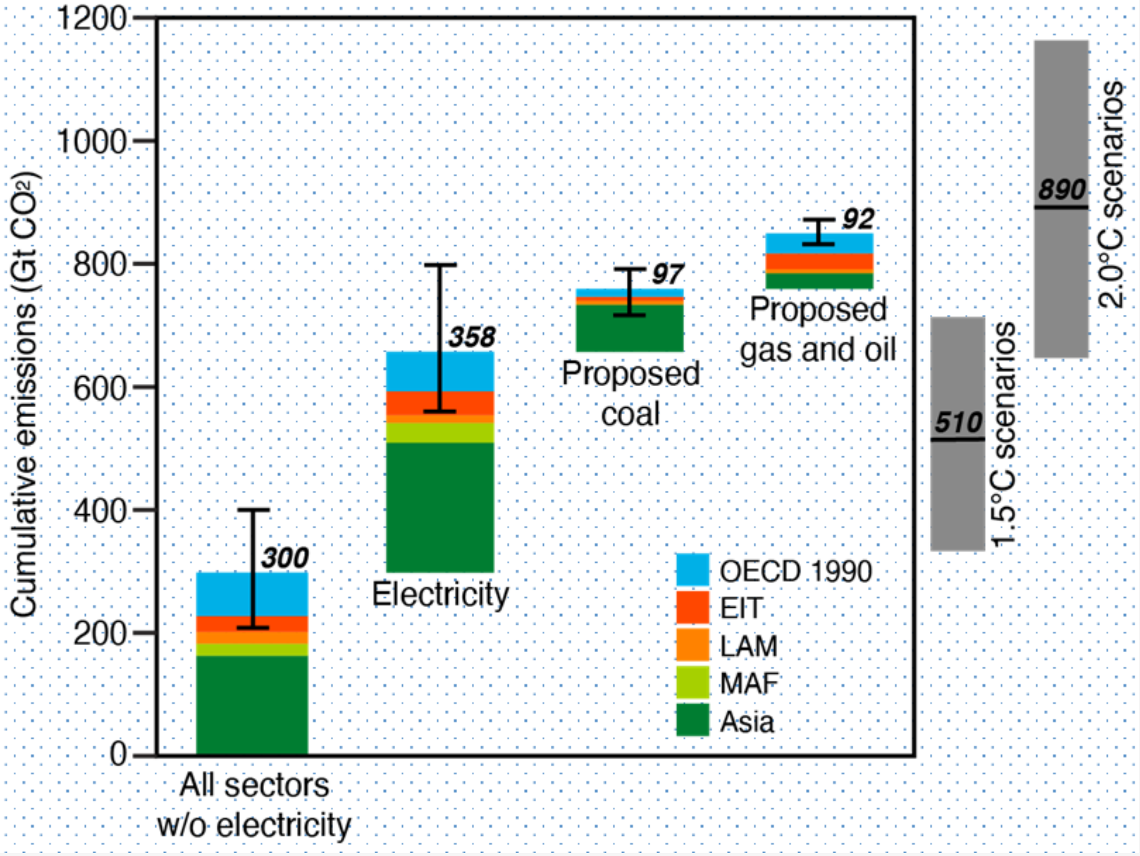
Still stuck in the era of fossil fuels



WGIII TECHNICAL SUMMARY – FIGURE TS.3

- We are still on a sustained 250 years of global emissions growth
- Carbon emissions of the last decade are about the same size as the remaining carbon budget for keeping global warming to 1.5°C with a 50% probability

Emissions from existing energy infrastructure exceed those consistent with pathways that limit warming to 1.5°C

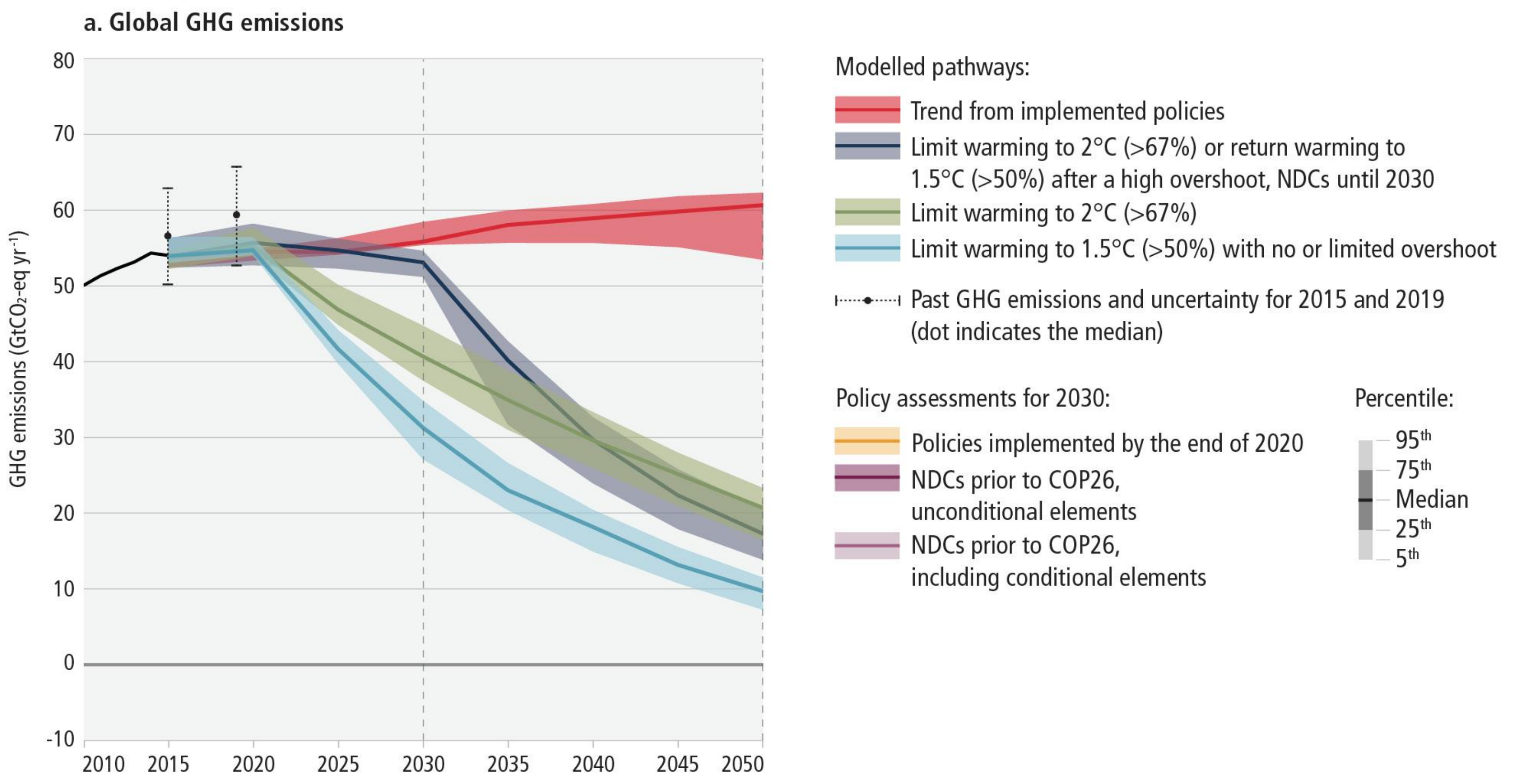


TECHNICAL SUMMARY FIGURE TS.8; SUMMARY FOR POLICY MAKERS – B.7

- Emissions from existing and planned fossil infrastructure are higher than those consistent with limiting warming to 1.5°C
- Largest discrepancy in emissions from power sector infrastructure.

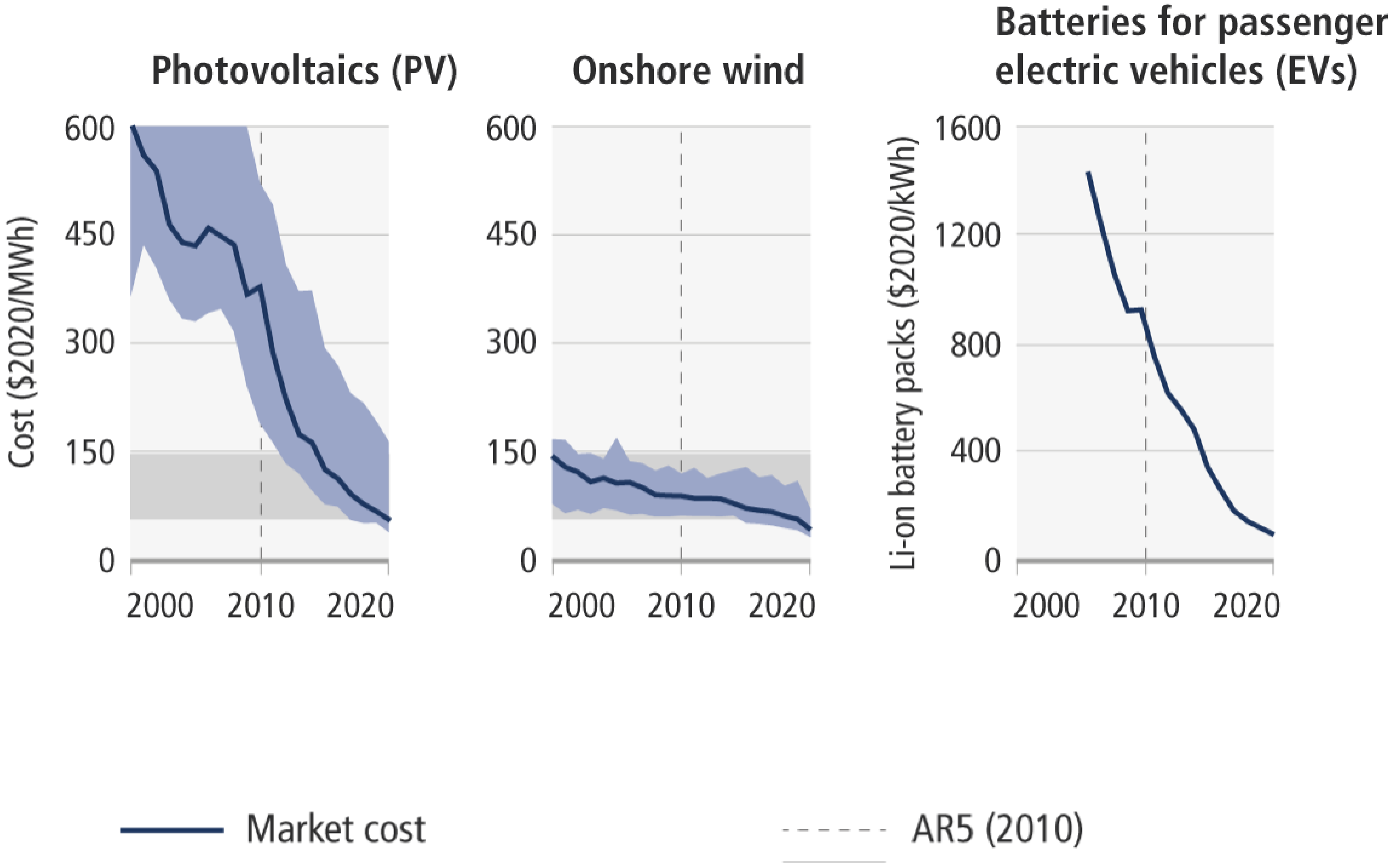
NDCs are insufficient to keep 1.5°C well within reach

Projected global GHG emissions from NDCs announced prior to COP26 would make it likely that warming will exceed 1.5°C and also make it harder after 2030 to limit warming to below 2°C.



- Emissions gaps in 2030 between pledges (NDCs) and optimal pathways for limiting warming to 1.5°C and 2°C
- Current GHG emissions pledges likely involve high temperature overshoot
- Such pathways are subject to climate-related risks and increased feasibility concerns.

