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

## The IPCC TG-Data Webinar and Demonstration on AR6 Scenarios Database event for Latin America

Roberto Schaeffer, Chapter 3 CLA

17 April 2023

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

# Chapter 3: Mitigation Pathways Compatible with Long-term Goals

## What does this Chapter can tell us about the AR6 Scenarios Database?

# WGIII scenario collection, vetting and assessment

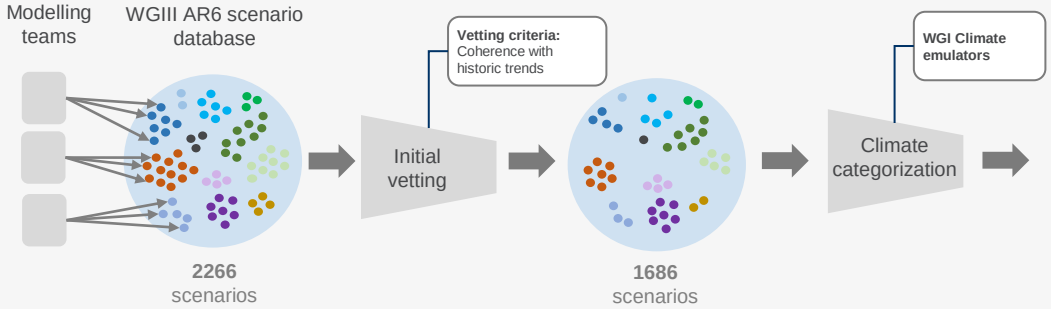



Table SPM1

| p50 (p5-p95) [B] | Global Mean Surface Air Temperature change | | GHG emissions Gt $CO_2$-eq/yr | | | GHG emissions reductions from 2019 % [B] | | | Emissions milestones [B,F] | | | | Cumulative $CO_2$ emissions Gt $CO_2$ [B] | | Cumulative net-negative $CO_2$ emissions Gt $CO_2$ | Temperature change 50% probability [C] °C | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category [F,G,I, K] [# pathways] | Category description | WG1 SSP & IPs alignment | 2030 | 2040 | 2050 | 2030 | 2040 | 2050 | Peak $CO_2$ emissions | Peak GHG emissions | net-zero $CO_2$ [% net-zero pathways] | net-zero GHGs [D] [% net-zero pathways] | 2020 to net-zero $CO_2$ | 2020-2100 | year of net-zero $CO_2$ to 2100 | at peak warming | 2100 |
| C1 (57) | Below 1.5°C with no or limited overshoot | SP, LD, Ren, SSP1-1.9 | 31 (21-36) | 17 (6-23) | 9 (1-15) | 43 (34-60) | 69 (58-90) | 84 (75-96) | 2020-2025 [100%] (2020-2025) | 2020-2025 [100%] (2020-2025) | 2050-2055 [100%] (2035-2070) | 2095-2100 [52%] (2050-...) | 510 (330-750) | 320 (-210-570) | -200 (-560-0) | 1.6 (1.3-1.8) | 1.9 (0.8-1.5) |
| C2 (133) | Below 1.5°C with high overshoot | Reg | 42 (31-55) | 25 (16-34) | 14 (5-21) | 23 (0-44) | 55 (40-71) | 75 (62-91) | 2020-2025 [100%] (2020-2030) | 2020-2025 [100%] (2020-2030) | 2055-2060 [100%] (2045-2070) | 2070-2075 [87%] (2055-...) | 720 (540-930) | 400 (-90-620) | -330 (-620--30) | 1.7 (1.4-1.8) | 1.4 (0.8-1.5) |
| C3 (270) | Likely below 2°C | SSP2-2.6 | 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 [100%] (2020-2030) | 2070-2075 [91%] (2060-...) | ...-... [30%] (2075-...) | 890 (640-1160) | 800 (500-1140) | -40 (-280-0) | 1.7 (1.4-1.8) | 1.6 (1.1-1.8) |
| C3a (204) | Immediate action | | 40 (30-49) | 29 (21-36) | 20 (13-26) | 27 (13-40) | 47 (35-60) | 63 (52-76) | 2020-2025 [100%] (2020-2025) | 2020-2025 [100%] (2020-2025) | 2075-2080 [88%] (2060-...) | ...-... [24%] (2080-...) | 860 (640-1180) | 790 (480-1150) | -10 (-280-0) | 1.7 (1.4-1.8) | 1.6 (1.1-1.8) |
| C3b (97) | NDCs | GS | 52 (47-55) | 29 (20-36) | 18 (10-25) | 5 (0-14) | 46 (34-60) | 68 (56-82) | 2020-2025 [100%] (2020-2030) | 2020-2025 [100%] (2020-2030) | 2065-2070 [96%] (2060-2100) | ...-... [42%] (2075-...) | 910 (720-1150) | 800 (560-1050) | -70 (-300-0) | 1.8 (1.4-1.8) | 1.6 (1.1-1.7) |
| C4 (175) | Below 2°C | | 50 (41-56) | 38 (28-43) | 28 (19-33) | 10 (0-27) | 31 (20-50) | 49 (35-65) | 2020-2025 [100%] (2020-2030) | 2020-2025 [100%] (2020-2030) | 2075-2080 [86%] (2065-...) | ...-... [31%] (2075-...) | 1210 (970-1500) | 1160 (700-1490) | -30 (-390-0) | 1.9 (1.5-2.0) | 1.8 (1.2-2.0) |
| C5 (152) | Below 2.5°C | | 52 (46-56) | 45 (36-52) | 39 (30-49) | 6 (-1-18) | 18 (4-31) | 29 (11-46) | 2020-2025 [100%] (2020-2035) | 2020-2025 [100%] (2020-2035) | ...-... [40%] (2075-...) | ...-... [11%] (2090-...) | 1780 (1400-2360) | 1790 (1260-2360) | 0 (-140-0) | 2.2 (1.6-2.5) | 2.1 (1.5-2.5) |
| C6 (97) | Below 3°C | SSP2-4.5 Mod-Act | 54 (50-62) | 53 (48-61) | 52 (40-57) | 2 (-10-11) | 3 (-14-14) | 5 (-2-18) | 2030-2035 [96%] (2020-2085) | 2030-2035 [96%] (2020-2085) | ...-... [0%] (...-...) | ...-... [0%] (...-...) | 2790 (2440-3520) | 2790 (2440-3520) | 0 (0-0) | 2.7 (2.0-2.9) | 2.7 (2.0-2.9) |
| C7 (104) | Below 4°C | SSP3-7.0 Cur Pol | 62 (53-69) | 67 (56-76) | 70 (58-83) | -11 (-18-3) | -19 (-31-0) | -24 (-41--2) | 2070-2075 [56%] (2025-2095) | 2070-2075 [56%] (2025-2095) | ...-... [0%] (...-...) | ...-... [0%] (...-...) | 4220 (3180-5000) | 4220 (3180-5000) | 0 (0-0) | 3.5 (2.5-3.9) | 3.5 (2.3-3.9) |
| C8 (229) | Above 4°C | SSP5-8.5 | 71 (68-80) | 79 (77-96) | 87 (82-112) | -20 (-34-17) | -35 (-66--29) | -46 (-92--36) | 2080-2085 [89%] (2060-2095) | 2080-2085 [89%] (2060-2095) | ...-... [0%] (...-...) | ...-... [0%] (...-...) | 5600 (4910-7450) | 5600 (4910-7450) | 0 (0-0) | 4.2 (3.3-5.0) | 4.2 (3.3-5.0) |

