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

Structured expert dialogue (PR2-SED3) – Part II
8 June 2022 Bonn

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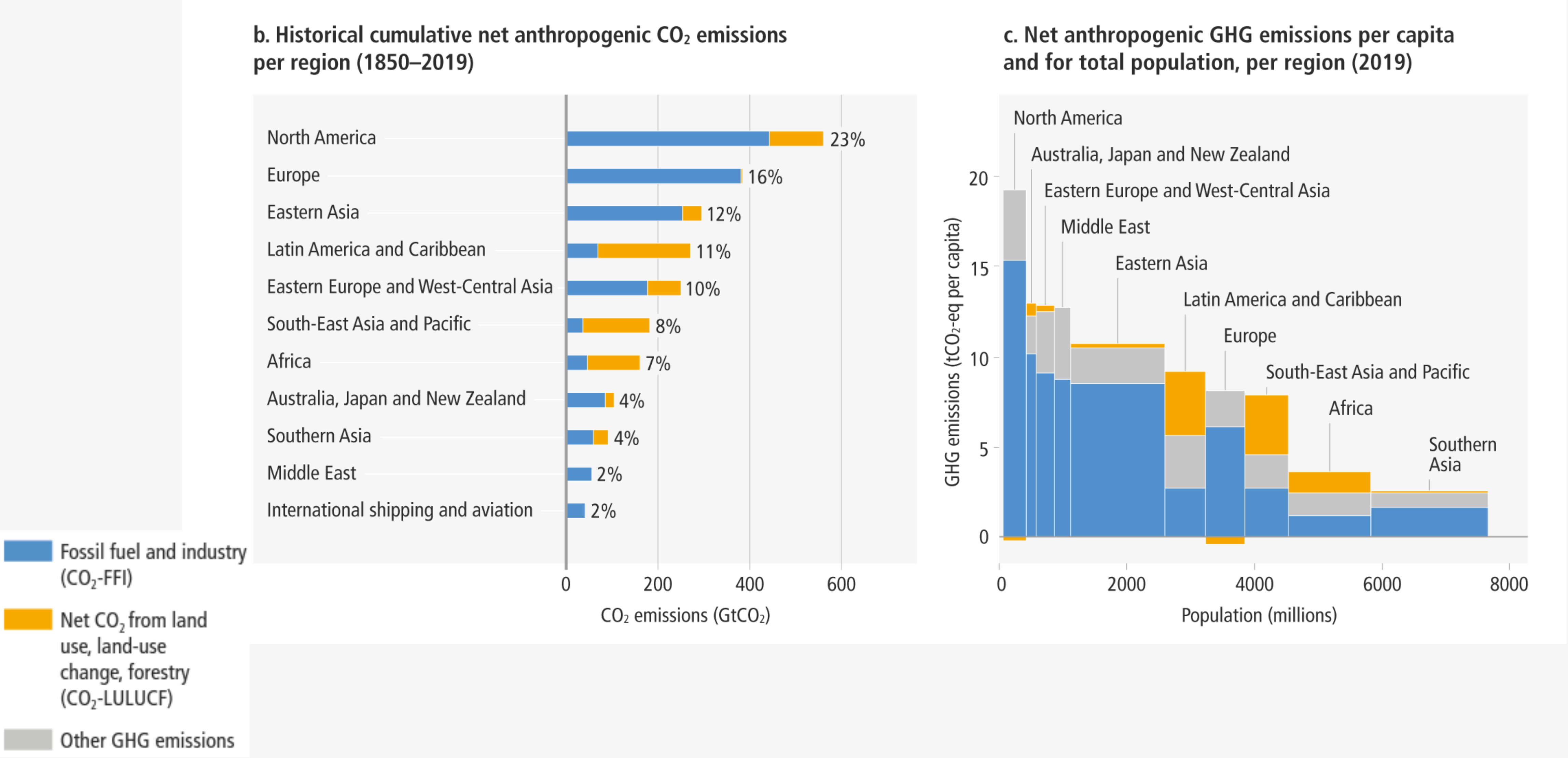
Key findings of WG III AR6 – Part II :

WG III insights into the effect of steps taken by parties in order to achieve the long- term temperature goal of the convention

Three part presentation:

- *Historical Emissions* *– Alaa Al Khourdajie*
- *Emissions pathways and net zero CO2 / GHGs* *– Keywan Riahi*
- *Finance* *– Dipak Dasgupta*

Historical Emissions #1



Historical Emissions #2

d. Regional indicators (2019) and regional production vs consumption accounting (2018)

	Africa	Australia, Japan, New Zealand	Eastern Asia	Eastern Europe, West-Central Asia	Europe	Latin America and Caribbean	Middle East	North America	South-East Asia and Pacific	Southern Asia
Population (million persons, 2019)	1292	157	1471	291	620	646	252	366	674	1836
GDP per capita (USD1000ppp2017 per person)[1]	5.0	43	17	20	43	15	20	61	12	6.2
Net GHG 2019[2] (production basis)										
% GHG contributions	9%	3%	27%	6%	8%	10%	5%	12%	9%	8%
GHG emissions intensity (tCO_2-eq / USD1000ppp 2017)	0.78	0.30	0.62	0.64	0.18	0.61	0.64	0.31	0.65	0.42
GHG per capita (tCO_2-eq per person)	3.9	13	11	13	7.8	9.2	13	19	7.9	2.6
CO_2FFI, 2018, per person										
Production-based emissions (tCO_2FFI per person, based on 2018 data)	1.2	10	8.4	9.2	6.5	2.8	8.7	16	2.6	1.6
Consumption-based emissions (tCO_2FFI per person, based on 2018 data)	0.84	11	6.7	6.2	7.8	2.8	7.6	17	2.5	1.5

[1] GDP per capita in 2019 in USD2017 currency purchasing power basis.

[2] Includes CO_2FFI, CO_2LULUCF and Other GHGs, excluding international aviation and shipping.

The regional groupings used in this figure are for statistical purposes only and are described in Annex II, Part I.

Historical Emissions #3

- **Historical contributions to cumulative net anthropogenic CO2 emissions between 1850 and 2019 vary substantially across regions in terms of total magnitude, but also in terms of contributions to CO2-FFI (1650 ± 73 GtCO2-eq) and net CO2-LULUCF (760 ± 220 GtCO2-eq) emissions.**

- **Between 1850 and 2019, Developed Countries contributed 57% to cumulative CO2-FFI emissions, followed by Asia and Pacific 21%, Eastern Europe and West-Central Asia 9%, Latin America and Caribbean 4%, the Middle East 3%, and Africa 3%. (following the high level classification of regions and areas - 6 regions)**

- **Least developed countries contributed 0.4%.**

- **Developed Countries still have the highest share of historic cumulative emissions (45%) when CO2-LULUCF emissions are included.**

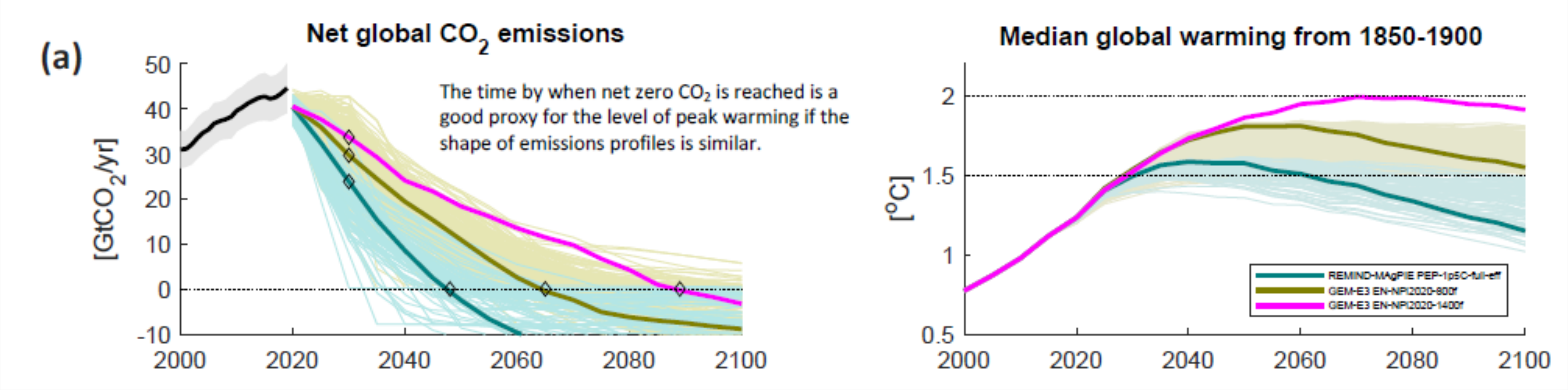
Key findings of WG III AR6 – Part II :