Evidence of progress with renewables



SUMMARY FOR POLICY MAKERS – FIGURE SPM.3

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

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Emissions pathways (SPM C1-C3)

Keywan Riahi (IIASA)
Coordinating Lead Autor, Chapter 3

SBSTA, 8 June
Special Event (11:00-14:00)

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

WGIII scenario collection, vetting and assessment

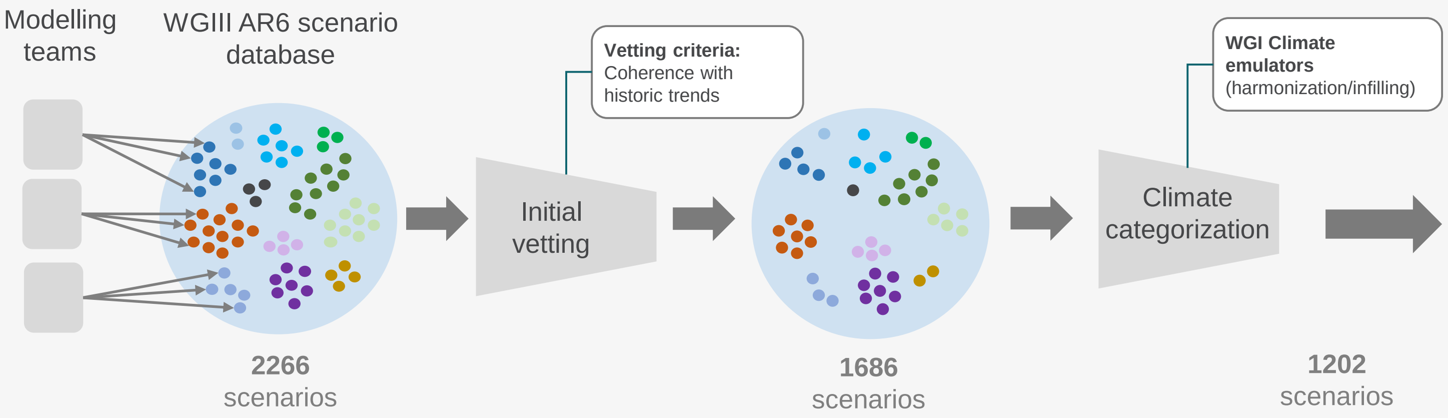
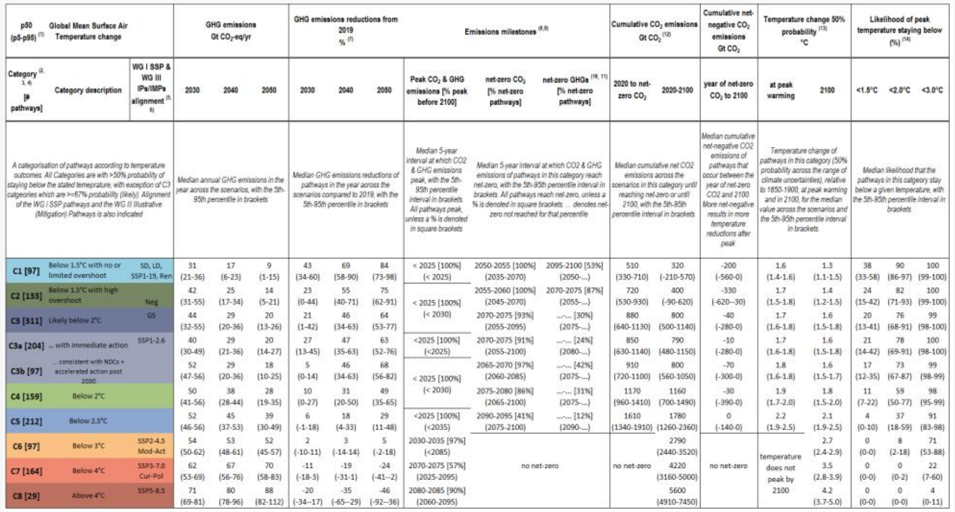


Table SPM1



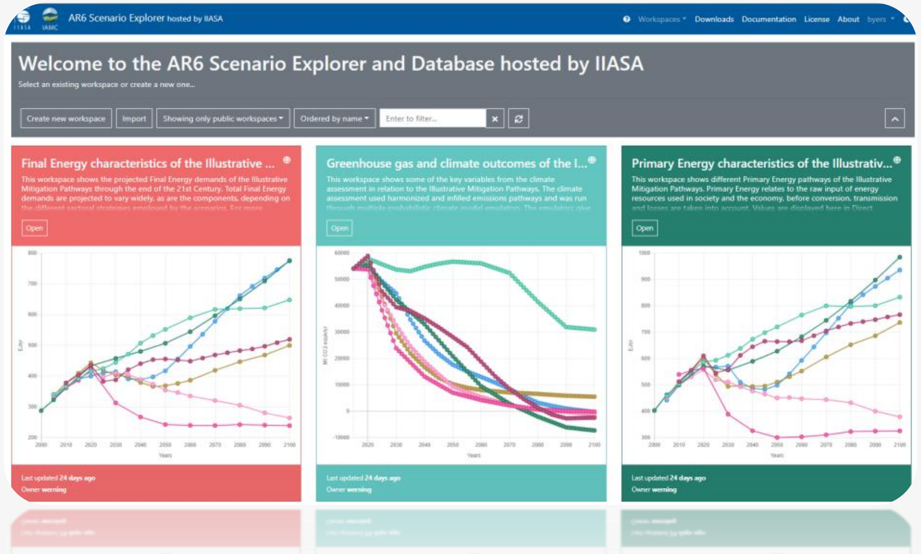
Category [# pathways]	Category description	WG I SSP & WG III IPs/IMPs alignment	GHG emissions Gt CO_2-eq/yr 2030	2040	2050	GHG emissions reductions from 2019 % 2030	2040	2050	Emissions milestones: Peak CO_2 & GHG emissions [% peak before 2100]	net-zero CO_2 [% net-zero pathways]	net-zero GHGs [% net-zero pathways]	Cumulative CO_2 emissions Gt CO_2: 2020 to net-zero CO_2	2020-2100	Cumulative net-negative CO_2 emissions Gt CO_2: year of net-zero CO_2 to 2100	Temperature change 50% probability °C: at peak warming	2100	Likelihood of peak temperature staying below (%): <1.5°C	<2.0°C	<3.0°C
A categorisation of pathways according to temperature outcomes. All Categories are with >50% probability of staying below the stated temeprature, with exception of C3 catgeories which are >=67% probability (likely). Alignment of the WG I SSP pathways and the WG III Illustrative (Mitigation) Pathways is also indicated			Median annual GHG emissions in the year across the scenarios, with the 5th-95th percentile in brackets			Median GHG emissions reductions of pathways in the year across the scenarios compared to 2019, with the 5th-95th percentile in brackets			Median 5-year interval at which CO2 & GHG emissions peak, with the 5th-95th percentile interval in brackets. All pathways peak, unless a % is denoted in square brackets	Median 5-year interval at which CO2 & GHG emissions of pathways in this category reach net-zero, with the 5th-95th percentile interval in brackets. All pathways reach net-zero, unless a % is denoted in square brackets. … denotes net-zero not reached for that percentile		Median cumulative net CO2 emissions across the scenarios in this category until reaching net-zero or until 2100, with the 5th-95th percentile interval in brackets		Median cumulative net-negative CO2 emissions of pathways that occur between the year of net-zero CO2 and 2100. More net-negative results in more temperature reductions after peak	Temperature change of pathways in this category (50% probability across the range of climate uncertainties), relative to 1850-1900, at peak warming and in 2100, for the median value across the scenarios and the 5th-95th percentile interval in brackets		Median likelihood that the pathways in this catgeory stay below a given temperature, with the 5th-95th percentile interval in brackets		
C1 [97]	Below 1.5°C with no or limited overshoot	SD, LD, SSP1-19, Ren	31 (21-36)	17 (6-23)	9 (1-15)	43 (34-60)	69 (58-90)	84 (73-98)	< 2025 [100%] (< 2025)	2050-2055 [100%] (2035-2070)	2095-2100 [53%] (2050-...)	510 (330-710)	320 (-210-570)	-200 (-560-0)	1.6 (1.4-1.6)	1.3 (1.1-1.5)	38 (33-58)	90 (86-97)	100 (99-100)
C2 [133]	Below 1.5°C with high overshoot	Neg	42 (31-55)	25 (17-34)	14 (5-21)	23 (0-44)	55 (40-71)	75 (62-91)	< 2025 [100%] (< 2030)	2055-2060 [100%] (2045-2070)	2070-2075 [87%] (2055-...)	720 (530-930)	400 (-90-620)	-330 (-620--30)	1.7 (1.5-1.8)	1.4 (1.2-1.5)	24 (15-42)	82 (71-93)	100 (99-100)
C3 [311]	Likely below 2°C	GS	44 (32-55)	29 (20-36)	20 (13-26)	21 (1-42)	46 (34-63)	64 (53-77)		2070-2075 [93%] (2055-2095)	...-... [30%] (2075-...)	880 (640-1130)	800 (500-1140)	-40 (-280-0)	1.7 (1.6-1.8)	1.6 (1.5-1.8)	20 (13-41)	76 (68-91)	99 (98-100)
C3a [204]	... with immediate action	SSP1-2.6	40 (30-49)	29 (21-36)	20 (14-27)	27 (13-45)	47 (35-63)	63 (52-76)	<2025 [100%] (<2025)	2070-2075 [91%] (2055-2100)	...-... [24%] (2080-...)	850 (630-1140)	790 (480-1150)	-10 (-280-0)	1.7 (1.6-1.8)	1.6 (1.5-1.8)	21 (14-42)	78 (69-91)	100 (98-100)
C3b [97]	... consistent with NDCs + accelerated action post 2030		52 (47-56)	29 (20-36)	18 (10-25)	5 (0-14)	46 (34-63)	68 (56-82)	< 2025 [100%] (< 2030)	2065-2070 [97%] (2060-2085)	...-... [42%] (2075-...)	910 (720-1100)	800 (560-1050)	-70 (-300-0)	1.8 (1.6-1.8)	1.6 (1.5-1.7)	17 (12-35)	73 (67-87)	99 (98-99)
C4 [159]	Below 2°C		50 (41-56)	38 (28-44)	28 (19-35)	10 (0-27)	31 (20-50)	49 (35-65)		2075-2080 [86%] (2065-2100)	...-... [31%] (2075-...)	1170 (960-1410)	1160 (700-1490)	-30 (-390-0)	1.9 (1.7-2.0)	1.8 (1.5-2.0)	11 (7-22)	59 (50-77)	98 (95-99)
C5 [212]	Below 2.5°C		52 (46-56)	45 (37-53)	39 (30-49)	6 (-1-18)	18 (4-33)	29 (11-48)	<2025 [100%] (<2035)	2090-2095 [41%] (2075-2100)	...-... [12%] (2090-...)	1610 (1340-1910)	1780 (1260-2360)	0 (-140-0)	2.2 (1.9-2.5)	2.1 (1.9-2.5)	4 (0-10)	37 (18-59)	91 (83-98)
C6 [97]	Below 3°C	SSP2-4.5 Mod-Act	54 (50-62)	53 (48-61)	52 (45-57)	2 (-10-11)	3 (-14-14)	5 (-2-18)	2030-2035 [97%] (<2085)	no net-zero		no net-zero	2790 (2440-3520)	no net-zero	temperature does not peak by 2100	2.7 (2.4-2.9)	0 (0-0)	8 (2-18)	71 (53-88)
C7 [164]	Below 4°C	SSP3-7.0 Cur-Pol	62 (53-69)	67 (56-76)	70 (58-83)	-11 (-18-3)	-19 (-31-1)	-24 (-41--2)	2070-2075 [57%] (2025-2095)				4220 (3160-5000)			3.5 (2.8-3.9)	0 (0-0)	0 (0-2)	22 (7-60)
C8 [29]	Above 4°C	SSP5-8.5	71 (69-81)	80 (78-96)	88 (82-112)	-20 (-34--17)	-35 (-65--29)	-46 (-92--36)	2080-2085 [90%] (2060-2095)				5600 (4910-7450)			4.2 (3.7-5.0)	0 (0-0)	0 (0-0)	4 (0-11)

190 Models (91+ modeling families):

- ✓ 98 globally comprehensive,
- ✓ 71 national or multi-regional,
- ✓ 20 sectoral models
- ✓ Input and output data