**190 Models (91+ modeling families)**

- ✓ 98 globally comprehensive
- ✓ 71 national or multi-regional
- ✓ 20 sectoral models

**Scenarios**

- ✓ 3131 submitted scenarios
- ✓ 2266 with sufficient information for climate assessment
- ✓ 1686 scenarios passed the vetting

**Table 3.1 | Classification of emissions scenarios into warming levels using MAGICC**

| Category | Description | WGI SSP | WGIII IP/IMP | Scenarios |
|---|---|---|---|---|
| **C1: Limit warming to 1.5°C (>50%) with no or limited overshoot** | Reach or exceed 1.5°C during the 21st century with a likelihood of ≤67%, and limit warming to 1.5°C in 2100 with a likelihood >50%. Limited overshoot refers to exceeding 1.5°C by up to about 0.1°C and for up to several decades. | SSP1-1.9 | IMP-SP, IMP-LD, IMP-Ren | **97** |
| **C2: Return warming to 1.5°C (>50%) after a high overshoot** | Exceed warming of 1.5°C during the 21st century with a likelihood of >67%, and limit warming to 1.5°C in 2100 with a likelihood of >50%. High overshoot refers to temporarily exceeding 1.5°C global warming by 0.1°C–0.3°C for up to several decades. | | IMP-Neg[a] | **133** |
| **C3: *Limit warming to 2°C (>67%)*** | Limit peak warming to 2°C throughout the 21st century with a likelihood of >67%. | SSP1-2.6 | IMP-GS | **311** |
| **C4: Limit warming to 2°C (>50%)** | Limit peak warming to 2°C throughout the 21st century with a likelihood of >50%. | | | **159** |
| **C5: Limit warming to 2.5°C (>50%)** | Limit peak warming to 2.5°C throughout the 21st century with a likelihood of >50%. | | | **212** |
| **C6: Limit warming to 3°C (>50%)** | Limit peak warming to 3°C throughout the 21st century with a likelihood of >50%. | SSP2-4.5 | ModAct | **97** |
| **C7: Limit warming to 4°C (>50%)** | Limit peak warming to 4°C throughout the 21st century with a likelihood of >50%. | SSP3-7.0 | CurPol | **164** |
| **C8: Exceed warming of 4°C (≥50%)** | Exceed warming of 4°C during the 21st century with a likelihood of ≥50%. | SSP5-8.5 | | **29** |
| **C1, C2, C3: limit warming to 2°C (>67%) or lower** | All scenarios in Categories C1, C2 and C3 | | | **541** |