WG III insights into the effect of steps taken by parties in order to achieve the long- term temperature goal of the convention

Three part presentation:

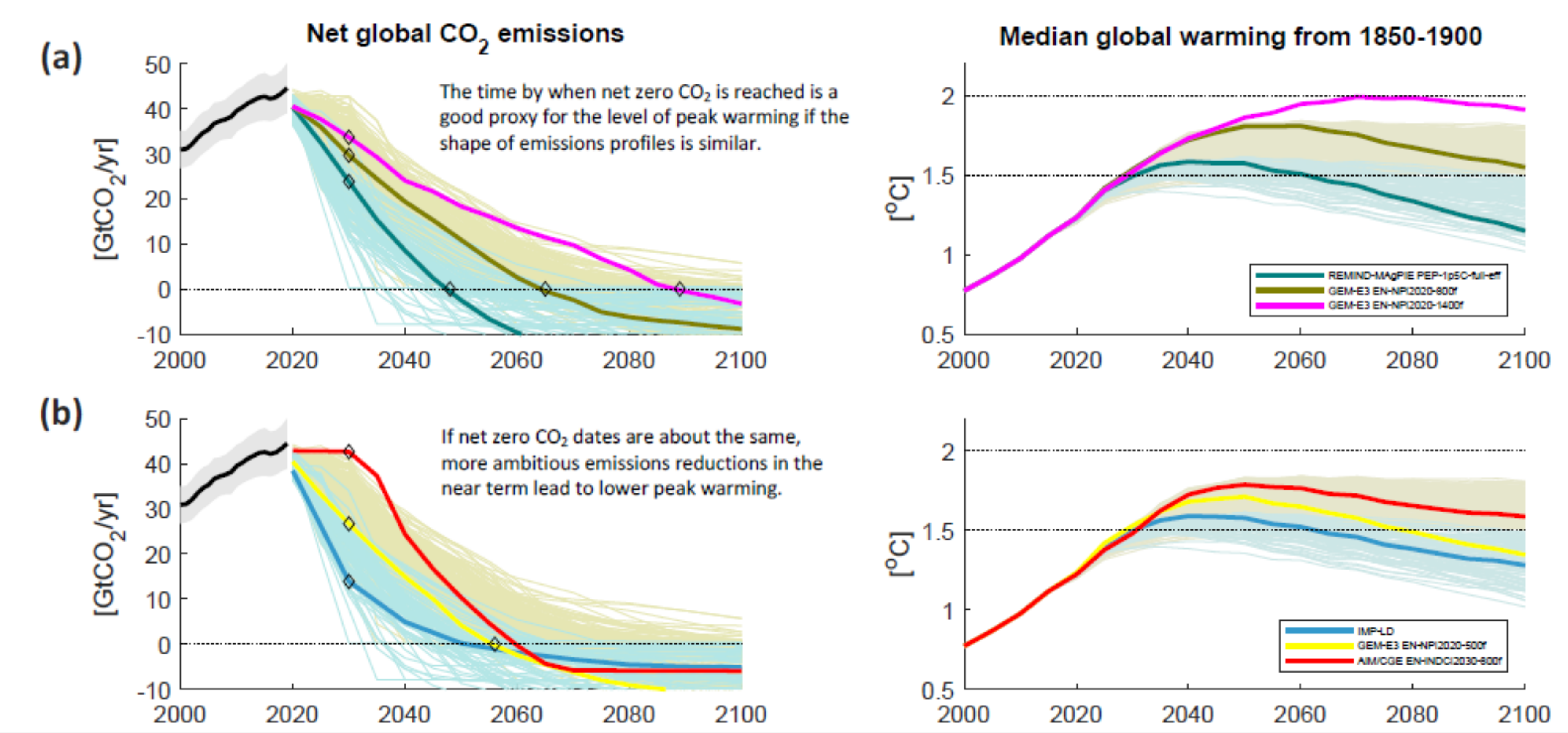
- *Historical Emissions* – *Alaa Al Khourdajie*
- *Emissions pathways and net zero CO2 / GHGs* – *Keywan Riahi*
- *Finance* – *Dipak Dasgupta*

Net zero CO_2 and mean global warming



Cross-Chapter Box 3: Understanding net zero CO2 and net zero GHG emissions
Source: Capter 3 WGIII

Net zero CO_2 and mean global warming



Cross-Chapter Box 3: Understanding net zero CO2 and net zero GHG emissions
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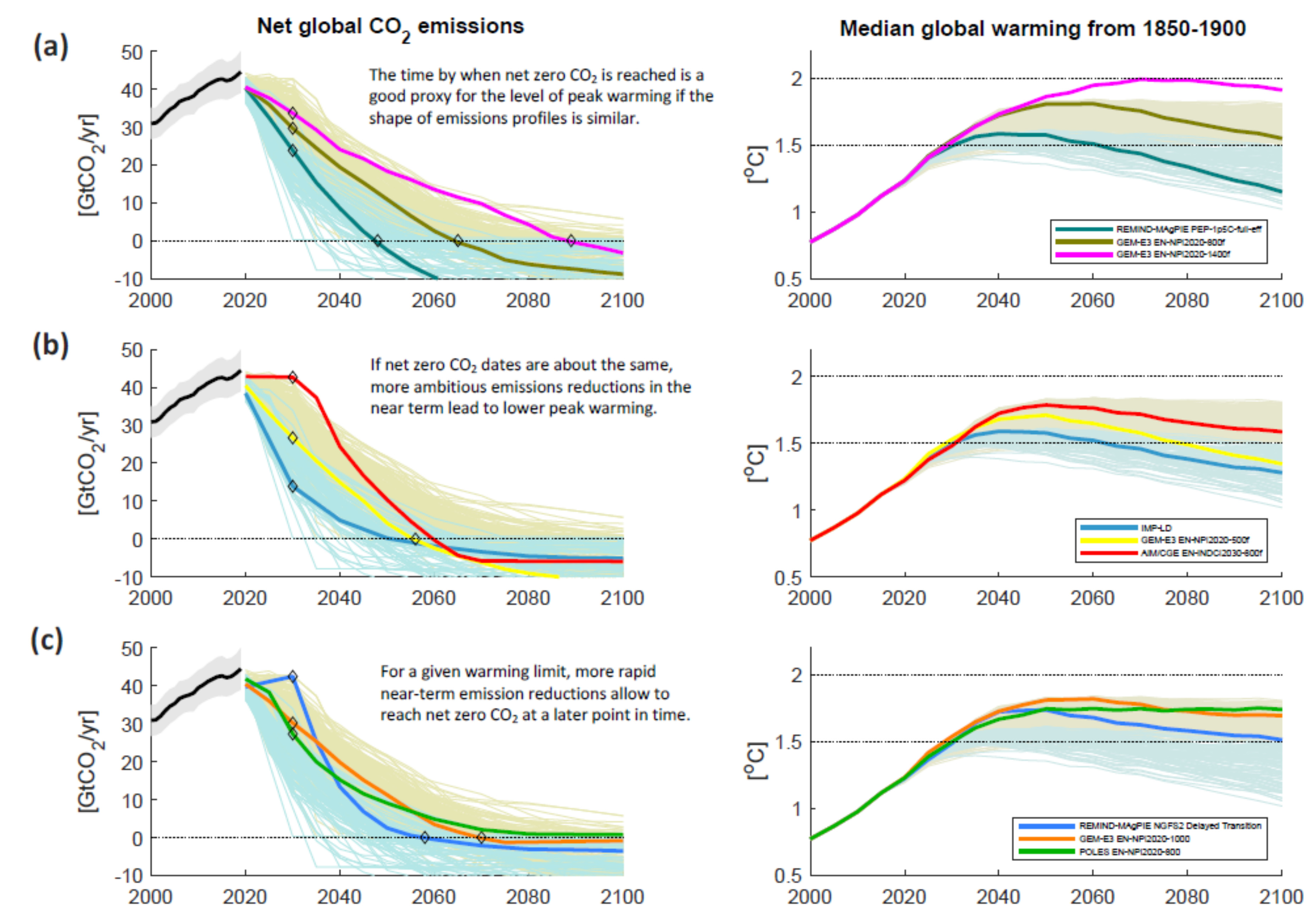
Net zero CO_2 and mean global warming