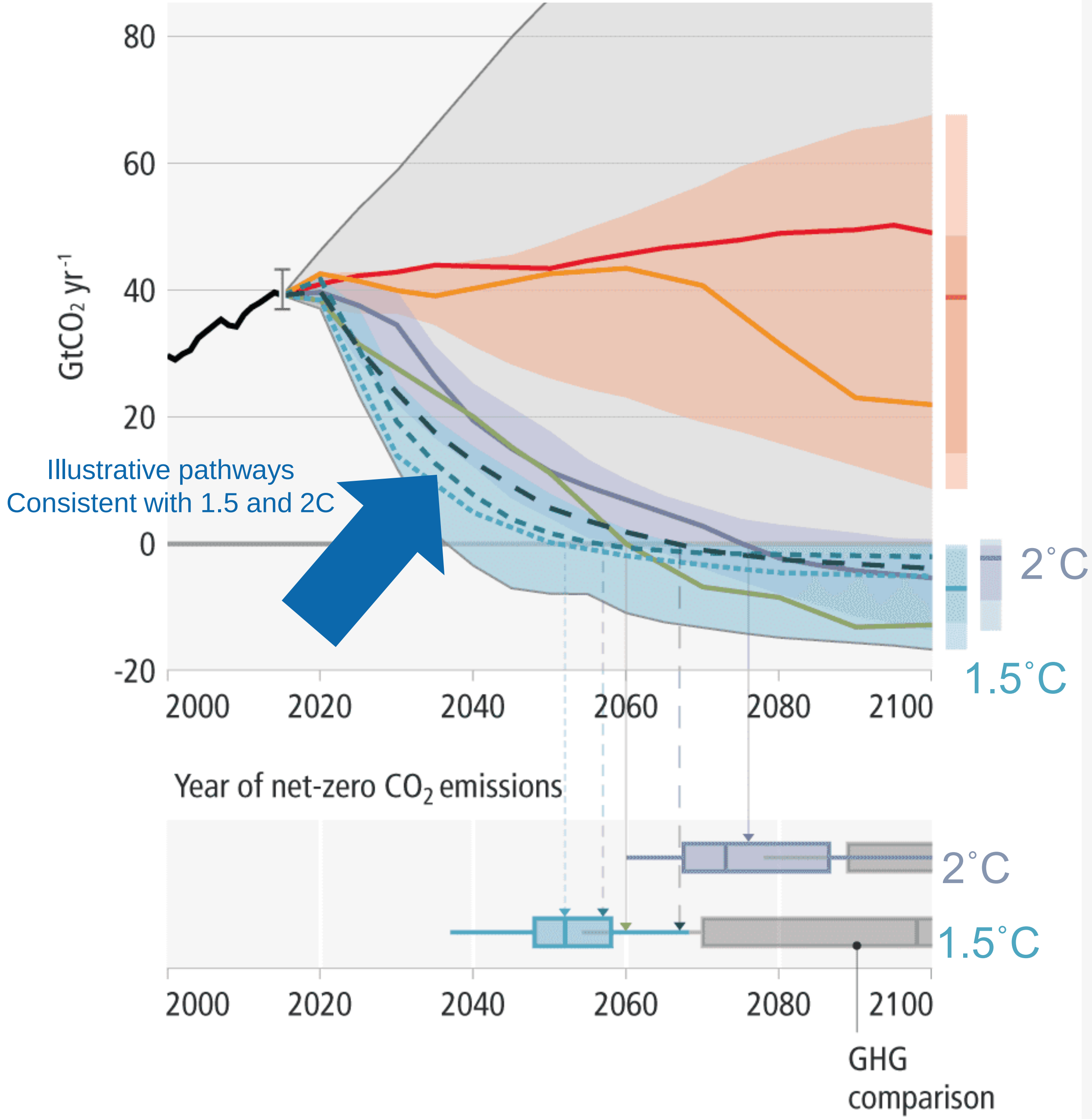
Scenarios :

- ✓ 3131 submitted scenarios (global, sectoral, national)
- ✓ 2266 with sufficient information for climate assessment
- ✓ 1686 scenarios passed the baseline vetting
- ✓ 1202 in final Ch 3 climate assessment



Visit the Scenario Explorer at https://data.ece.iiasa.ac.at/ar6/

Global CO_2 Emissions

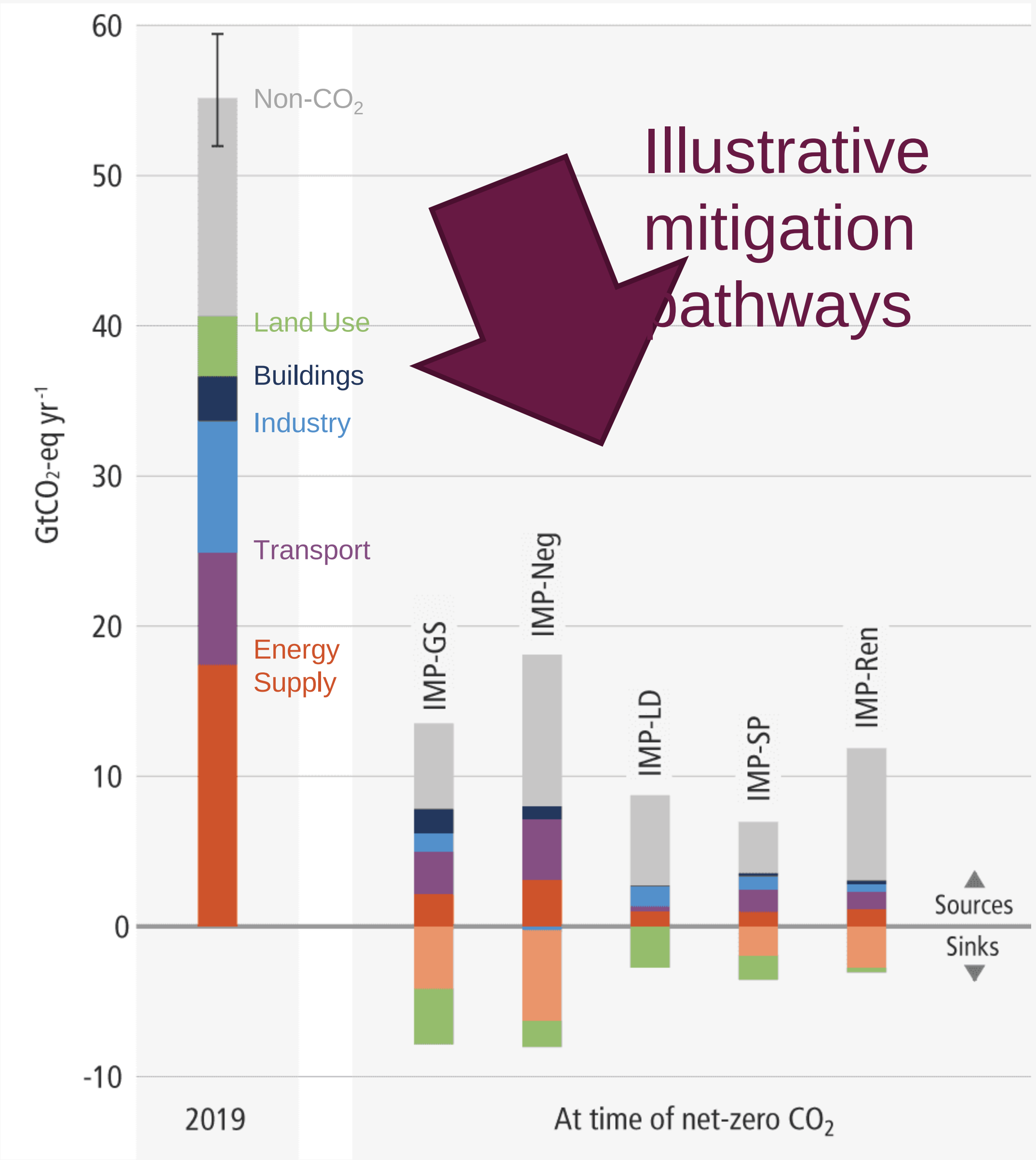


Alternative pathways are possible to limit warming to 1.5˚C or 2˚C

Halting climate change requires to reach net zero CO_2 emissions:

→ 1.5˚C: early 2050s

→ 2˚C: early 2070s



(based on IPCC-assessed scenarios- Chapter 3)

Net-zero CO_2 emissions means a balance between emissions sources and sinks

AFOLU and energy supply are transformed into a CO_2 sink, while other sectors emit at reduced scale

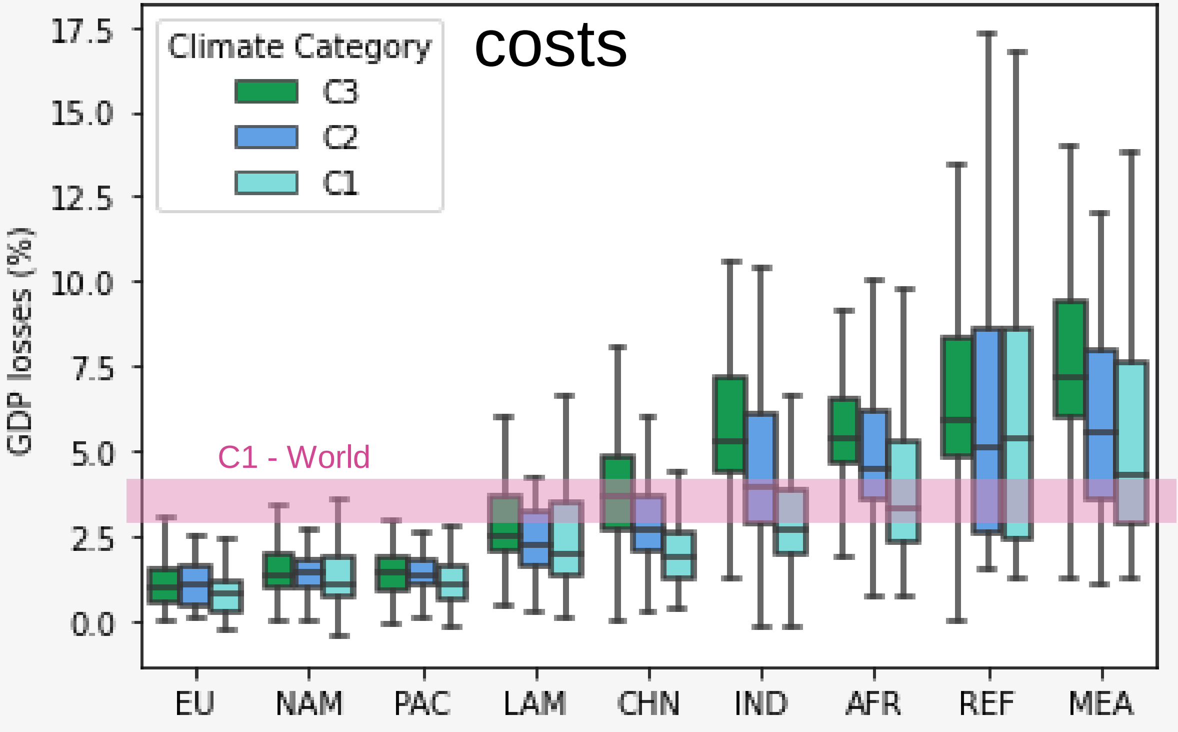
Note most models do include a limited set of CDR only (mainly BECCS and forests

Limiting warming to 1.5 or 2C requires rapid and deep emissions reductions across all sectors

- GHG emissions reductions by 2030:
  → **27%** [13–45%] for 2C
  → **43%** [34–60%] for 1.5C with no or limited overshoot
- Not all pathways reach net zero GHG to limit warming to 1.5 with no or limited overshoot. Those who reach net zero GHG (or below) manage to draw down temperature and lead to lower long-term temperature and impacts.
- 1.5C pathways with no or low overshoot that reach net zero GHGs or not (C1a/b) have same emissions reduction rates in the near term (2030/2040). Differences become more pronounced at about mid century and the extend to which CDR is contributing to net negative GHG emissions in the long term.