# WGIII AR6 scenario assessment process

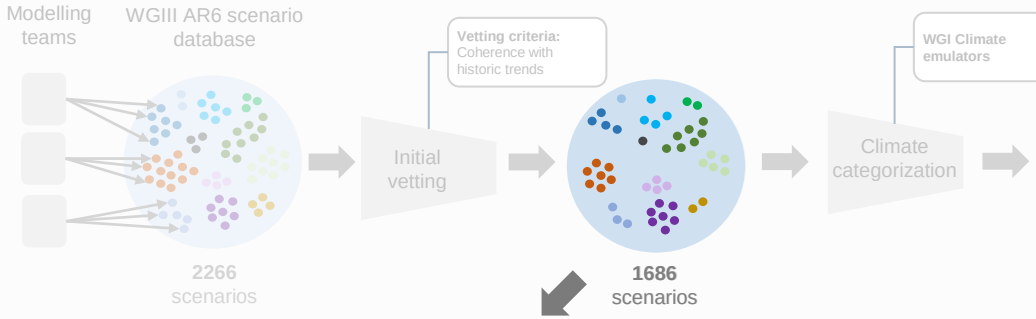
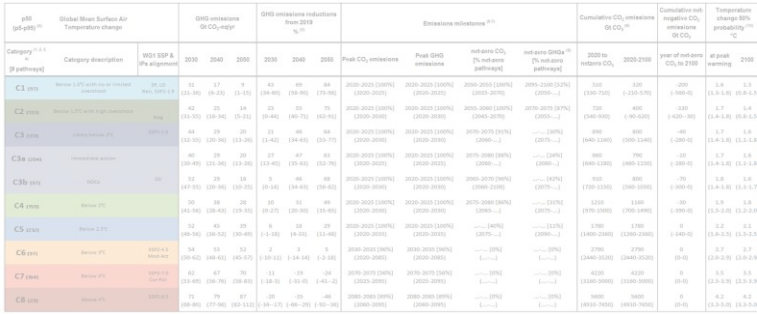
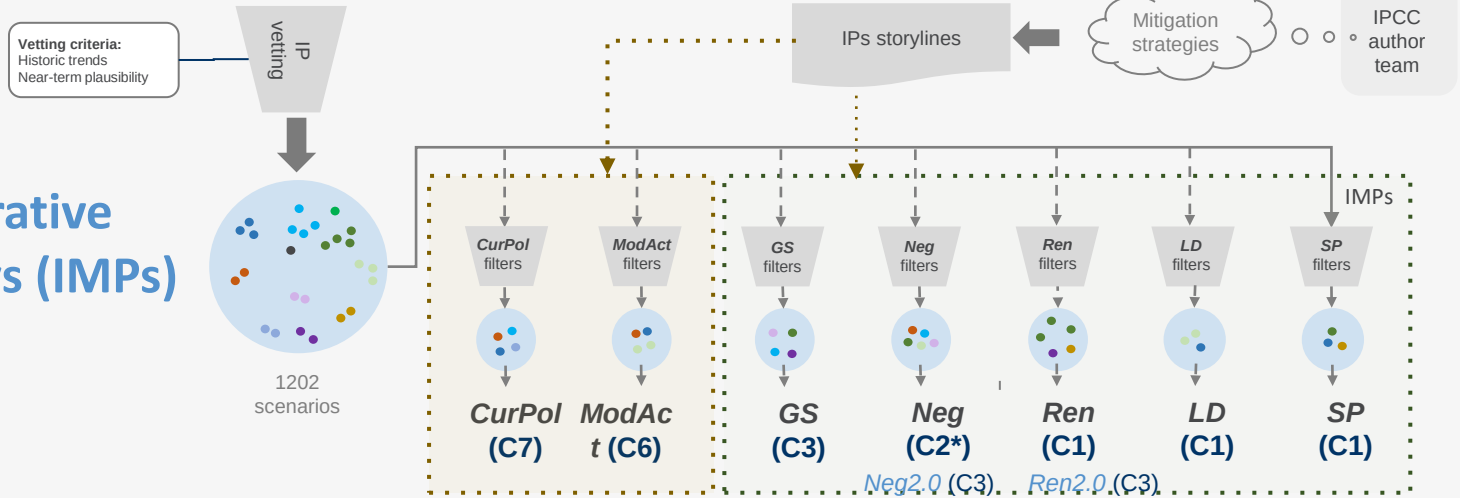