Cross-Chapter Box 3: Understanding net zero CO2 and net zero GHG emissions
Source: Capter 3 WGIII

Net zero CO_2 and GHG in Table SPM 1

p50 [p5-p95] (1)			GHG emissions Gt CO_2-eq/yr (7)			GHG emissions reductions from 2019 % (8)			Emissions milestones (9,10)				Cumulative CO_2 emissions Gt CO_2 (13)		Cumulative net-negative CO_2 emissions Gt CO_2	Global mean temperature changes 50% probability (14) °C		Likelihood of peak global warming staying below (%) (15)		
Category (2, 3, 4) [# pathways]	Category / subset label	WG I SSP & WG III IPs/IMPs alignment (5, 6)	2030	2040	2050	2030	2040	2050	Peak CO_2 emissions (% peak before 2100)	Peak GHG emissions (% peak before 2100)	Net-zero CO_2 (% net-zero pathways)	Net-zero GHGs (11, 12) (% net-zero pathways)	2020 to net-zero CO_2	2020-2100	Year of net-zero CO_2 to 2100	at peak warming	2100	<1.5°C	<2.0°C	<3.0°C
C1 [97]	limit warming to 1.5°C (>50%) with no or limited overshoot		31 [21-36]	17 [6-23]	9 [1-15]	43 [34-60]	69 [58-90]	84 [73-98]	2020-2025 (100%) [2020-2025]		2050-2055 (100%) [2035-2070]	2095-2100 (52%) [2050-...]	510 [330-710]	320 [-210-570]	-220 [-660--20]	1.6 [1.4-1.6]	1.3 [1.1-1.5]	38 [33-58]	90 [86-97]	100 [99-100]
C1a [50]	... with net-zero GHGs	SSP1-1.9, SP LD	33 [22-37]	18 [6-24]	8 [0-15]	41 [31-59]	66 [58-89]	85 [72-100]				2070-2075 (100%) [2050-2090]	550 [340-760]	160 [-220-620]	-360 [-680--140]	1.6 [1.4-1.6]	1.2 [1.1-1.4]	38 [34-60]	90 [85-98]	100 [99-100]
C1b [47]	... without net-zero GHGs	Ren	29 [21-36]	16 [7-21]	9 [4-13]	48 [35-61]	70 [62-87]	84 [76-93]				...-... [0%] [...-...]	460 [320-590]	360 [10-540]	-60 [-440-0]	1.6 [1.5-1.6]	1.4 [1.3-1.5]	37 [33-56]	89 [87-96]	100 [99-100]
C2 [133]	return warming to 1.5°C (>50%) after a high overshoot	Neg	42 [31-55]	25 [17-34]	14 [5-21]	23 [0-44]	55 [40-71]	75 [62-91]	2020-2025 (100%) [2020-2030]	[2020-2025]	2055-2060 (100%) [2045-2070]	2070-2075 (87%) [2055-...]	720 [530-930]	400 [-90-620]	-360 [-680--60]	1.7 [1.5-1.8]	1.4 [1.2-1.5]	24 [15-42]	82 [71-93]	100 [99-100]
C3 [311]	*limit warming to 2°C (>67%)*		44 [32-55]	29 [20-36]	20 [13-26]	21 [1-42]	46 [34-63]	64 [53-77]	2020-2025 (100%) [2020-2030]	[2020-2025]	2070-2075 (93%) [2055-...]	...-... (30%) [2075-...]	890 [640-1160]	800 [510-1140]	-40 [-290-0]	1.7 [1.6-1.8]	1.6 [1.5-1.8]	20 [13-41]	76 [68-91]	99 [98-100]
C3a [204]	... with action starting in 2020	SSP1-2.6	40 [30-49]	29 [21-36]	20 [14-27]	27 [13-45]	47 [35-63]	63 [52-76]	2020-2025 (100%) [2020-2025]		2070-2075 (91%) [2055-...]	...-... (24%) [2080-...]	860 [640-1180]	790 [480-1150]	-30 [-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]	... NDCs until 2030	GS	52 [47-56]	29 [20-36]	18 [10-25]	5 [0-14]	46 [34-63]	68 [56-82]	2020-2025 (100%) [2020-2030]		2065-2070 (97%) [2055-2090]	...-... (41%) [2075-...]	910 [720-1150]	800 [560-1050]	-60 [-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]	limit warming to 2°C (>50%)		50 [41-56]	38 [28-44]	28 [19-35]	10 [0-27]	31 [20-50]	49 [35-65]			2080-2085 (86%) [2065-...]	...-... (31%) [2075-...]	1210 [970-1490]	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]	limit warming to 2.5°C (>50%)		52 [46-56]	45 [37-53]	39 [30-49]	6 [-1-18]	18 [4-33]	29 [11-48]			...-... (41%) [2080-...]	...-... (12%) [2090-...]	1780 [1400-2360]	1780 [1260-2360]	0 [-160-0]	2.2 [1.9-2.5]	2.1 [1.9-2.5]	4 [0-10]	37 [18-59]	91 [83-98]
C6 [97]	limit warming to 3°C (>50%)	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 (96%)	2020-2025 (97%) [2020-2090]	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]	limit warming to 4°C (>50%)	SSP3-7.0 Cur-Pol	62 [53-69]	67 [56-76]	70 [58-83]	-11 [-18-3]	-19 [-31-1]	-24 [-41--2]	2085-2090 (57%)	2090-2095 (56%) [2040-...]				4220 [3160-5000]			3.5 [2.8-3.9]	0 [0-0]	0 [0-2]	22 [7-60]
C8 [29]	exceed warming of 4°C (>=50%)	SSP5-8.5	71 [69-81]	80 [78-96]	88 [82-112]	-20 [-34--17]	-35 [-65--29]	-46 [-92--36]	2080-2085 (90%) [2070-...]					5600 [4910-7450]			4.2 [3.7-5.0]	0 [0-0]	0 [0-0]	4 [0-11]