Macroeconomic costs of mitigation small compared to GDP growth and (for 2C) smaller than economic benefits of avoided impacts

Regional costs



Costs reflect cost-effective allocation of mitigation and does not consider any financial transfers or other equity considerations

- The aggregate global effects of mitigation on global GDP are small compared to global projected GDP growth:

  → 2.6 - 4.2% GDP loss by 2050 for 1.5C

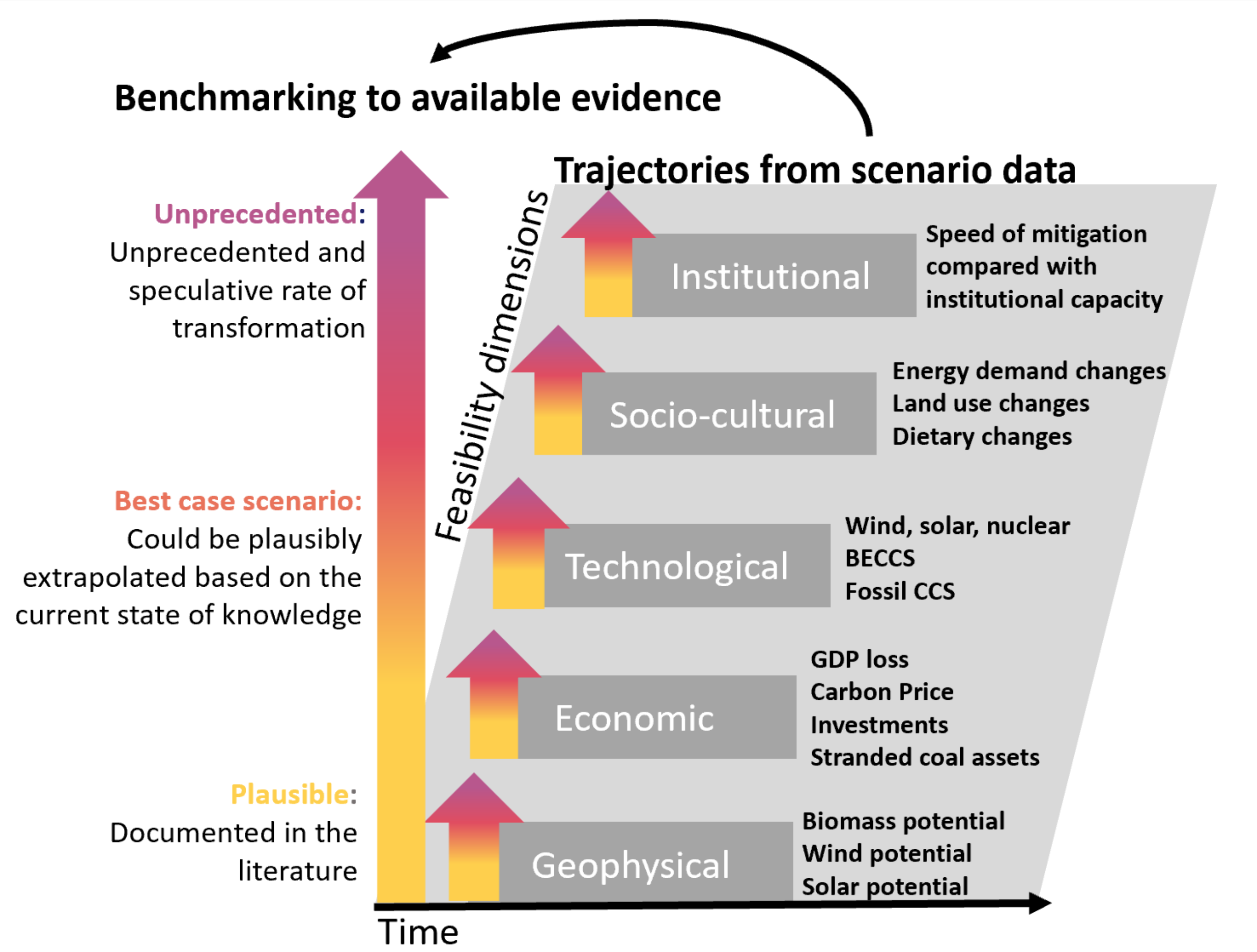
  → 1.3–2.7% GDP loss by 2050 for 2C

  Assuming coordinated global action. The corresponding average reduction in annual global GDP growth over 2020-2050 is 0.04–0.09 percentage points.

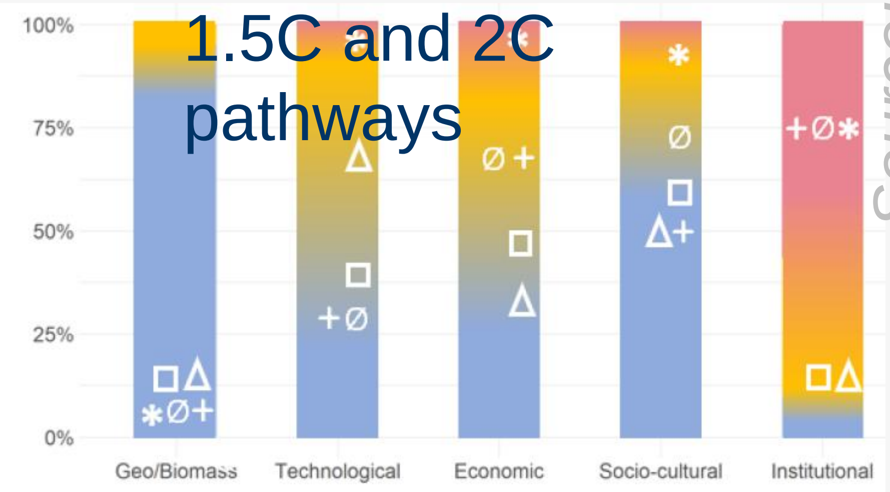
- Global GDP is projected to at least double (increase by at least 100%) over by 2050.

Source: Chapter 3, WGIII

Key challenges comprise governance and institutional dimension



Feasibility evaluation of 1.5C and 2C pathways



Source: Chapter 3 and TS, WGIII

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System transformations to limit global warming: Energy systems [C4]

SBSTA - IPCC Special event: Unpacking the new scientific knowledge and key findings in the Working Group III contribution to the Sixth Assessment report: Mitigation of Climate Change

Smail Khennas
Lead author
Working Group 3

8th June 2022

Reducing GHG emissions: major energy transitions

Substantial reduction of GHG emissions across the full energy sector requires:

- **Substantial reduction in overall fossil fuel use**,
- Deployment of **low-emission e**nergy sources,
- **Switching** to alternative energy carriers, and
- Energy **efficiency and conservation**.

Substantial reduction of fossil fuels and widespread electrification

Net-zero CO_2 energy system by 2050

- Substantial reduction in overall fossil fuel use; use of CCS in the remaining fossil system
- Electricity systems that emit no net CO_2;
- Widespread electrification of the energy system including end uses;
- In applications hard to electrify: **Energy carriers** such as sustainable biofuels, low-emissions hydrogen
- Greater physical, institutional, and operational integration across the energy system

Electricity systems powered predominantly by renewables increasingly viable

- Electricity systems powered predominantly by renewables increasingly viable. But more challenging to supply the entire **energy** system with renewable energy.
- A variety of systemic solutions to accommodate **large shares of renewables** have emerged. However Operational, technological, economic, regulatory, and social challenges remain.
- A broad **portfolio of options** e.g. energy storage, smart grids, demand-side management, sustainable biofuels, hydrogen will ultimately be needed to accommodate large shares of renewables.

Limiting global warming to below2ºC will leave a substantial amount of fossil fuels stranded

- This could also be extended to considerable fossil fuel infrastructure.
- CCS could allow fossil fuels to be used longer, reducing stranded assets.
- Discounted value of the stranded fossil fuels and fossil fuel infrastructure: around **1–4 trillion dollars from 2015 to 2050 to limit global warming to approximately 2ºC.** Higher if global warming is limited to approximately 1.5ºC.
- Coal assets are projected to be at risk of being stranded before 2030, while oil and gas assets are projected to be more at risk toward mid-century.

Methane emissions from energy supply in 2019: a substantial amount

M**ethane** emissions from **energy supply:**

- 18% [13-23%] of **GHG** emissions from **energy supply**
- 32% [22-42%] of **global methane** emissions
- 6% [2-4%] of global **GHG** emissions.

About 50–80% of these emissions could be avoided with currently **available tec**hnologies at less than **USD50 tCO2-eq-1.**

THANK YOU FOR YOUR ATTENTION

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Mitigation of Climate Change

Demand, Services and Social Aspects of Mitigation

Joyashree Roy (AIT/JU)
-Coordinating Lead Author Chapters 5 – Demand, Services and Social Aspects of Mitigation

SBSTA-IPCC Special Event, Bonn, June 8, 2022
(virtual presentation)

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

Demand-side measures and new ways of end-use service provision can reduce global GHG emissions in end use sectors by 40-70% by 2050 compared to two baseline scenarios