Table SPM1






## Illustrative Pathways (IMPs)

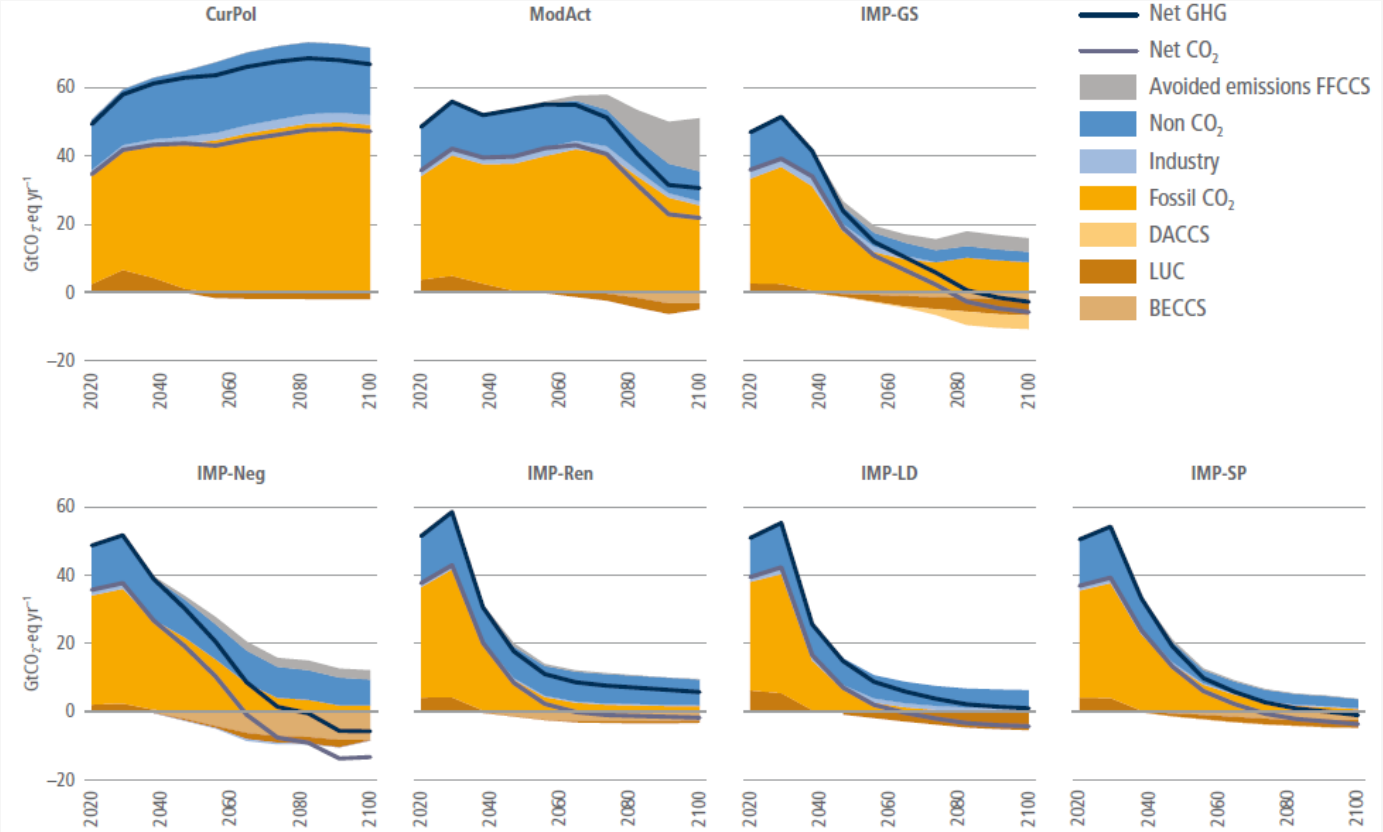



**Figure 3.7 | The residual fossil fuel and industry emissions, carbon dioxide removal (CDR) {LUC, DACCS, BECCS}, and non-$CO_2$ emissions (using AR6 GWP-100) for each of the seven illustrative pathways (IPs).** Fossil CCS is also shown, though this does not lead to emissions to the atmosphere (Section 3.2.5).