Net zero CO_2 and GHG in Table SPM 1

p50 [p5-p95] [1]			GHG emissions Gt CO_2-eq/yr [7]			GHG emissions reductions from 2019 % [8]			Emissions milestones [9,10]				Cumulative CO_2 emissions Gt CO_2 [13]		Cumulative net-negative CO_2 emissions Gt CO_2	Global mean temperature changes 50% probability [14] °C		Likelihood of peak global warming staying below (%) [15]		
Category [2, 3, 4] [# pathways]	Category / subset label	WG I SSP & WG III IPs/IMPs alignment [5, 6]	2030	2040	2050	2030	2040	2050	Peak CO_2 emissions (% peak before 2100)	Peak GHG emissions (% peak before 2100)	Net-zero CO_2 (% net-zero pathways)	Net-zero GHGs [11, 12] (% net-zero pathways)	2020 to net-zero CO_2	2020-2100	Year of net-zero CO_2 to 2100	at peak warming	2100	<1.5°C	<2.0°C	<3.0°C
C1 [97]	limit warming to 1.5°C (>50%) with no or limited overshoot		31 [21-36]	17 [6-23]	9 [1-15]	43 [34-60]	69 [58-90]	84 [73-98]				2095-2100 (52%) [2050-...]	510 [330-710]	320 [-210-570]	-220 [-660–-20]	1.6 [1.4-1.6]	1.3 [1.1-1.5]	38 [33-58]	90 [86-97]	100 [99-100]
C1a [50]	... with net-zero GHGs	SSP1-1.9, SP LD	33 [22-37]	[illegible] [6-24]	[illegible] [0-15]	[illegible] [31-59]	[illegible] [58-89]	85 [72-100]	2020-2025 (100%) [2020-2025]		2050-2055 (100%) [2035-2070]	2070-2075 (100%) [2050-2090]	550 [340-760]	160 [-220-620]	-360 [-680–-140]	1.6 [1.4-1.6]	1.2 [1.1-1.4]	38 [34-60]	90 [85-98]	100 [99-100]
C1b [47]	... without net-zero GHGs	Ren	29 [21-36]	[illegible] [7-21]	9 [4-13]	[illegible] [35-61]	[illegible] [62-87]	[illegible] [76-93]				...-... [0%] [...-...]	460 [320-590]	360 [10-540]	-60 [-440-0]	1.6 [1.5-1.6]	1.4 [1.3-1.5]	37 [33-56]	89 [87-96]	100 [99-100]
C2 [133]	return warming to 1.5°C (>50%) after a high overshoot	Neg	42 [31-55]	25 [17-34]	14 [5-21]	23 [0-44]	55 [40-71]	75 [62-91]	2020-2025 (100%) [2020-2030]	[2020-2025]	2055-2060 (100%) [2045-2070]	2070-2075 (87%) [2055-...]	720 [530-930]	400 [-90-620]	-360 [-680–-60]	1.7 [1.5-1.8]	1.4 [1.2-1.5]	24 [15-42]	82 [71-93]	100 [99-100]
C3 [311]	*limit warming to 2°C (>67%)*		44 [32-55]	29 [20-36]	20 [13-26]	21 [1-42]	46 [34-63]	64 [53-77]	2020-2025 (100%) [2020-2030]	[2020-2025]	2070-2075 (93%) [2055-...]	...-... (30%) [2075-...]	890 [640-1160]	800 [510-1140]	-40 [-290-0]	1.7 [1.6-1.8]	1.6 [1.5-1.8]	20 [13-41]	76 [68-91]	99 [98-100]
C3a [204]	... with action starting in 2020	SSP1-2.6	40 [30-49]	29 [21-36]	20 [14-27]	27 [13-45]	47 [35-63]	63 [52-76]	2020-2025 (100%) [2020-2025]		2070-2075 (91%) [2055-...]	...-... (24%) [2080-...]	860 [640-1180]	790 [480-1150]	-30 [-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]	... NDCs until 2030	GS	52 [47-56]	29 [20-36]	18 [10-25]	5 [0-14]	46 [34-63]	68 [56-82]			2065-2070 (97%) [2055-2090]	...-... (41%) [2075-...]	910 [720-1150]	800 [560-1050]	-60 [-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]	limit warming to 2°C (>50%)		50 [41-56]	38 [28-44]	28 [19-35]	10 [0-27]	31 [20-50]	49 [35-65]	2020-2025 (100%) [2020-2030]		2080-2085 (86%) [2065-...]	...-... (31%) [2075-...]	1210 [970-1490]	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]	limit warming to 2.5°C (>50%)		52 [46-56]	45 [37-53]	39 [30-49]	6 [-1-18]	18 [4-33]	29 [11-48]			...-... (41%) [2080-...]	...-... (12%) [2090-...]	1780 [1400-2360]	1780 [1260-2360]	0 [-160-0]	2.2 [1.9-2.5]	2.1 [1.9-2.5]	4 [0-10]	37 [18-59]	91 [83-98]
C6 [97]	limit warming to 3°C (>50%)	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 (96%) [2020-2090]	2020-2025 (97%)				2790 [2440-3520]			2.7 [2.4-2.9]	0 [0-0]	8 [2-18]	71 [53-88]
C7 [164]	limit warming to 4°C (>50%)	SSP3-7.0 Cur-Pol	62 [53-69]	67 [56-76]	70 [58-83]	-11 [-18-3]	-19 [-31-1]	-24 [-41–-2]	2085-2090 (57%) [2040-...]	2090-2095 (56%)	no net-zero		no net-zero	4220 [3160-5000]	no net-zero	temperature does not peak by 2100	3.5 [2.8-3.9]	0 [0-0]	0 [0-2]	22 [7-60]
C8 [29]	exceed warming of 4°C (>=50%)	SSP5-8.5	71 [69-81]	80 [78-96]	88 [82-112]	-20 [-34–-17]	-35 [-65–-29]	-46 [-92–-36]	2080-2085 (90%) [2070-...]					5600 [4910-7450]			4.2 [3.7-5.0]	0 [0-0]	0 [0-0]	4 [0-11]