Demand and services

Energy

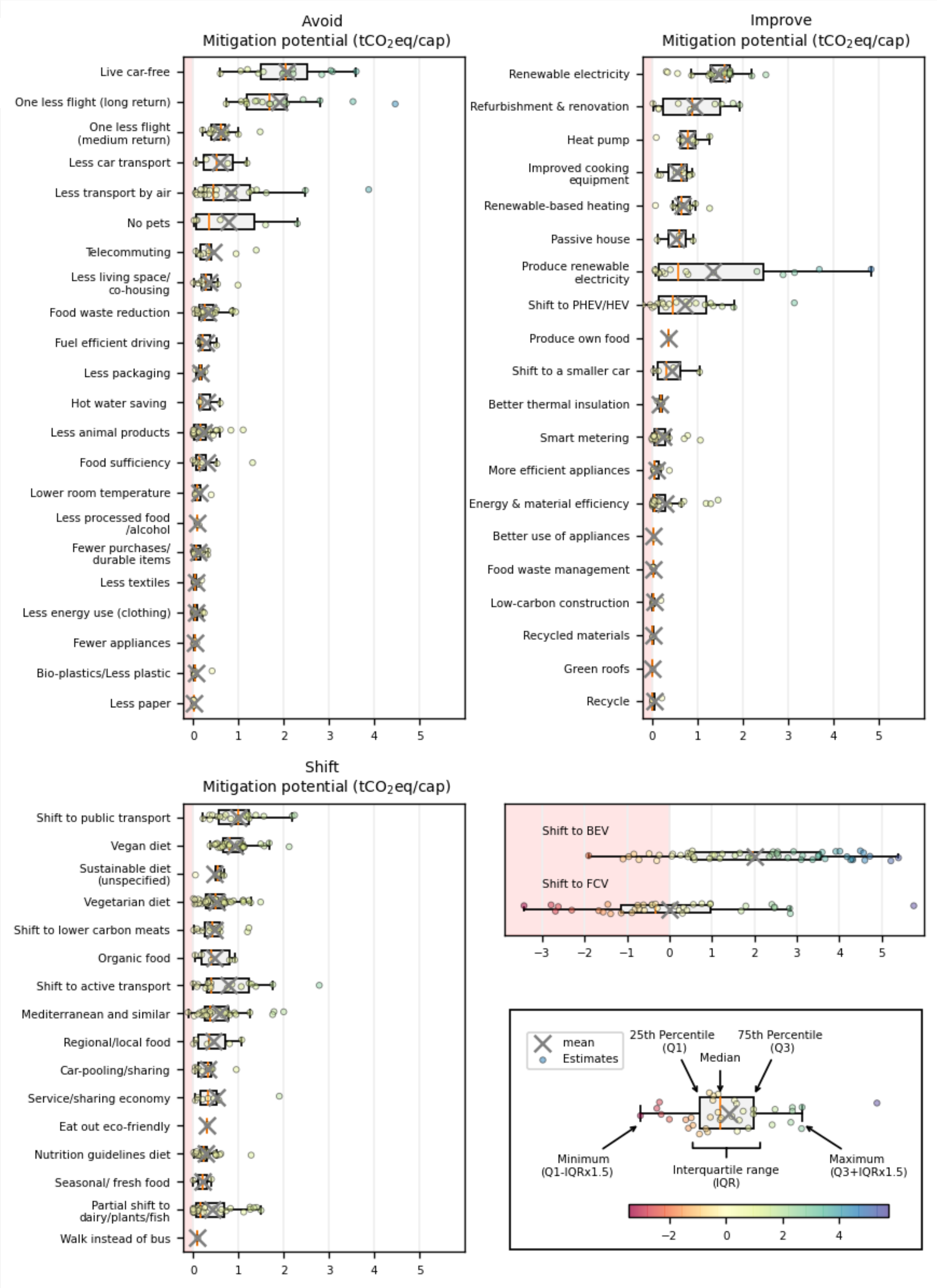
Land use

Industry

Urban

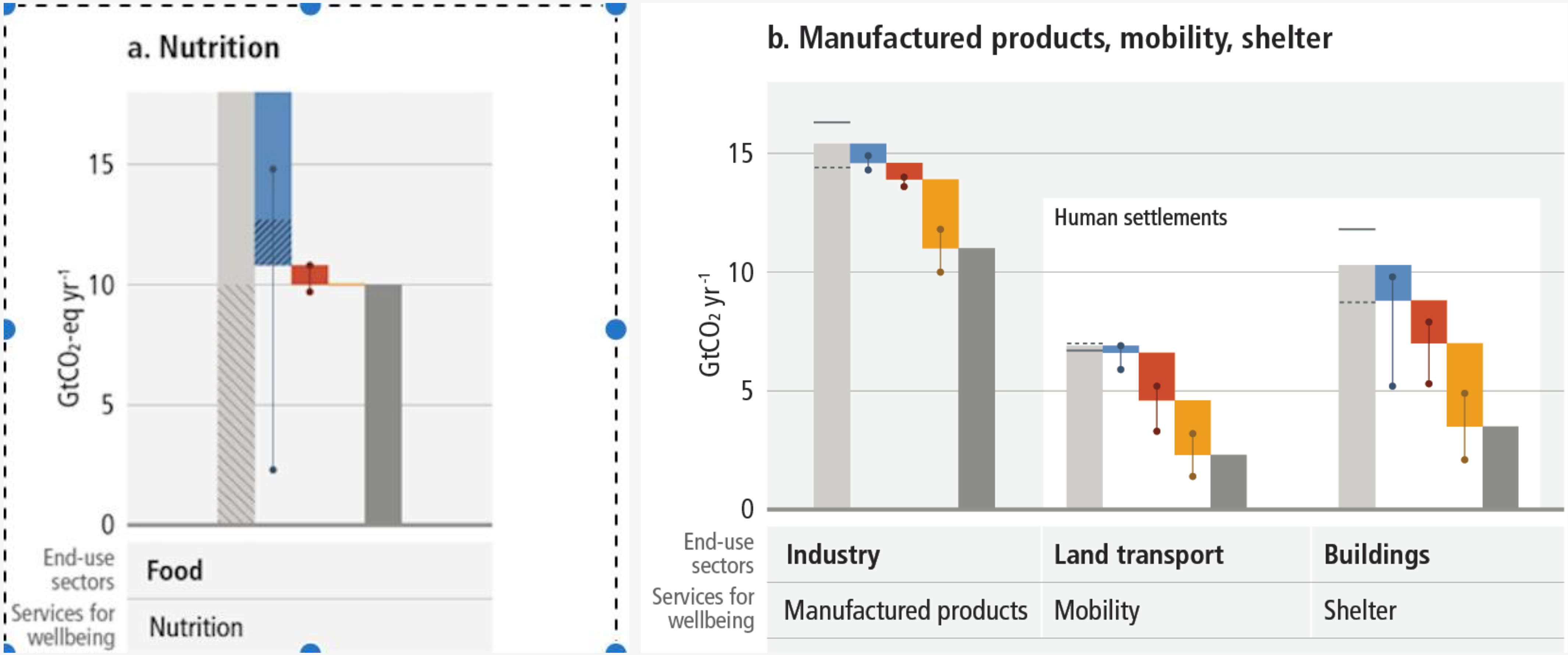
Buildings

Transport



60 options identified with mitigation potential

Demand and services



AFOLU

Direct reduction of food related emissions, excluding reforestation of freed up land

Total emissions 2050

Socio-cultural factors

Infrastructure use

End-use technology adoption

Emissions that cannot be avoided or reduced through demand-side options are assumed to be addressed by supply-side options

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

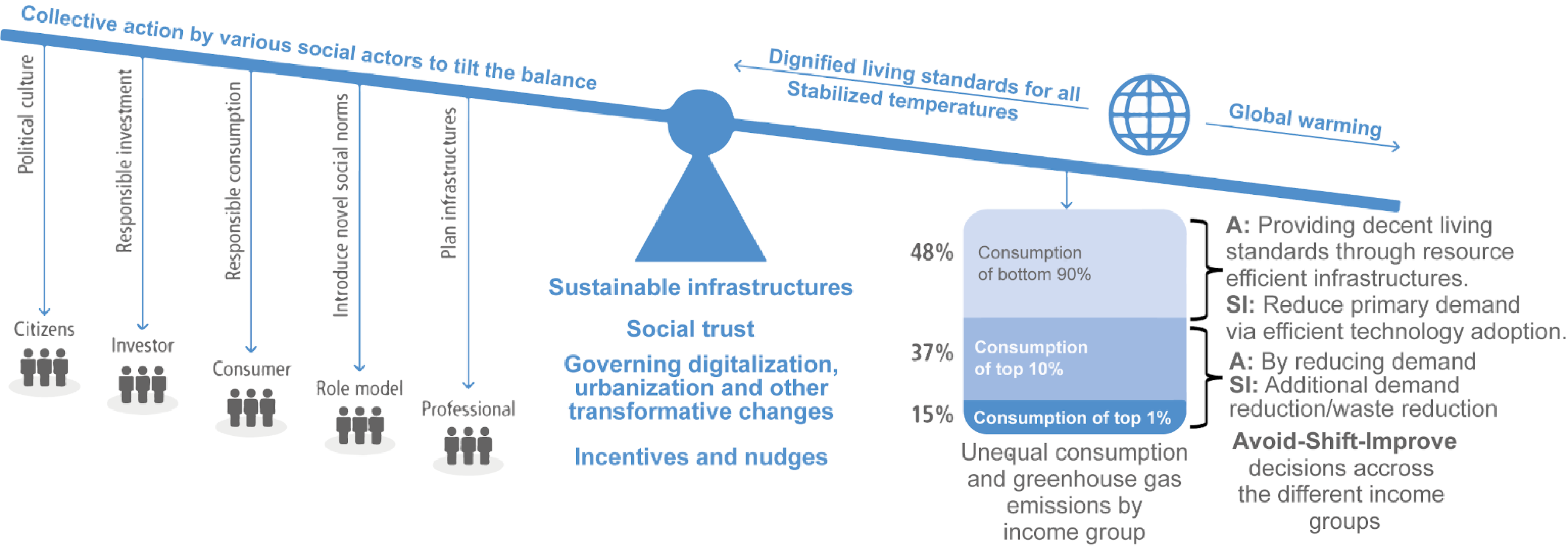
Demand side mitigation response options are consistent with improving basic wellbeing for all

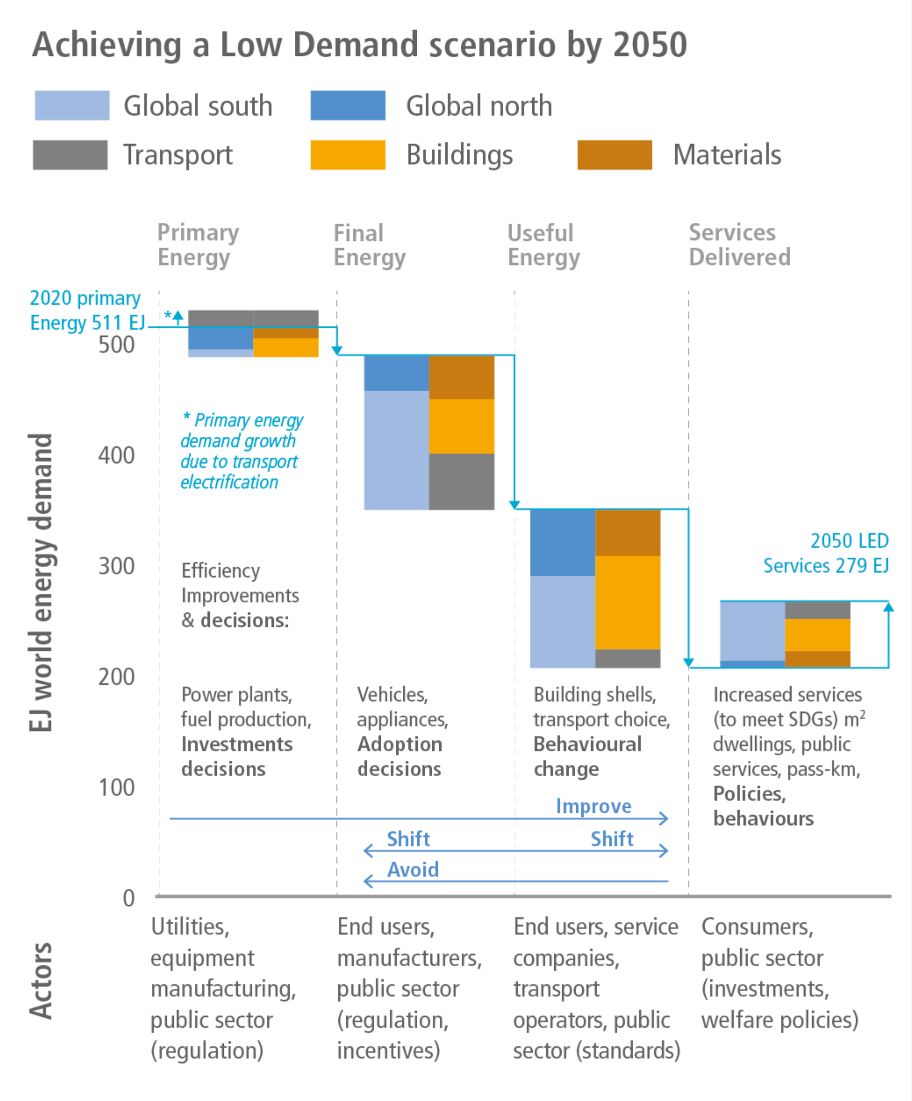
Legend
- High positive impact [+3]
- Medium positive impact [+2]
- Low positive impact [+1]
- Overall Neutral
- No impact
- Low negative impact [-1]
- Medium negative impact [-2]
- ★ Confidence level

Sectors	SDGs	2	6	7,11	3	6	7	11	11	4		1,2,8,10	5,10,16	5,16	10,16	11,16	8	9,12	8,12
	Mitigation strategies / Wellbeing dimensions	Food	Water	Air	Health	Sanitation	Energy	Shelter	Mobility	Education	Communication	Social protection	Participation	Personal Security	Social cohesion	Political stability	Economic stability	Material provision	Supply side / incumbents
Building	Sufficiency	[+1] ★★★	[+2] ★★★★	[+2] ★★★★★	[+3] ★★★★★	[+1] ★	[+3] ★★★★	[+1] ★	[+1] ★★	[+1] ★★	[+2] ★★★	[+1] ★★	[+1] ★★		[+2] ★★★★★		[+2] ★★★★	[+2] ★★★★	[-2] ★★★
Building	Efficiency	[+2] ★	[+2] ★★★★	[+3/-1] ★★★★	[+3/-1] ★★★★★	[+1] ★	[+3] ★★★★	[+2] ★★★★		[+1] ★★★	[+1] ★★★		[+1] ★★★★	[+1] ★★★	[+2/-1] ★★★★		[+2] ★★★★★	[+2/-1] ★★★★	[+2/-2] ★★★
Building	Lower carbon and renewable energy	[+2/-1] ★★★	[+2/-1] ★★★★	[+3] ★★★★★	[+3] ★★★★★		[+3] ★★★★	[+1] ★★★	[+1] ★★★	[+1] ★★★	[+2] ★★★		[+1] ★★★	[+1] ★★★	[+2/-1] ★★★★		[+2/-1] ★★★★★	[+2] ★★★★	[+2/-2] ★★★
Food	Food waste	[+1] ★★★	[+2] ★★★★	[+2] ★★★★	[+2] ★★★	[+1] ★★	[+1] ★★★★				[+1] ★★	[-1/+1] ★★★	[+1] ★★★			[+1] ★	[+1] ★★		[-1] ★★★
Food	Over-consumption	[+1] ★	[+1/-1] ★	[+1/-1] ★	[+3] ★★★★		[+1/-1] ★						[+2] ★★★★			[+1] ★			[+1/-2] ★
Food	Animal free protein	[+2] ★★★	[+2] ★★★★	[+3] ★★★★★	[+3] ★★★						[-1] ★★★	[+3] ★★★★★	[+1] ★★★★		[-1] ★	[+2] ★			[-1] ★★★
Transport	Teleworking and online education system	[+1] ★★		[+3] ★★★★	[+2] ★★★★		[+2] ★★★★	[+1] ★★	[+2] ★★★★	[-1] ★★★	[+2] ★★★★	[+1] ★★★★	[+2] ★★★★	[+1/-1] ★★★★	[+2] ★★★★	[+2] ★★★	[+2] ★★★		[+1] ★★★★
Transport	Non-motorized transport	[+2] ★★	[+1] ★★	[+1] ★★★★★	[+3] ★★★★★		[+2] ★★★★		[+3] ★★★★★	[+1] ★★★★	[+3] ★★★	[+1] ★★★	[+1] ★★	[+2] ★★★★	[+2] ★★★	[+2] ★★	[+2] ★★★		[+1] ★★★
Transport	Shared mobility	[+1] ★★		[+3] ★★★	[+2] ★★★★		[+1] ★★★		[+2] ★★★★		[+1] ★★★	[+2] ★★★	[+1] ★★★	[+1/-1] ★★★	[+1/-1] ★★★★	[-1] ★★★★	[+2] ★★★★	[+2] ★★★★	[-1] ★★
Transport	Evs	[+1] ★★★		[+2] ★★★★	[+1] ★★★★	[+1] ★★★★	[+3 ★★★★		[+2] ★★★★			[+3] ★★★★★	[+2] ★★★				[+2] ★★★★	[-1] ★★	[+1] ★★★
Urabn	Compact city	[+2/-1] ★★★	[+1] ★★	[+2/-1] ★★★	[+3/-1] ★★★★	[+1] ★★	[+3/-1] ★★★★★	[-1] ★★★★★	[+3] ★★★★★	[+1] ★★★★★	[+1/-1] ★★★	[+2] ★★	[+1] ★★	[+1] ★★★★	[+1/-1] ★★★★★		[+1] ★★★★	[+1] ★★	[+1/-2] ★★★
Urabn	Circular and shared economy	[+2] ★★★★	[+1] ★★★	[+2] ★★★	[+2] ★★★		[+3] ★★★	[+2/-1] ★★★	[+3] ★★★★★	[+1] ★★★★	[+1] ★★★★	[+1] ★★★	[+1] ★★★	[+2] ★★★★	[+1] ★★	[+1] ★★	[+2] ★★	[+3] ★★★	[-1] ★★★★
Urabn	Systems approach in urban policy and practice	[+1] ★★★	[+2] ★★★	[+2] ★★★	[+3] ★★★	[+1] ★★★	[+3] ★★★	[+2] ★★★	[+3] ★★★		[+1] ★★	[-1] ★★	[+1] ★★★	[+2] ★	[+1] ★★		[+1] ★★	[+3] ★★★★★	[+2/-2] ★★
Urabn	Nature based solutions	[+2] ★★★	[+1/-1] ★★★★★	[+3/-1] ★★★★	[+3] ★★★★★	[+1] ★★★	[+3] ★★★	[+1/-1] ★★★	[+1] ★★★	[+2] ★★★★		[+2] ★★	[+3] ★★	[+1] ★★★	[+2/-2] ★★★		[+3] ★★★★	[+1] ★★	[+1] ★★
Industry	Using less material by design	[+2] ★★	[+2] ★★★	[+3] ★★★	[+2] ★★	[+2] ★★★	[+3] ★★★★	[+2] ★★★★	[+2] ★★★★	[+1] ★★	[+2] ★★★	[+1] ★★	[+1] ★★★	[+1] ★★	[+1] ★★	[+1] ★★	[+2] ★★★	[+3] ★★	[-2] ★★
Industry	Product life extension	[+2] ★★	[+2] ★★★	[+3] ★★★	[+2] ★★	[+2] ★★★	[+3] ★★★★	[+2] ★★★★	[+2] ★★★★	[+1] ★★	[+2] ★★★	[+1] ★★	[-1] ★★★★	[+1] ★★	[+1] ★★	[+1] ★★	[+2] ★★★	[+3] ★★	[-2] ★★
Industry	Energy Efficiency	[+2] ★★	[+2] ★★★	[+3] ★★★	[+1] ★★	[+2] ★★★	[+3] ★★★★	[+2] ★★★★	[+2] ★★★★	[+1] ★★	[+2] ★★★	[+2] ★★★★	[+2] ★★★	[+1] ★★		[+1] ★★	[+2] ★★★	[+2] ★★	[-2] ★★
Industry	Circular economy	[+2] ★★★	[+2] ★★★	[+3] ★★★	[+1] ★★	[+2] ★★★	[+3] ★★★★	[+2] ★★★★	[+2] ★★★★	[+1] ★★	[+2] ★★★	[+1] ★★	[+1] ★★★	[+2] ★★	[+1] ★★		[+2] ★★★	[+3] ★★	[-2] ★★