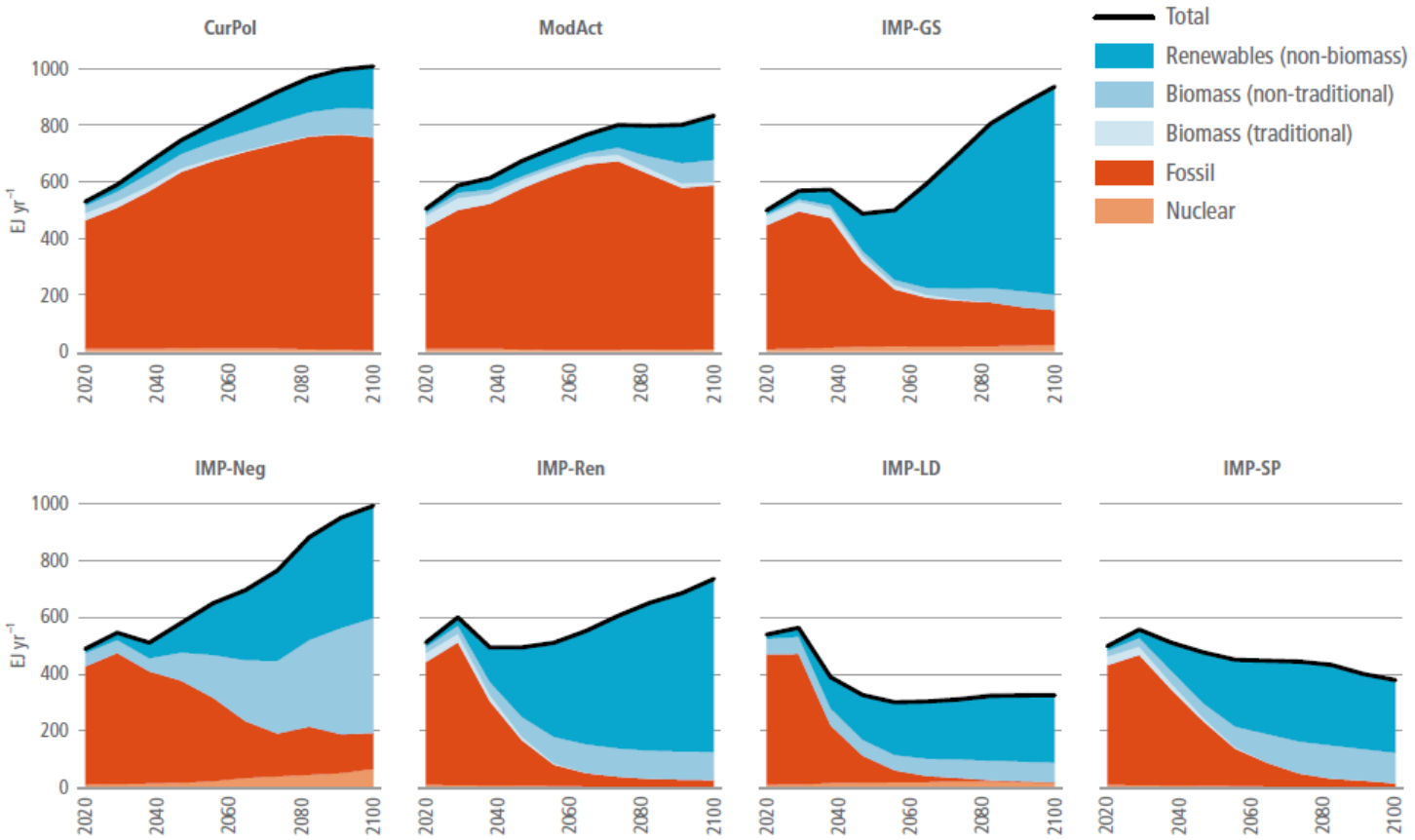



**Figure 3.8 | The energy system in each of the illustrative pathways (IPs).**

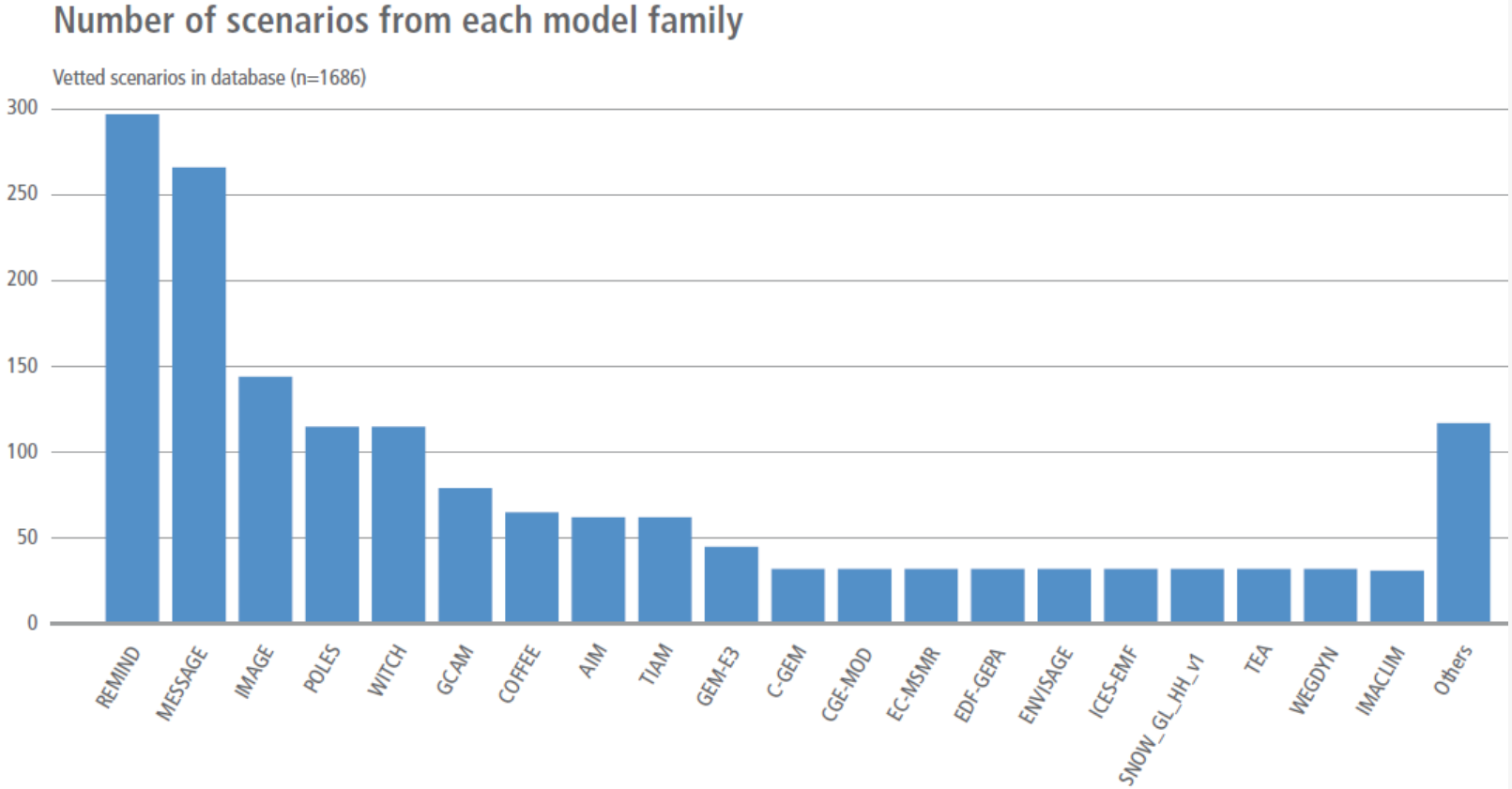



**Figure 3.1 | Scenario counts from each model family