With net zero GHGs

Without net zero GHGs

Net zero CO_2 and GHG in Table SPM 1

p50 [p5-p95] (1)			GHG emissions Gt CO_2-eq/yr (7)			GHG emissions reductions from 2019 % (8)			Emissions milestones (9,10)				Cumulative CO_2 emissions Gt CO_2 (13)		Cumulative net-negative CO_2 emissions Gt CO_2	Global mean temperature changes 50% probability (14) °C		Likelihood of peak global warming staying below (%) (15)		
Category (2, 3, 4) [# pathways]	Category / subset label	WG I SSP & WG III IPs/IMPs alignment (5, 6)	2030	2040	2050	2030	2040	2050	Peak CO_2 emissions (% peak before 2100)	Peak GHG emissions (% peak before 2100)	Net-zero CO_2 (% net-zero pathways)	Net-zero GHGs (11, 12) (% net-zero pathways)	2020 to net-zero CO_2	2020-2100	Year of net-zero CO_2 to 2100	at peak warming	2100	<1.5°C	<2.0°C	<3.0°C
C1 [97]	limit warming to 1.5°C (>50%) with no or limited overshoot		31 [21-36]	17 [6-23]	9 [1-15]	43 [34-60]	69 [58-90]	84 [73-98]	2020-2025 (100%) [2020-2025]			2095-2100 (52%) [2050-...]	510 [330-710]	320 [-210-570]	-220 [-660–-20]	1.6 [1.4-1.6]	1.3 [1.1-1.5]	38 [33-58]	90 [86-97]	100 [99-100]
C1a [50]	... with net-zero GHGs	SSP1-1.9, SP LD	33 [22-37]	18 [6-24]	8 [0-15]	41 [31-59]	66 [58-89]	85 [72-100]			2050-2055 (100%) [2035-2070]	2070-2075 (100%) [2050-2090]	550 [340-760]	160 [-220-620]	-360 [-680–-140]	1.6 [1.4-1.6]	1.2 [1.1-1.4]	38 [34-60]	90 [85-98]	100 [99-100]
C1b [47]	... without net-zero GHGs	Ren	29 [21-36]	16 [7-21]	9 [4-13]	48 [35-61]	70 [62-87]	84 [76-93]				...-... [0%] [...-...]	460 [320-590]	360 [10-540]	-60 [-440-0]	1.6 [1.5-1.6]	1.4 [1.3-1.5]	37 [33-56]	89 [87-96]	100 [99-100]
C2 [133]	return warming to 1.5°C (>50%) after a high overshoot	Neg	42 [31-55]	25 [17-34]	14 [5-21]	23 [0-44]	55 [40-71]	75 [62-91]	2020-2025 (100%) [2020-2030]	[2020-2025]	2055-2060 (100%) [2045-2070]	2070-2075 (87%) [2055-...]	720 [530-930]	400 [illegible]	-360 [illegible]	1.7 [illegible]	1.4 [illegible]	24 [illegible]	82 [illegible]	100 [illegible]
C3 [311]	*limit warming to 2°C (>67%)*		44 [illegible]	29 [illegible]	20 [illegible]	21 [illegible]	46 [illegible]	64 [illegible]	2020-2025 (100%) [2020-2030]	[2020-2025]	2070-2075 (93%) [2055-...]	...-... (30%) [2075-...]	890 [640-1160]	800 [510-1140]	-40 [illegible]	1.7 [illegible]	1.6 [illegible]	20 [illegible]	76 [68-91]	99 [98-100]
C3a [204]	... with action starting in 2020	SSP1-2.6	40 [30-49]	29 [21-36]	20 [illegible]	27 [13-45]	47 [35-63]	63 [52-76]	2020-2025 (100%) [2020-2025]		2070-2075 (91%) [illegible]	...-... (24%) [illegible]	860 [illegible]	790 [illegible]	-30 [illegible]	1.7 [1.6-1.8]	1.6 [1.5-1.8]	21 [14-42]	78 [69-91]	100 [98-100]
C3b [97]	... NDCs until 2030	GS	52 [47-56]	29 [20-36]	18 [illegible]	5 [0-14]	46 [34-63]	68 [56-82]			2065-2070 (97%) [illegible]	...-... (41%) [illegible]	910 [illegible]	800 [illegible]	-60 [illegible]	1.8 [illegible]	1.6 [1.5-1.7]	17 [12-35]	73 [67-87]	99 [98-99]
C4 [159]	limit warming to 2°C (>50%)		50 [41-56]	38 [28-44]	28 [illegible]	10 [0-27]	31 [20-50]	49 [35-65]	2020-2025 (100%) [2020-2030]		2080-2085 (86%) [2065-...]	...-... (31%) [2075-...]	[illegible] [970-1490]	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]	limit warming to 2.5°C (>50%)		52 [46-56]	45 [37-53]	39 [illegible]	6 [-1-18]	18 [4-33]	29 [11-48]			...-... (41%) [2080-...]	...-... (12%) [2090-...]	1780 [1400-2360]	1780 [1260-2360]	0 [-160-0]	2.2 [1.9-2.5]	2.1 [1.9-2.5]	4 [0-10]	37 [18-59]	91 [83-98]
C6 [97]	limit warming to 3°C (>50%)	SSP2-4.5 Mod-Act	54 [50-62]	53 [48-61]	52 [illegible]	2 [illegible]	3 [illegible]	5 [illegible]	2030-2035 [illegible] [2020-2090]	[illegible]	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]	limit warming to 4°C (>50%)	SSP3-7.0 Cur-Pol	62 [53-69]	67 [56-76]	70 [58-83]	-11 [-18-3]	-19 [-31-1]	-24 [-41–-2]	2085-2090 (57%) [2040-...]	2090-2095 (56%)				4220 [3160-5000]			3.5 [2.8-3.9]	0 [0-0]	0 [0-2]	22 [7-60]
C8 [29]	exceed warming of 4°C (>=50%)	SSP5-8.5	71 [69-81]	80 [78-96]	88 [82-112]	-20 [-34–-17]	-35 [-65–-29]	-46 [-92–-36]	2080-2085 (90%) [2070-...]					5600 [4910-7450]			4.2 [3.7-5.0]	0 [0-0]	0 [0-0]	4 [0-11]

Emissions declines to 2030, 2040, 2050 are very similar

C1a and C1b have broadly the same peak warming

C1a and C1b have thus similar cumulative CO_2 until time of net zero

C1a and C1b reach net zero CO_2 around the same time

Net zero CO_2 and GHG in Table SPM 1

p50 [p5-p95] (1) Category (2, 3, 4) [# pathways]	Category / subset label	WG I SSP & WG III IPs/IMPs alignment (5, 6)	GHG emissions $Gt\ CO_2$-eq/yr (7) 2030	2040	2050	GHG emissions reductions from 2019 % (8) 2030	2040	2050	Emissions milestones (9,10): Peak CO_2 emissions (% peak before 2100)	Peak GHG emissions (% peak before 2100)	Net-zero CO_2 (% net-zero pathways)	Net-zero GHGs (11, 12) (% net-zero pathways)	Cumulative CO_2 emissions $Gt\ CO_2$ (13): 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	Global mean temperature changes 50% probability (14) °C: at peak warming	2100	Likelihood of peak global warming staying below (%) (15): <1.5°C	<2.0°C	<3.0°C
C1 [97]	limit warming to 1.5°C (>50%) with no or limited overshoot		31 [21-36]	17 [6-23]	9 [1-15]	43 [34-60]	69 [58-90]	84 [73-98]	2020-2025 (100%) [2020-2025]		2050-2055 (100%) [2035-2070]	2095-2100 (52%) [2050-...]	510 [330-710]	320 [-210-570]	-220 [-660--20]	1.6 [1.4-1.6]	1.3 [1.1-1.5]	38 [33-58]	90 [86-97]	100 [99-100]
C1a [50]	... with net-zero GHGs	SSP1-1.9, SP LD	33 [22-37]	18 [6-24]	8 [0-15]	41 [31-59]	66 [58-89]	85 [72-100]				2070-2075 (100%) [2050-2090]	550 [340-760]	160 [-220-620]	-360 [-680--140]	1.6 [1.4-1.6]	1.2 [1.1-1.4]	38 [34-60]	90 [85-98]	100 [99-100]
C1b [47]	... without net-zero GHGs	Ren	29 [21-36]	16 [7-21]	9 [4-13]	48 [35-61]	70 [62-87]	84 [76-93]				...-... [0%] [...-...]	460 [320-590]	360 [10-540]	-60 [-440-0]	1.6 [1.5-1.6]	1.4 [1.3-1.5]	37 [33-56]	89 [87-96]	100 [99-100]
C2 [133]	return warming to 1.5°C (>50%) after a high overshoot	Neg	42 [31-55]	25 [17-34]	14 [5-21]	23 [0-44]	55 [40-71]	75 [62-91]	2020-2025 (100%) [2020-2030]	[2020-2025]	2055-2060 (100%) [2045-2070]	2070-2075 (87%) [2055-...]	720 [530-930]	400 [-90-620]	-360 [-680--60]	1.7 [1.5-1.8]	1.4 [1.2-1.5]	24 [15-42]	82 [71-93]	100 [99-100]
C3 [311]	*limit warming to 2°C (>67%)*		44 [32-55]	29 [20-36]	20 [13-26]	21 [1-42]	46 [34-63]	64 [53-77]	[illegible]	[illegible]	[illegible]	...-... (30%) [illegible]	890 [640-1160]	800 [510-1140]	-40 [-290-0]	1.7 [1.6-1.8]	1.6 [1.5-1.8]	20 [13-41]	76 [68-91]	99 [98-100]
C3a [204]	... with action starting in 2020	SSP1-2.6	40 [30-49]	29 [21-36]	20 [14-27]	27 [13-45]	47 [35-63]	63 [52-76]	2020-2025 (100%) [illegible]		[illegible]	...-... (24%) [2080-...]	860 [640-1180]	790 [480-1150]	-30 [-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]	... NDCs until 2030	GS	52 [47-56]	29 [20-36]	18 [10-25]	5 [0-14]	46 [34-63]	68 [56-82]			[illegible] [2055-2090]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.6 [1.5-1.7]	17 [12-35]	73 [67-87]	99 [98-99]
C4 [159]	limit warming to 2°C (>50%)		50 [41-56]	38 [28-44]	28 [19-35]	10 [0-27]	31 [20-50]	49 [35-65]	2020-2025 (100%) [2020-2030]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.8 [1.5-2.0]	11 [7-22]	59 [50-77]	98 [95-99]
C5 [212]	limit warming to 2.5°C (>50%)		52 [46-56]	45 [37-53]	39 [30-49]	6 [-1-18]	18 [4-33]	29 [11-48]			...-... (41%) [2080-...]	...-... (12%) [2090-...]	1780 [1400-2360]	1780 [1260-2360]	0 [-160-0]	2.2 [1.9-2.5]	2.1 [1.9-2.5]	4 [0-10]	37 [18-59]	91 [83-98]
C6 [97]	limit warming to 3°C (>50%)	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 (96%)	2020-2025 (97%) [2020-2090]	no net-zero		no net-zero	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	71 [53-88]
C7 [164]	limit warming to 4°C (>50%)	SSP3-7.0 Cur-Pol	62 [53-69]	67 [56-76]	70 [58-83]	-11 [-18-3]	-19 [-31-1]	-24 [-41--2]	2085-2090 (57%)	2090-2095 (56%) [2040-...]				4220 [3160-5000]		[illegible] does [illegible] peak by 2100	[illegible] [2.8-3.9]	[illegible] [0-0]	0 [0-2]	22 [7-60]
C8 [29]	exceed warming of 4°C (>=50%)	SSP5-8.5	71 [69-81]	80 [78-96]	88 [82-112]	-20 [-34--17]	-35 [-65--29]	-46 [-92--36]	2080-2085 (90%) [2070-...]					5600 [4910-7450]			4.2 [3.7-5.0]	0 [0-0]	0 [0-0]	4 [0-11]