People matters

Tilting the balance towards less resource intensive service provisioning





Improved service provisioning systems enable increases in service levels and at the same time a reduction in upstream energy demand by 45%.

Demand and services

- Demand-side mitigation encompasses changes in infrastructure use, end-use technology adoption, and socio-cultural and behavioural change.
- more efficient end-use energy conversion can improve services while reducing the need for upstream energy by 45% by 2050 compared to 2020
- There are regional differences in potential
  - Lowest quartile of population require additional housing, nutrition, energy and resources for human wellbeing

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

Combine behavioral interventions

- Social norms, role models that recognize the social and planetary wellbeing
- Taxes on positional goods/status consumption
- Choice architectures (nutritional need, waste reduction, feedback, social comparison, economic incentives, defaults, etc.) – help in better decision making by individuals

Multiple known options:

5-30% of global annual GHG emissions from end-use sectors are **avoidable** by 2050, compared to 2050 emissions projection of two scenarios consistent with policies announced by national governments until 2020:

through changes in the built environment, new and repurposed infrastructures and service provision through compact cities, co-location of jobs and housing, more efficient use of floor space and energy in buildings, and reallocation of street space for active mobility

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Thankyou

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Mitigation Synergies and Trade-offs with wider Sustainable Devt

D5.1 Accelerated and equitable climate action in mitigating, and adapting to, climate change impacts is critical to sustainable development. Climate change actions can also result in some trade-offs. The trade-offs of individual options could be managed through policy design..

Response Assessments need to consider:

- Aggregate economic efficiency, including the benefits of avoided impacts;
- Ethics and equity, including culture and capacity;
- Technology, innovation and transition processes
- Socio-political frameworks, including institutions and governance

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.

Countries start from very different situations

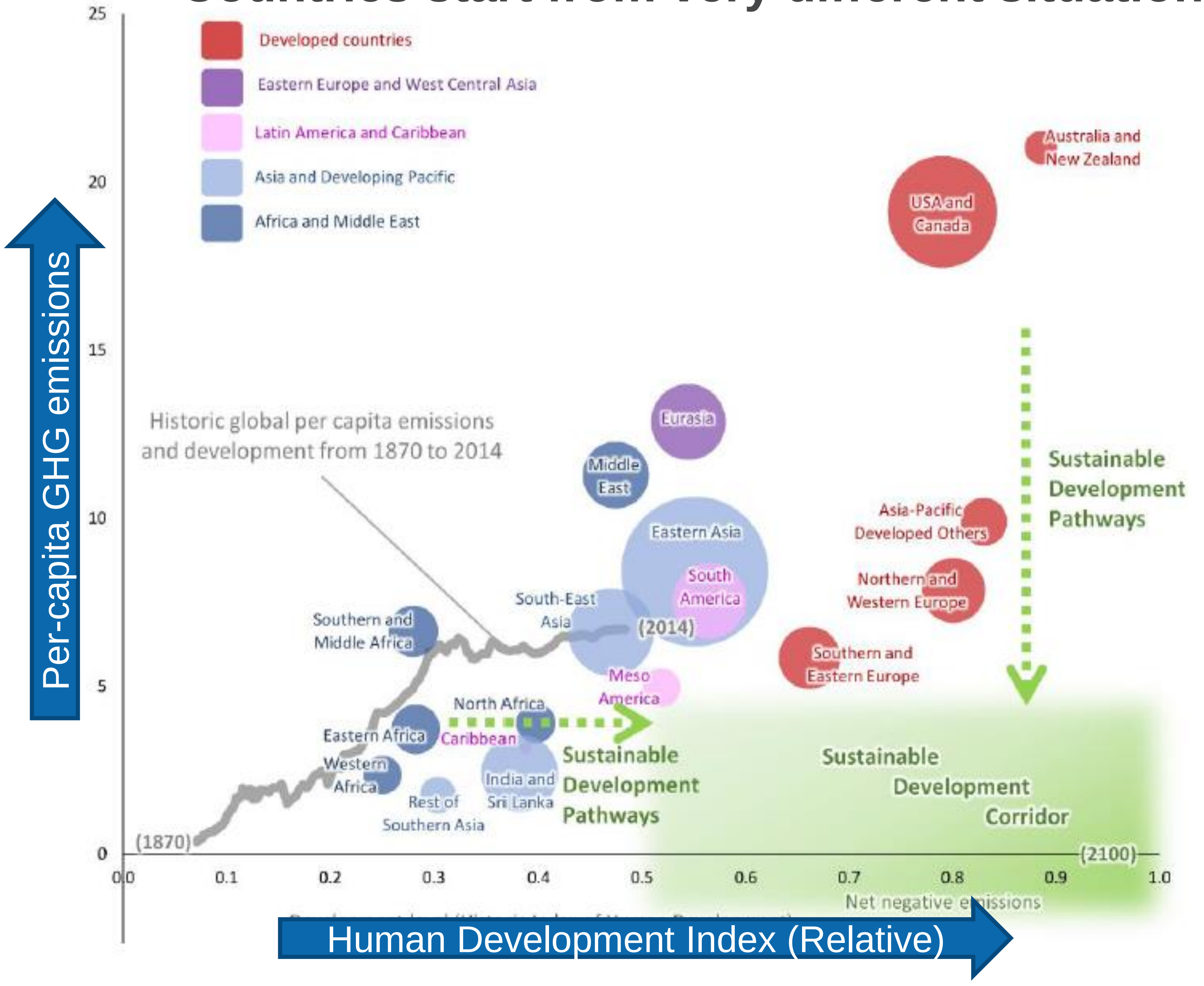


Figure TS.1: Sustainable development pathways towards fulfilling the Sustainable Development Goals

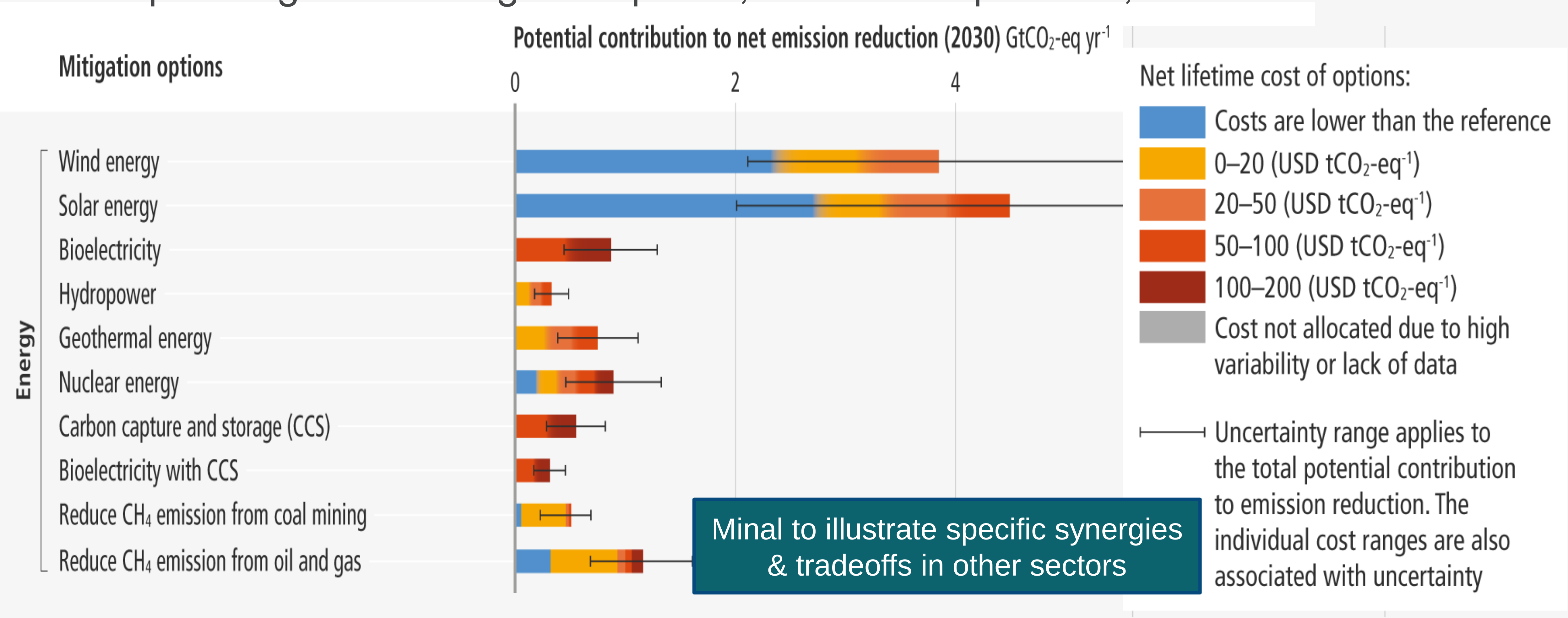
Ethics and equity, inc culture and capacity

- 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

Emissions mitigation and SD

Technology, innovation and transitions

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



Minal to illustrate specific synergies & tradeoffs in other sectors

Emissions mitigation and SD

Socio-political dimensions, governance and institutions

- Ambitious mitigation pathways imply large and sometimes disruptive changes in economic structure, with significant distributional consequences, within and between countries. Equity remains a central element in the UN climate regime
- Applying just transition principles and implementing them through collective and participatory decision-making processes helps integrate equity principles into policies at all scales, in different ways, depending on national circumstances – several countries have national *Just Transition* commissions or task forces ..
- Broadening equitable access to domestic & international finance, technologies for mitigation, and capacity, while explicitly addressing needs can integrate equity and justice into national and international policies - catalyst to accelerate mitigation and shifting development pathways towards sustainability

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WORKING GROUP III – MITIGATION OF CLIMATE CHANGE

ipcc

INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Climate Change 2022

Mitigation of Climate Change

Minal Pathak, Senior Scientist, WGIII Technical Support Unit

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

Mitigation and Sustainable Development

- Mitigation is a necessary condition for the achievement of many sustainable development goals and also for sustainability

- There are particular challenges for developing countries

- Enhanced mitigation and broader action to shift development pathways towards sustainability will have distributional consequences within and between countries

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

Synergies and Trade-offs with SDGs

- Mitigation actions have implications for the achievement of SDGs, some positive but others negative
- Synergies and trade-offs depend on a number of factors including the development context, scale and timing of action
- Potential conflicts between reducing emissions and sustainable development can be managed with well-implemented mitigation and policies.