defined as all versions under the same model's name.**

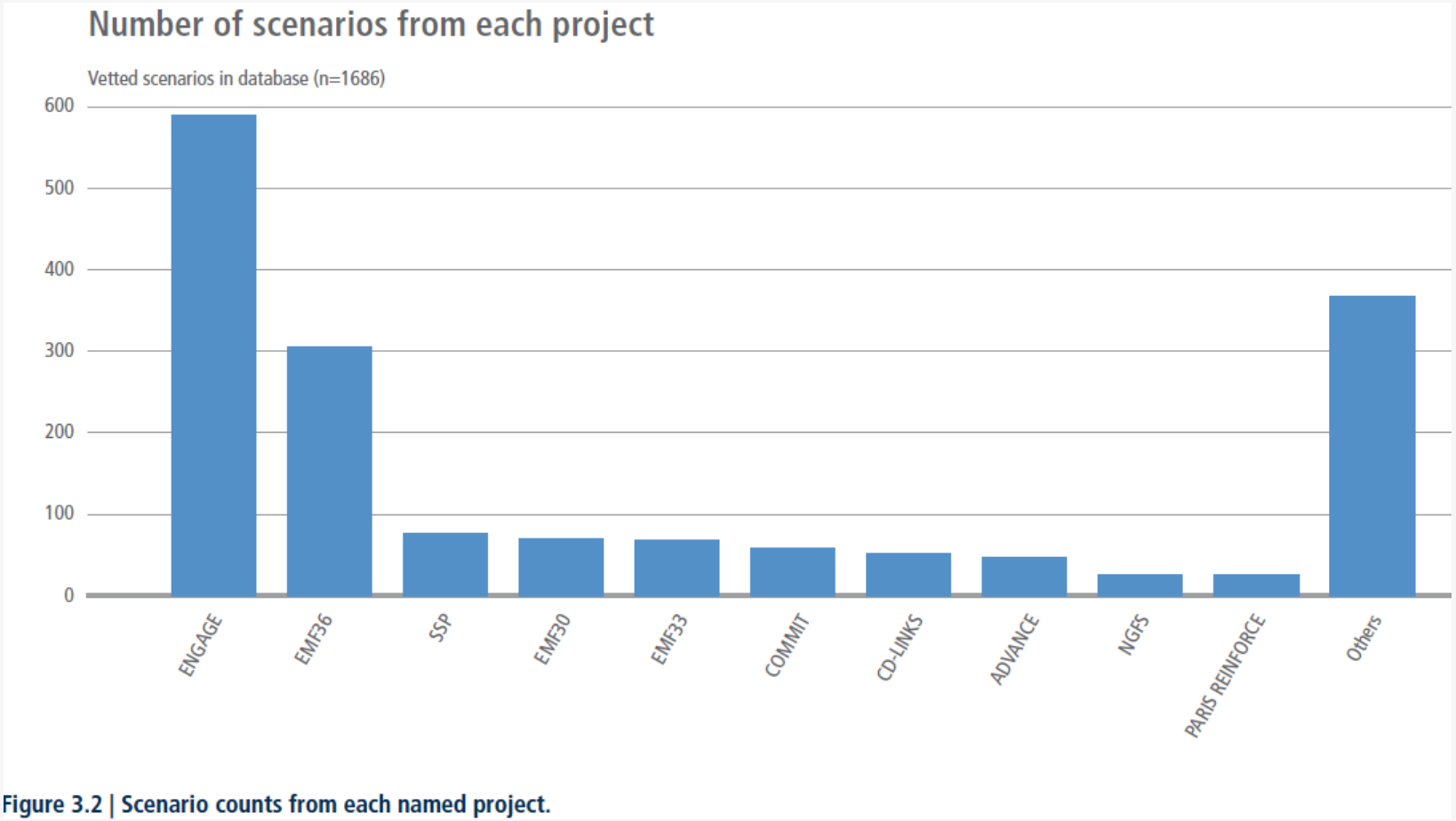



**Figure 3.2 | Scenario counts from each named project.**

## Number of scenarios in each climate category

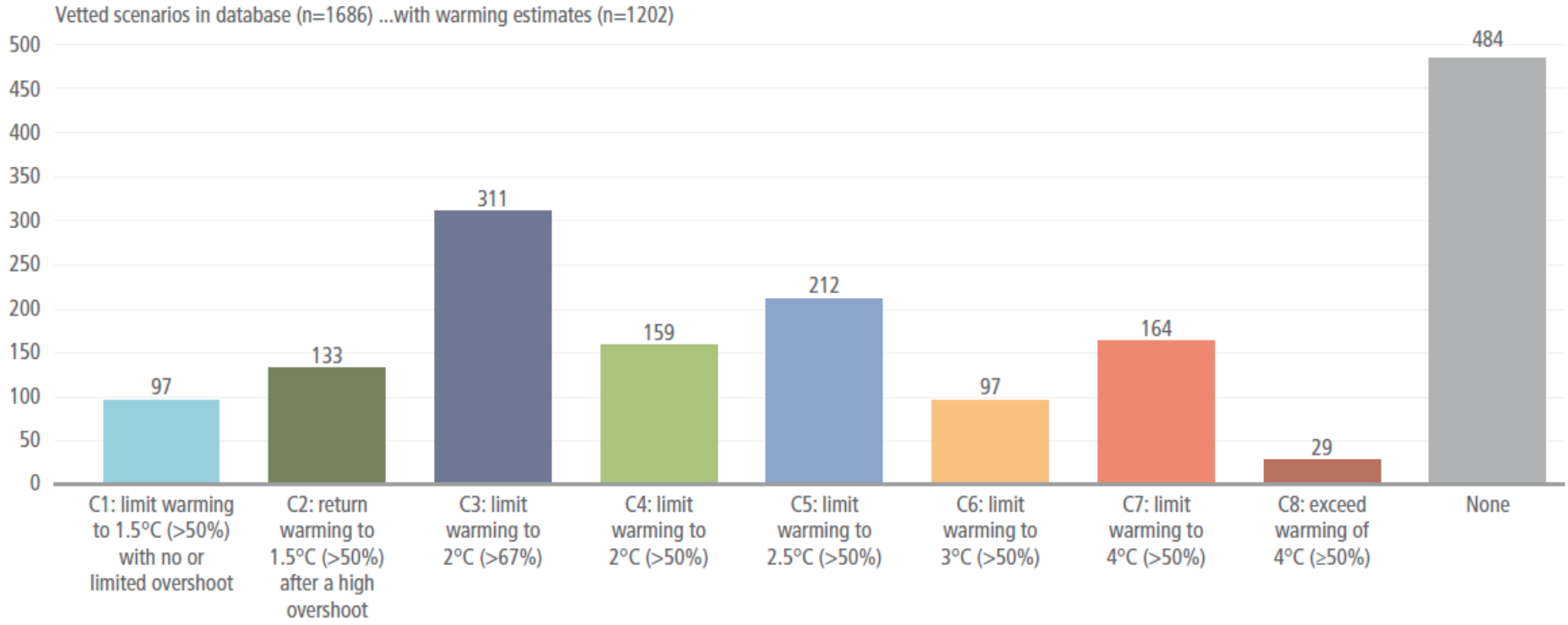



**Figure 3.3 | Of the 1686 scenarios that passed vetting, 1202 had sufficient data available to be classified according to temperature, with an uneven distribution across warming levels.**