In C1a pathways net zero GHG is reached about 10-30 years after net zero CO2

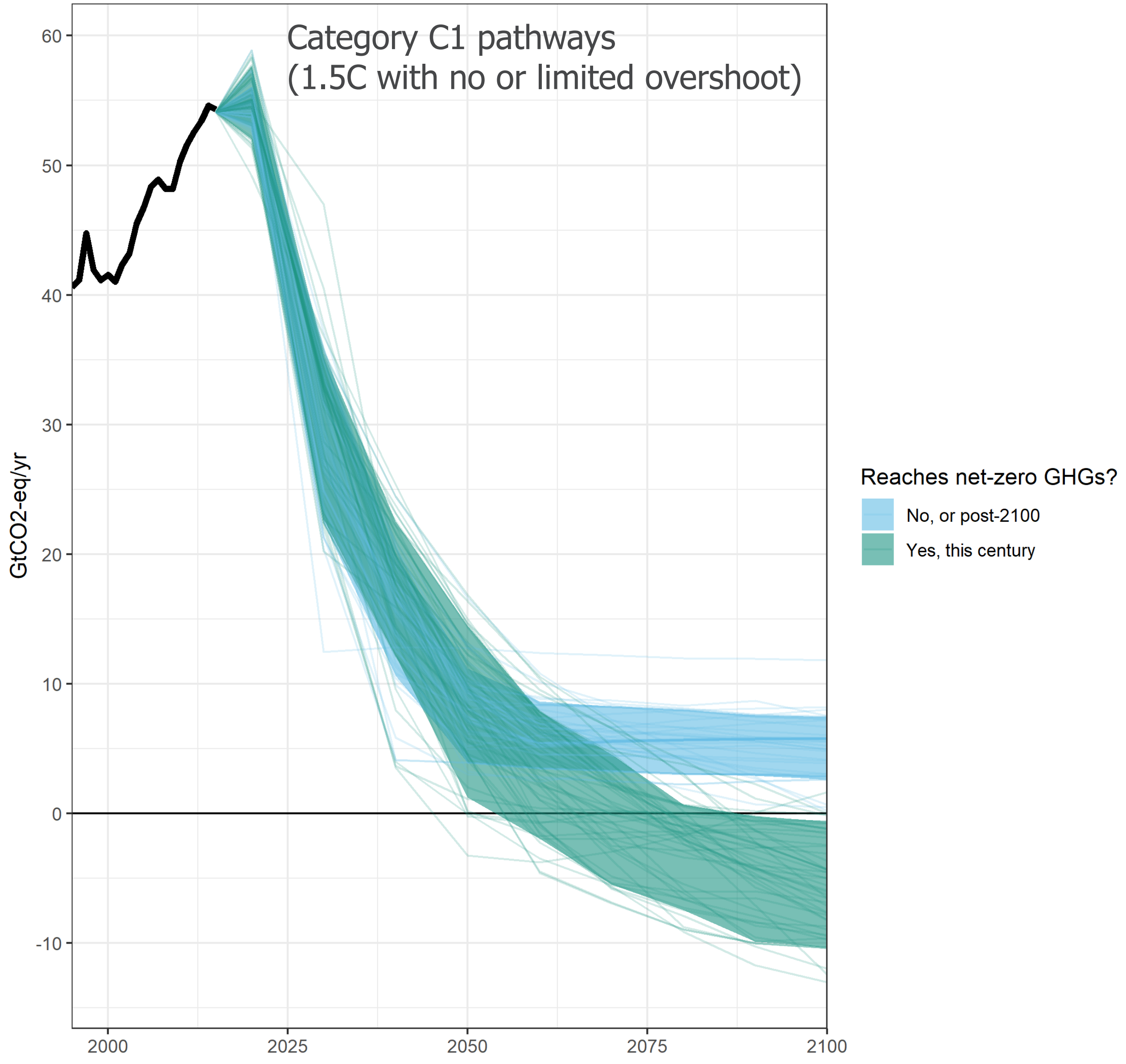
High reliance on net negative CO_2 emissions in C1a to reach net zero GHGs (and below)

Long-term warming is reduced significantly in C1a

Pathways reaching net zero GHGs return warming to lower levels in the long term

SPM C.2.4

- At the time of global net zero GHG emissions, net negative CO 2 emissions counterbalance metric-weighted non-CO 2 GHG emissions. Typical emissions pathways that reach and sustain global net zero GHG emissions based on the 100-year global warming potential (GWP-100) 7 are projected to result in a gradual decline of global warming. About half of the assessed pathways that limit warming to 1.5°C (>50%) with no or limited overshoot (C1 category) reach net zero GHG emissions during the second half of the 21st century. These pathways show greater reduction in global warming after the peak to 1.2 [1.1–1.4] °C by 2100 than modelled pathways in the same category that do not reach net zero GHG emissions before 2100 and that result in warming of 1.4 [1.3–1.5] °C by 2100. In modelled pathways that limit warming to 2°C (>67%) (C3 category), there is no significant difference in warming by 2100 between those pathways that reach net zero GHGs (around 30%) and those that do not (high confidence). In pathways that limit warming to 2°C (>67%) or lower and that do reach net zero GHG, net zero GHG occurs around 10–40 years later than net zero CO 2 emissions (medium confidence). {Cross-Chapter Box 2 in Chapter 2, 3.3, Cross-Chapter Box 3 in Chapter 3; AR6 WGI SPM D1.8



Key findings of WG III AR6 – Part II :

WG III insights into the effect of steps taken by parties in order to achieve the long- term temperature goal of the convention

Three part presentation:

- *Historical Emissions – Alaa Al Khourdajie*
- *Emissions pathways and net zero CO2 / GHGs – Keywan Riahi*
- *Finance – Dipak Dasgupta*

Finance: Key Questions, 2022 (AR6) versus 2014 (AR5)

- ***How Big are measured annual climate finance flows?*** Public and private (USD 685 billion 2018, versus USD 359 billion 2012) (multiple sources)
- ***How Big are the Gaps in Financing?*** Investment Needs versus Flows to Achieve the Low-Carbon Transition (USD 3-5 trillion a year, versus est. USD 1.2 trillion earlier). Biggest gap in developing countries.
- ***What are the Barriers and Enabling Opportunities?***

  -*Crises and Macroeconomic Headwinds* (2020 Pandemic+ debt+ climate effects; versus 2008 GFC),

  -*Progress in USD 100 Billion Goal* to Developing Countries (Weak, earlier n.a.)

  -*Progress in Aligning the Financial System* (Weak, earlier n.a.)