Examples

- Electrification using renewables combined with encouraging people to use public transport
- In industry, electrification, using materials more efficiently, reusing and recycling, and minimising waste
- Protecting and restoring nature, avoiding deforestation, and sustainably managing soils and livestock

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

There is a strong link between sustainable development, vulnerability and climate risks

- Limited economic, social and institutional resources often result in high vulnerability and low adaptive capacity, especially in developing countries.
- There is evidence of mitigation and adaptation synergies in human settlements, land management, and in relation to ecosystems.
- Land and aquatic ecosystems can be adversely affected by some mitigation actions, depending on their implementation.
- Coordinated cross-sectoral policies and planning can maximise synergies and avoid or reduce trade-offs between mitigation and adaptation

Equity and Just Transition

- Ambitious mitigation pathways imply large and sometimes disruptive changes in economic structure, with significant distributional consequences, within and between countries.
- The consideration of ethics and equity can help address the uneven distribution of adverse impacts associated ambitious mitigation.
- Applying just transition principles and implementing them through collective and participatory decision-making processes is an effective way of integrating equity principles into policies at all scales. This is already taking place in many countries and regions

Mitigation and development (Enabling conditions)

- Patterns of development create behavioural, spatial, social and economic barriers to the acceleration of mitigation at all scales.
- Mitigation action can be usefully complemented with actions that shift or change these development patterns to reduce emissions
- Trade-offs can be evaluated and minimised by giving emphasis to capacity building, finance, governance, technology transfer, investments, and development and social equity considerations with meaningful participation of Indigenous Peoples and vulnerable populations
- Choices taken by policymakers, citizens, private sector and other stakeholders can influence societies' development pathways
- Enabling conditions can accelerate mitigation

Strengthening the response through enabling shifting development pathways toward sustainability

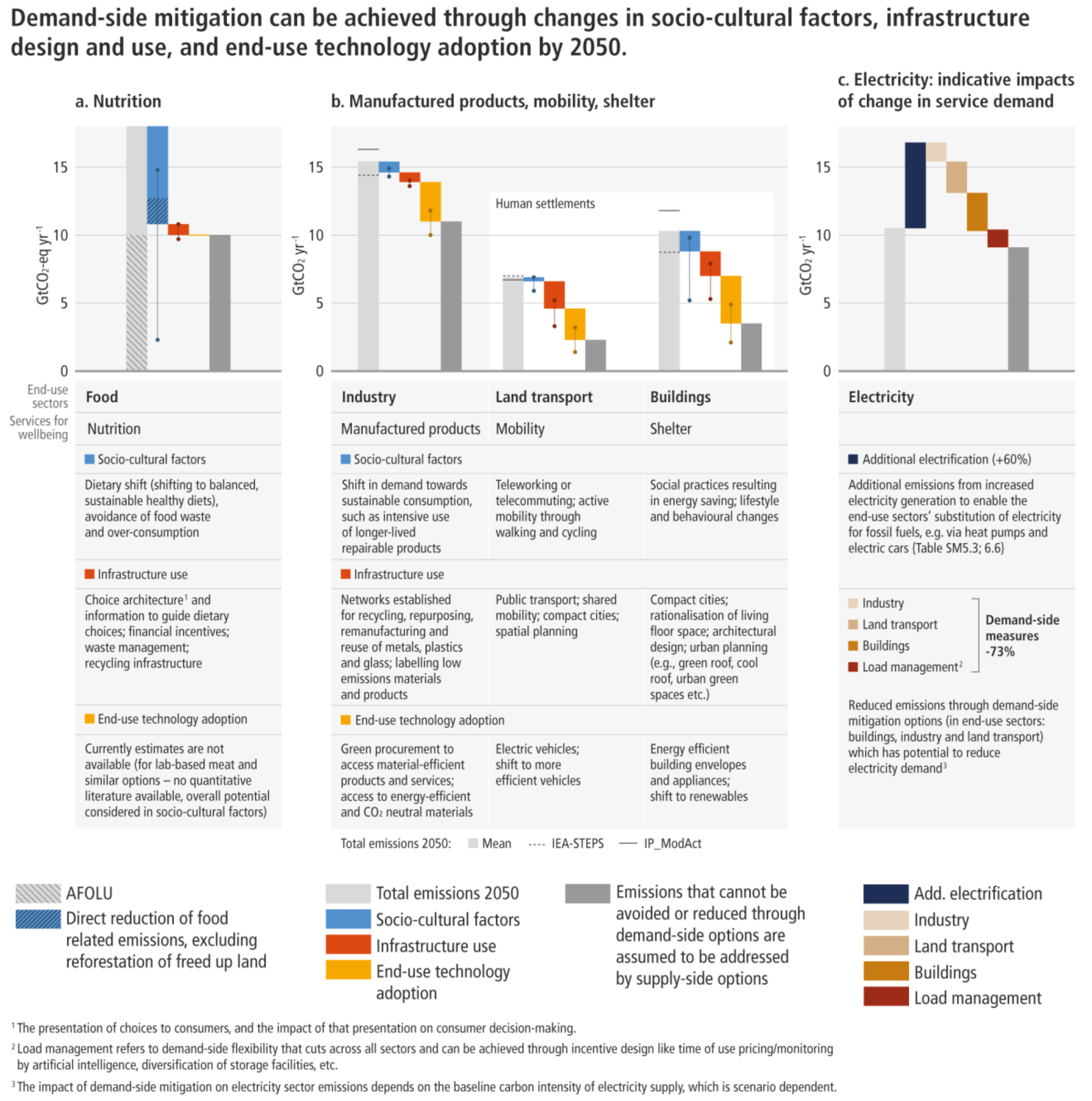
Current development pathways may create barriers to accelerated mitigation, but shifting them towards sustainability can open up climate-development synergies

Many mitigation options are already technically, economically and socio-culturally feasible in the near term, but face institutional barriers

Strengthening enabling conditions can:

- Enable system transformations
- Increase feasibility of mitigation options
- Shift development pathways towards sustainability

Enabling conditions include behaviour, technology, institutions and capacity, policies, governance and finance



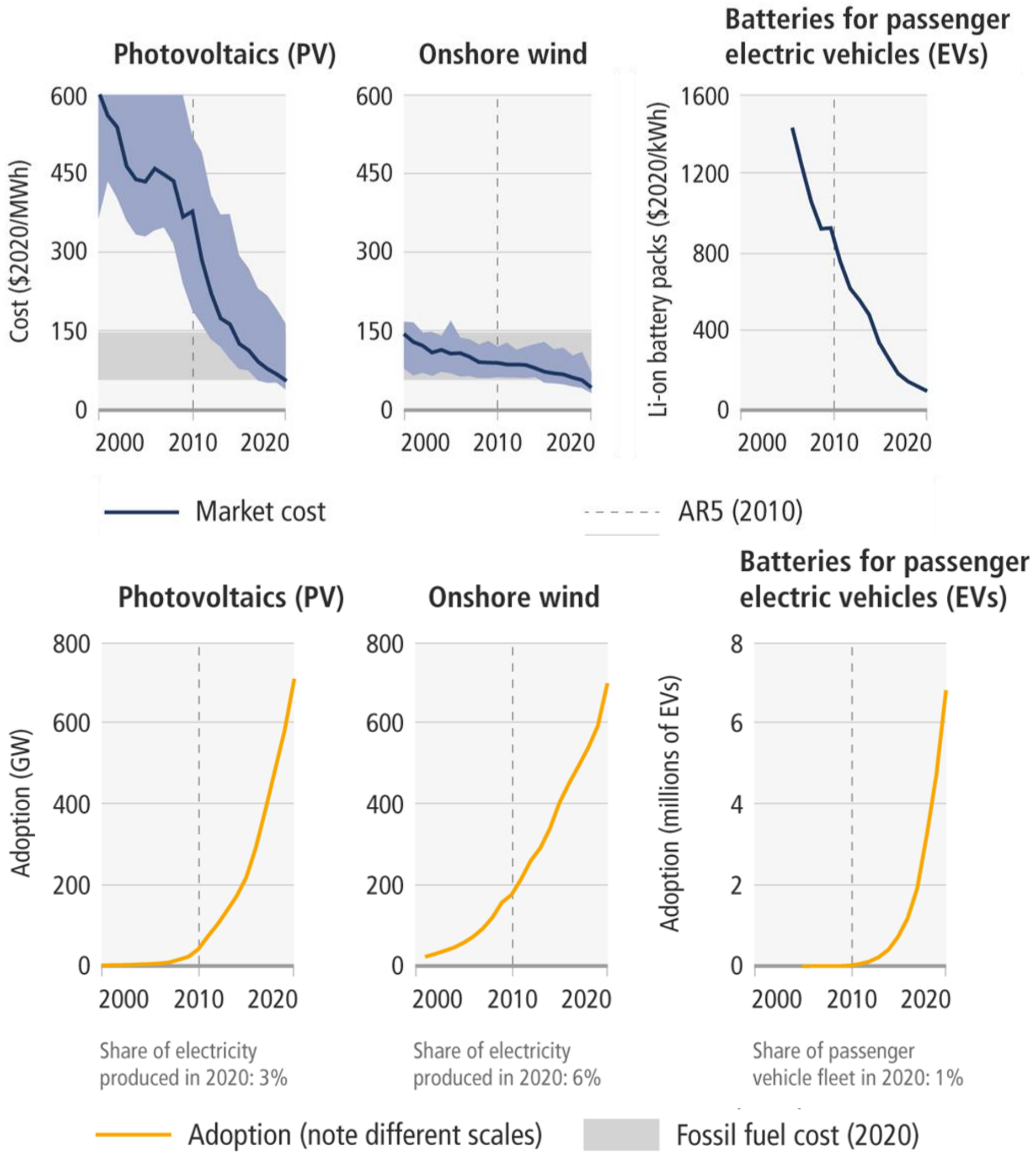
Behaviour change and demand-side measures