  *Continuing high fossil fuel investments which exceed low-carbon

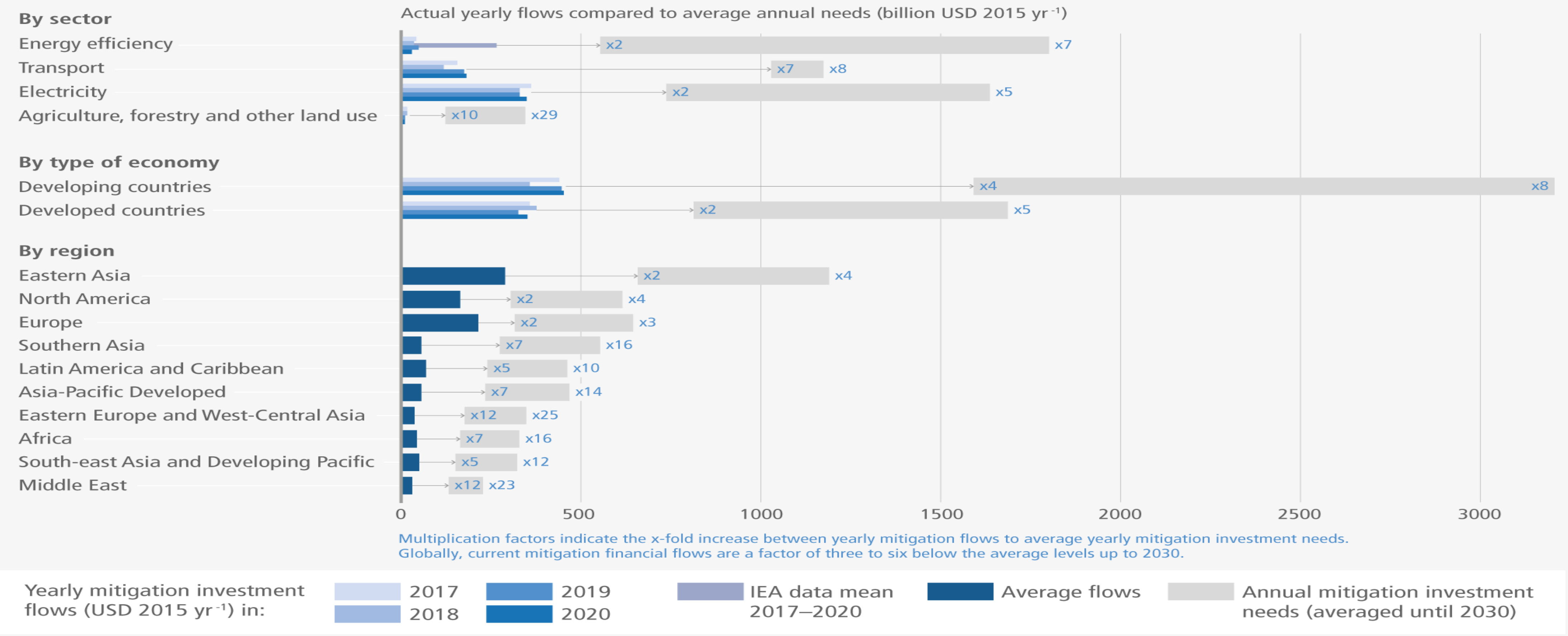
  *Gaps in financing and costs in developing countries highest

  *Flows to low-income and vulnerable countries weakest (Just Transition)

  *Credible signals required from governments (+ climate risk disclosure)

  ****Many Immediate and actionable steps/options feasible***

Tracked financial flows fall short of levels needed (3-6 times bigger annually for 2020-2030) to achieve mitigation goals



FINANCIAL FLOW GAPS TO MEET NT 1.5C AND 2C GOALS

Seven Urgent Options> Scaling Up Climate Finance to Developing Regions

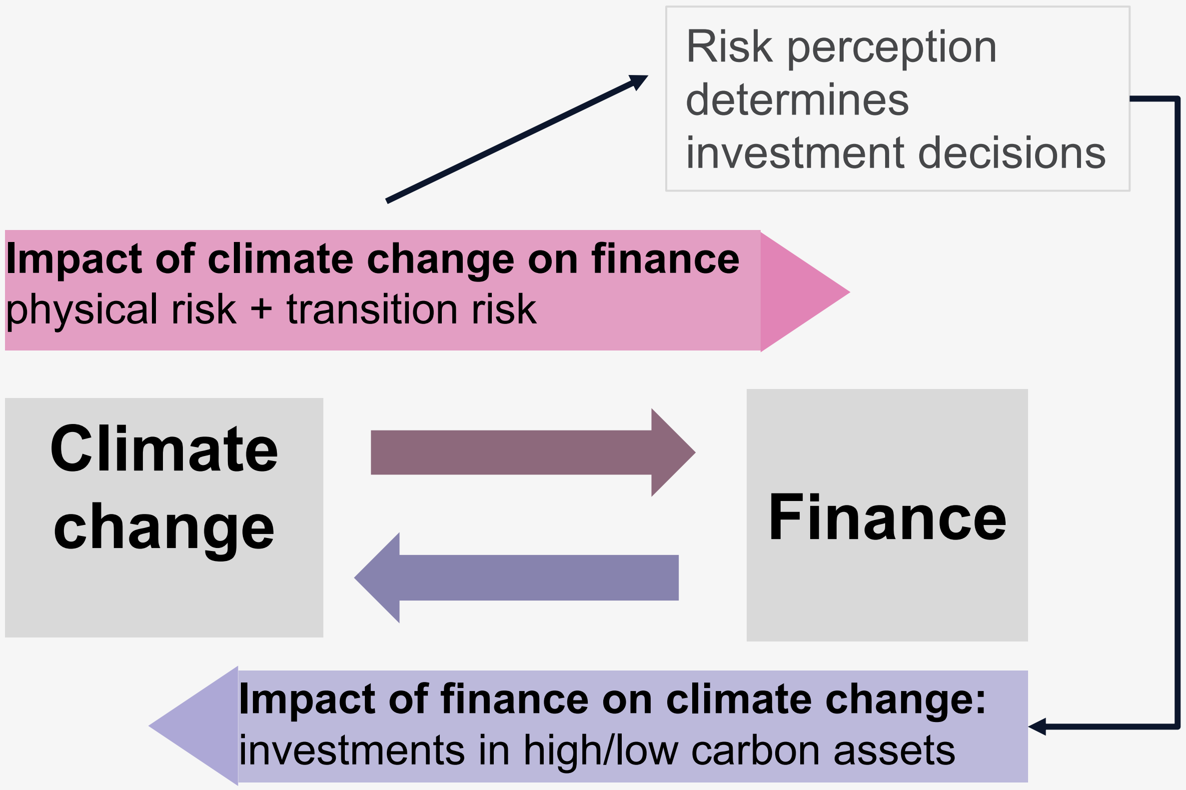
- ***Accelerated financial support*** *from developed to developing countries* ***is critical enabler*** of low-GHG and just transitions: address high costs, terms and conditions of finance, and vulnerability to climate change
- ***Scaled up public grants*** for mitigation and adaptation funding for vulnerable countries, especially in Sub-Saharan Africa; 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 USD 100 billion-a-year goal
- ***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

Aligning the Financial System (Art. 2.1 (c)) will need more than ‘climate risk disclosure’

- **Green bonds, ESG** (environmental, social and governance) and sustainable finance products have expanded since AR5, but finance flows remain below needs in all sectors and regions, transparency missing
- **Finance flows for fossil fuels** are still greater than those for climate adaptation and mitigation
- **Sufficient global capital and liquidity** to close global investment gaps, given the size of the global financial system
- **Deep barriers to redirect capital** to climate action both within and outside the global financial sector and given macroeconomic headwinds
- **Clear signal**ing by governments>stronger alignment of public finance and policy essential>reduce risk and uncertainty for investors
- **Central banks** and financial regulators can do much more to support climate action
- Greater support for **technology development**, diffusion and transfer
- Role of multilateral and national **climate funds** and development banks
- **Lowering financing costs** for underserved groups, communities, gender-responsive such as green banks, funds and risk- sharing mechanisms
- **Enhanced international cooperation** partnerships, including sub-national regions, cities, and state and non-state actors

Climate and finance: risks and impacts

A TWO-SIDED RELATION: 1. RISK



Source: author's illustration based on AR6 WGIII Ch.15

Climate-financial risk

Physical risk: Mitigation report 'overemphasizes' late (2050-2100) risks, beyond NT financial horizons
Adaptation Report has NT risks but non-monetized

- **Direct:** increased frequency/magnitude of climate-related hazards and chronic impacts → losses on physical assets and human lives
- **Indirect**: reduced food and water security → increased risk of conflicts → decreased value of land and businesses in affected areas

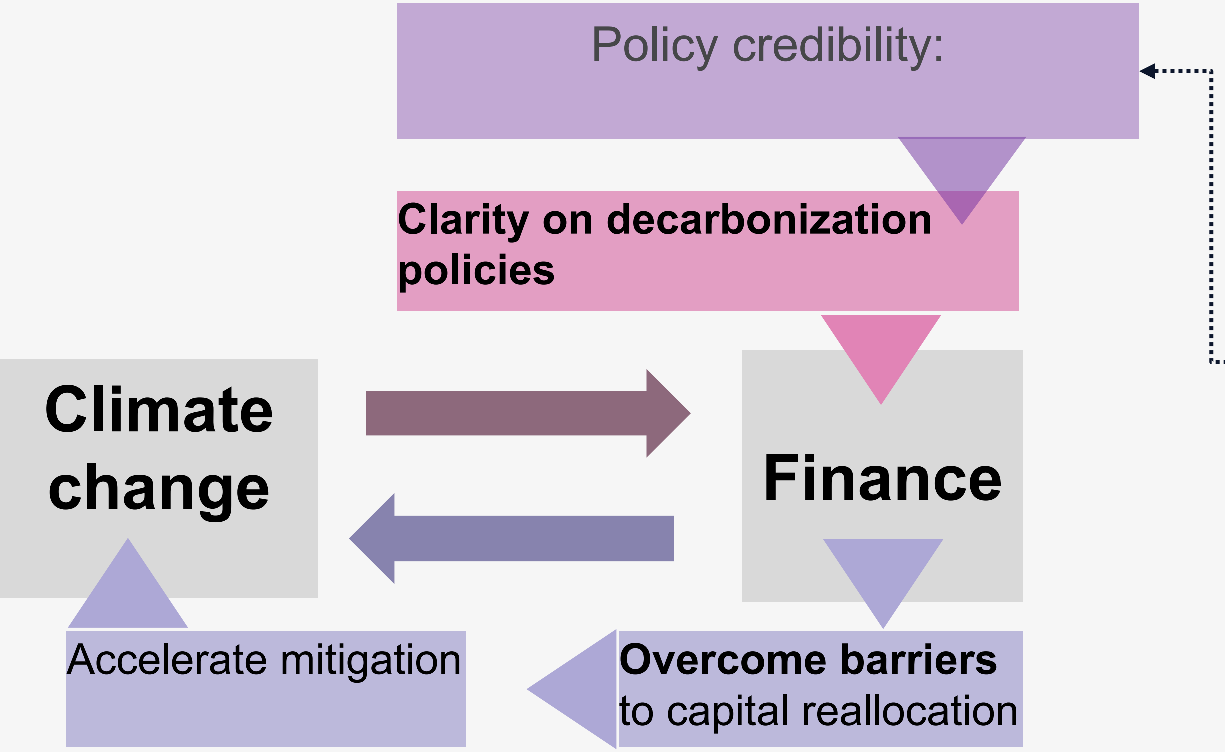
Transition risk: policy change & carbon price risks

- **Orderly** transition is ideal scenario.
- **Disorderly** transition: complexity of policy process implies possibility of late and sudden transition (+Stranded Assets) with unanticipated effects on prices and financial stability.
- The purpose of assessing transition risk is to avoid its materiality.

Source: AR6 WGIII Ch.15

Policy ‘credibility’ is central

POLICY CREDIBILITY CAN REDUCE UNCERTAINTY IN DECISION MAKING



Source: author’s illustration based on AR6 WGIII Ch.15

Governments and Intern. Community

Clear policy signalling is the key to:

- reduce uncertainty on future scenarios
- instruments that are aligned with public finance constraints
- create incentives to reallocate capital towards climate-aligned investments for decision makers
  - in public and private financial institutions
  - Households
  - Political and social consensus

Source: AR6 WGIII Ch.15

Early-Stage Risk Reduction in Capital Markets Critical

-Highest risks are at initial stages

-Grants and technology support can de-risk early project preparation

-Concessional finance, grants and guarantees can de-risk second stage

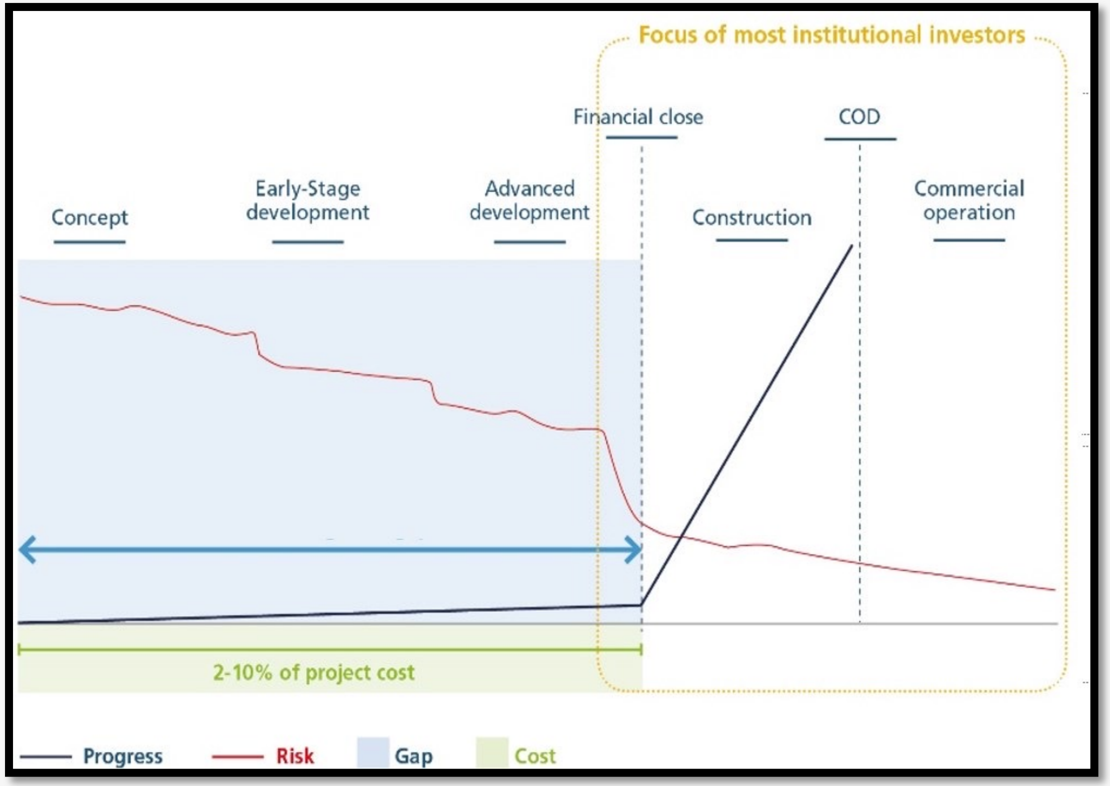
-Institutional investors pick-up the later and mature financing stage

-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'

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THANK YOU FOR YOUR ATTENTION
[Matt Bridgestock, Director and Architect at John Gilbert Architects]