- 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

Technology and Innovation

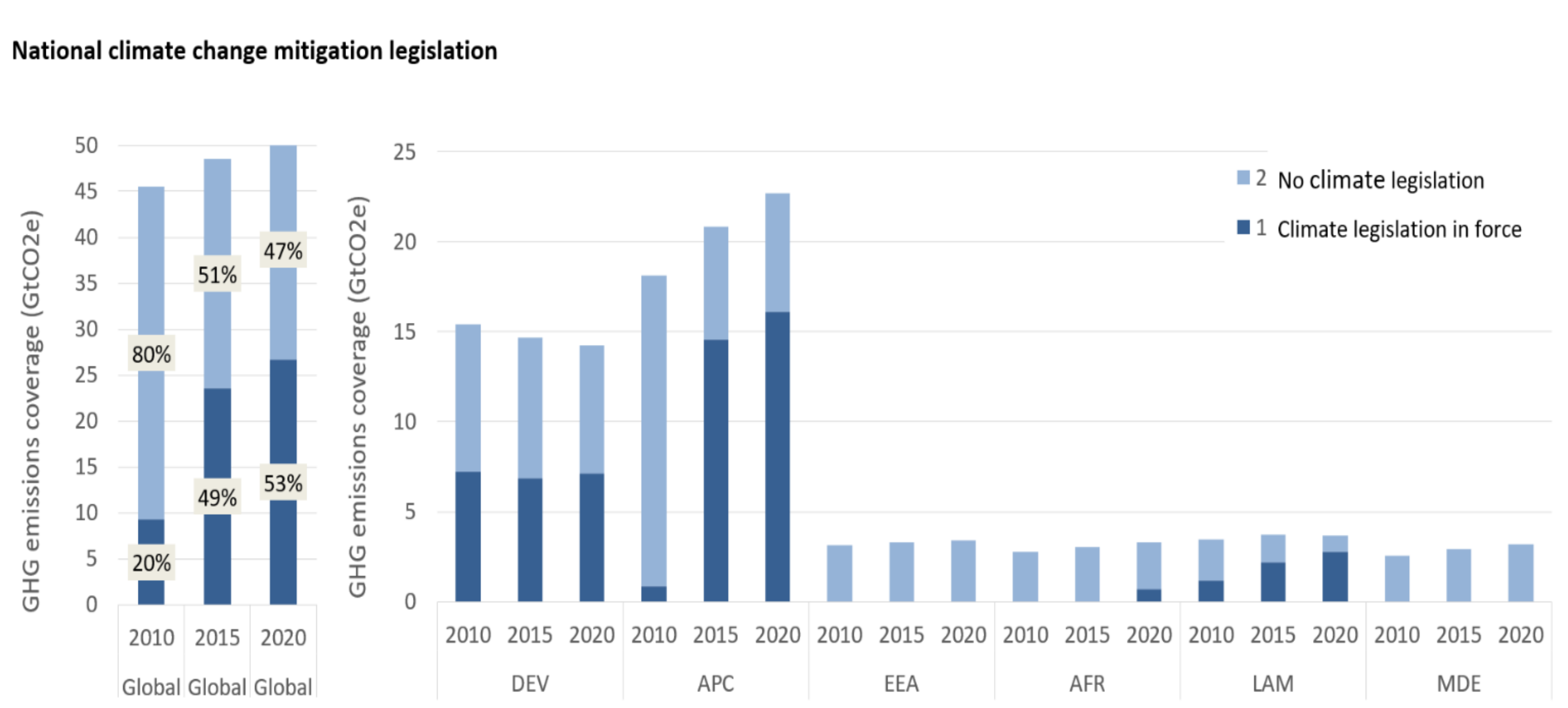
- investment and policies **push forward low emissions** technological **innovation**
- **some options** are technically **viable**, rapidly becoming **cost-effective**, and have relatively **high public support**. Other options face mainly institutional barriers

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



Climate governance provides frameworks for action and a basis for policies

- Laws and strategies provide a direction, set targets, mainstream action, create specialised organisations and enable mobilisation of finance
- Effective national institutions address coordination challenges, build consensus for action and inform strategy setting
- Breadth of civil engagement influences political support for mitigation-related policy



Policies are growing in number and scope and work more effectively when designed in complementary ways

- Regulatory instruments at the sectoral level are effective and when designed with flexibility mechanisms can reduce costs
- Economic instruments have incentivized low-cost reductions, but require higher prices and/or complementary mechanisms to induce higher cost reductions
- Removing fossil fuel subsidies would reduce emissions, improve revenue and macroeconomic performance and yield co-benefits, but may yield distributional impacts which require mitigation
- Policy packages are better able to realise synergies and avoid trade-offs and may be better able to support a low-emission development future than individual policies
- Sectoral, behavioural, financial or macroeconomic policies can help shift development pathways towards sustainability by broadening the range of mitigation options

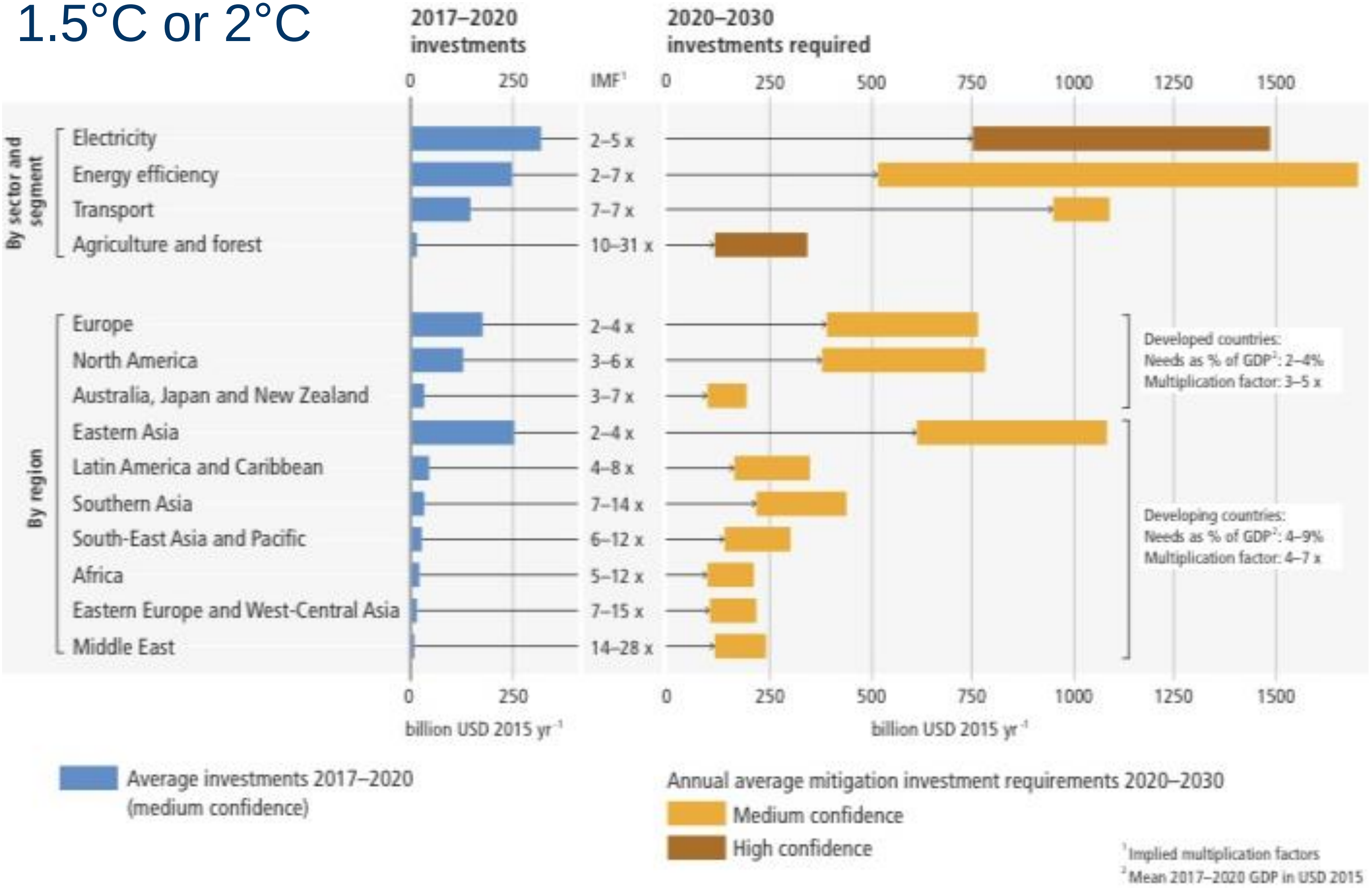
International cooperation is a critical enabler of ambitious climate mitigation goals

- International processes (UNFCCC, Kyoto Protocol, Paris Agreement) are enhancing international cooperation, national ambition and policy development
- Transnational partnerships stimulate policy development, technology diffusion, and state-non-state interaction – uncertainties remain on their costs, feasibility and effectiveness
- International cooperation outside the UNFCCC provides critical support to mitigation
  - regions, sectors and industries, types of emissions
  - sub- and transnational levels
- International environmental and sectoral agreements are helping to reduce emissions
  - Trade roles may stimulate but could also limit adoption of mitigation technologies and policies
  - Aspirations in international aviation and shipping are lower than in other sectors

Finance

- 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
- 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

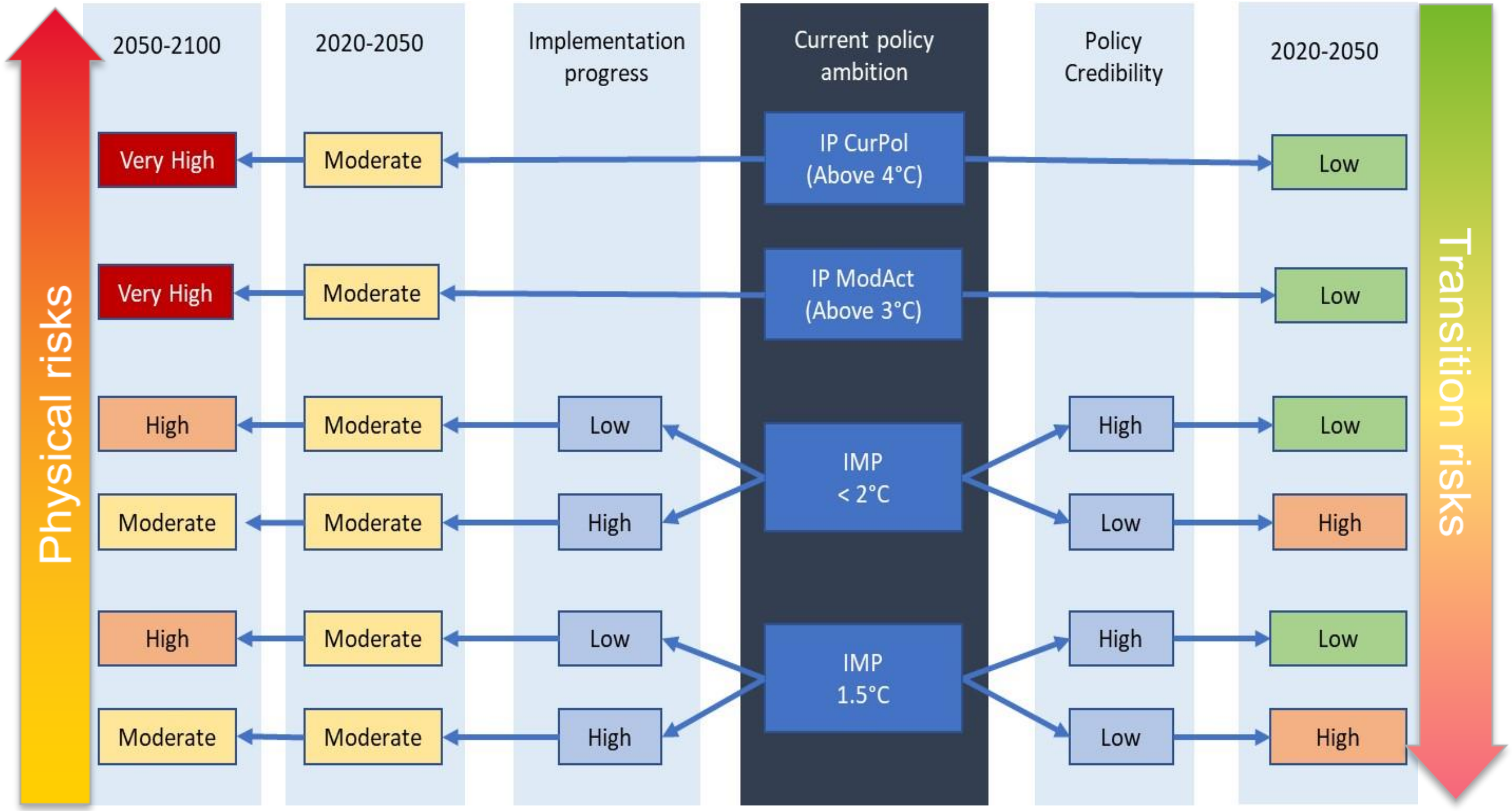
Financial flows are a factor of three to six below the average levels needed between 2020-2030 to limit warming to below 1.5°C or 2°C



Based on chapter 15/ figure 15.4

- Mitigation gaps are wide for all sectors, and widest for the AFOLU sector
- The challenge of closing gaps is largest in developing countries as a whole
- There is sufficient global capital and liquidity to close global investment gaps

Inappropriate risk assessment as key barrier



- There are significant barriers to redirect capital to climate action both within and outside the global financial sector
- Clear policy choices and signals from governments and the international community can support an appropriate risk assessment and scaling up mitigation finance flows

Based on chapter 15/ figure 15.6

Turning gaps into investment opportunities

- Investors, central banks, and financial regulators are driving increased awareness of climate risk. This increased awareness can support climate policy development and implementation
- Ambitious global climate policy coordination and stepped-up (public) climate financing over the next decade (2021–2030) can help address macroeconomic uncertainty and alleviate developing countries' debt burden post-COVID-19
- Innovative financing approaches could help reduce the systemic underpricing of climate risk in markets and foster demand for Paris-aligned investment opportunities. Approaches include de-risking investments, robust 'green' labelling and disclosure schemes, in addition to a regulatory focus on transparency and reforming international monetary system financial sector regulations