## Scenario categories | GHG emissions | Emissions milestones | Cumulative emissions | Temperature outcomes

| p50 (p5-p95) [0] | Global Mean Surface Air Temperature change | | GHG emissions Gt $CO_2$-eq/yr | | | GHG emissions reductions from 2019 % [5] | | | Emissions milestones [6,7] | | | | Cumulative $CO_2$ emissions Gt $CO_2$ [9] | | Cumulative net-negative $CO_2$ emissions Gt $CO_2$ | Temperature change 50% probability [10] °C | | Likelihood of staying below (%) [11] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category [1, 2, 3, 4] [# pathways] | Category description | WG1 SSP & IPs alignment | 2030 | 2040 | 2050 | 2030 | 2040 | 2050 | Peak $CO_2$ emissions | Peak GHG emissions | net-zero $CO_2$ [% net-zero pathways] | net-zero GHGs [8] [% net-zero pathways] | 2020 to netzero $CO_2$ | 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] | Below 1.5°C with no or limited overshoot | SP, LD Ren, SSP1-1.9 | 31 (21-36) | 17 (6-23) | 9 (1-15) | 43 (34-60) | 69 (58-90) | 84 (73-98) | 2020-2025 [100%] (2020-2025) | 2020-2025 [100%] (2020-2025) | 2050-2055 [100%] (2035-2070) | 2095-2100 [52%] (2050-...) | 510 (330-710) | 320 (-210-570) | -200 (-560-0) | 1.6 (1.3-1.6) | 1.3 (0.8-1.5) | 38 (33-73) | 90 (86-98) | 100 (99-100) |
| C2 [133] | Below 1.5°C with high overshoot | Neg | 42 (31-55) | 25 (16-34) | 14 (5-21) | 23 (0-44) | 55 (40-71) | 75 (62-91) | 2020-2025 [100%] (2020-2030) | 2020-2025 [100%] (2020-2030) | 2055-2060 [100%] (2045-2070) | 2070-2075 [87%] (2055-...) | 720 (540-930) | 400 (-90-620) | -330 (-620--30) | 1.7 (1.4-1.8) | 1.4 (0.8-1.5) | 24 (15-58) | 82 (71-95) | 100 (99-100) |
| C3 [311] | Likely below 2°C | SSP2-2.6 | 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 [100%] (2020-2030) | 2070-2075 [91%] (2060-...) | ...-... [30%] (2075-...) | 890 (640-1160) | 800 (500-1140) | -40 (-280-0) | 1.7 (1.4-1.8) | 1.6 (1.1-1.8) | 20 (13-66) | 76 (68-97) | 99 (98-100) |
| C3a [204] | Immediate action | | 40 (30-49) | 29 (21-36) | 20 (13-26) | 27 (13-45) | 47 (35-63) | 63 (52-76) | 2020-2025 [100%] (2020-2025) | 2020-2025 [100%] (2020-2025) | 2075-2080 [88%] (2060-...) | ...-... [24%] (2080-..) | 860 (640-1180) | 790 (480-1150) | -10 (-280-0) | 1.7 (1.4-1.8) | 1.6 (1.1-1.8) | 21 (14-70) | 78 (69-97) | 100 (98-100) |
| C3b [97] | NDCs | GS | 52 (47-55) | 29 (20-36) | 18 (10-25) | 5 (0-14) | 46 (34-63) | 68 (56-82) | 2020-2025 [100%] (2020-2030) | 2020-2025 [100%] (2020-2030) | 2065-2070 [96%] (2060-2100) | ...-... [42%] (2075-...) | 910 (720-1150) | 800 (560-1050) | -70 (-300-0) | 1.8 (1.4-1.8) | 1.6 (1.1-1.7) | 17 (12-61) | 73 (67-96) | 99 (98-99) |
| C4 [159] | Below 2°C | | 50 (41-56) | 38 (28-43) | 28 (19-35) | 10 (0-27) | 31 (20-50) | 49 (35-65) | 2020-2025 [100%] (2020-2030) | 2020-2025 [100%] (2020-2030) | 2075-2080 [86%] (2065-...) | ...-... [31%] (2075-...) | 1210 (970-1500) | 1160 (700-1490) | -30 (-390-0) | 1.9 (1.5-2.0) | 1.8 (1.2-2.0) | 11 (7-50) | 59 (50-93) | 98 (95-99) |
| C5 [212] | Below 2.5°C | | 52 (46-56) | 45 (36-52) | 39 (30-49) | 6 (-1-18) | 18 (4-33) | 29 (11-48) | 2020-2025 [100%] (2020-2035) | 2020-2025 [100%] (2020-2035) | ...-... [40%] (2075-...) | ...-... [11%] (2090-...) | 1780 (1400-2360) | 1780 (1260-2360) | 0 (-140-0) | 2.2 (1.6-2.5) | 2.1 (1.5-2.5) | 4 (0-28) | 37 (18-84) | 91 (83-99) |
| 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 [96%] (2020-2085) | 2030-2035 [96%] (2020-2085) | ...-... [0%] (...-...) | ...-... [0%] (...-...) | 2790 (2440-3520) | 2790 (2440-3520) | 0 (0-0) | 2.7 (2.0-2.9) | 2.7 (2.0-2.9) | 0 (0-2) | 8 (2-45) | 71 (53-96) |
| C7 [164] | Below 4°C | SSP3-7.0 Cur-Pol | 62 (53-69) | 67 (56-76) | 70 (58-83) | -11 (-18-3) | -19 (-31-0) | -24 (-41--2) | 2070-2075 [56%] (2025-2095) | 2070-2075 [56%] (2025-2095) | ...-... [0%] (...-...) | ...-... [0%] (...-...) | 4220 (3160-5000) | 4220 (3160-5000) | 0 (0-0) | 3.5 (2.5-3.9) | 3.5 (2.5-3.9) | 0 (0-0) | 0 (0-5) | 22 (7-80) |
| C8 [29] | Above 4°C | SSP5-8.5 | 71 (68-80) | 79 (77-96) | 87 (82-112) | -20 (-34--17) | -35 (-66--29) | -46 (-92--36) | 2080-2085 [89%] (2060-2095) | 2080-2085 [89%] (2060-2095) | ...-... [0%] (...-...) | ...-... [0%] (...-...) | 5600 (4910-7450) | 5600 (4910-7450) | 0 (0-0) | 4.2 (3.3-5.0) | 4.2 (3.3-5.0) | 0 (0-0) | 0 (0-0) | 4 (0-27) |

**Table SPM 1**

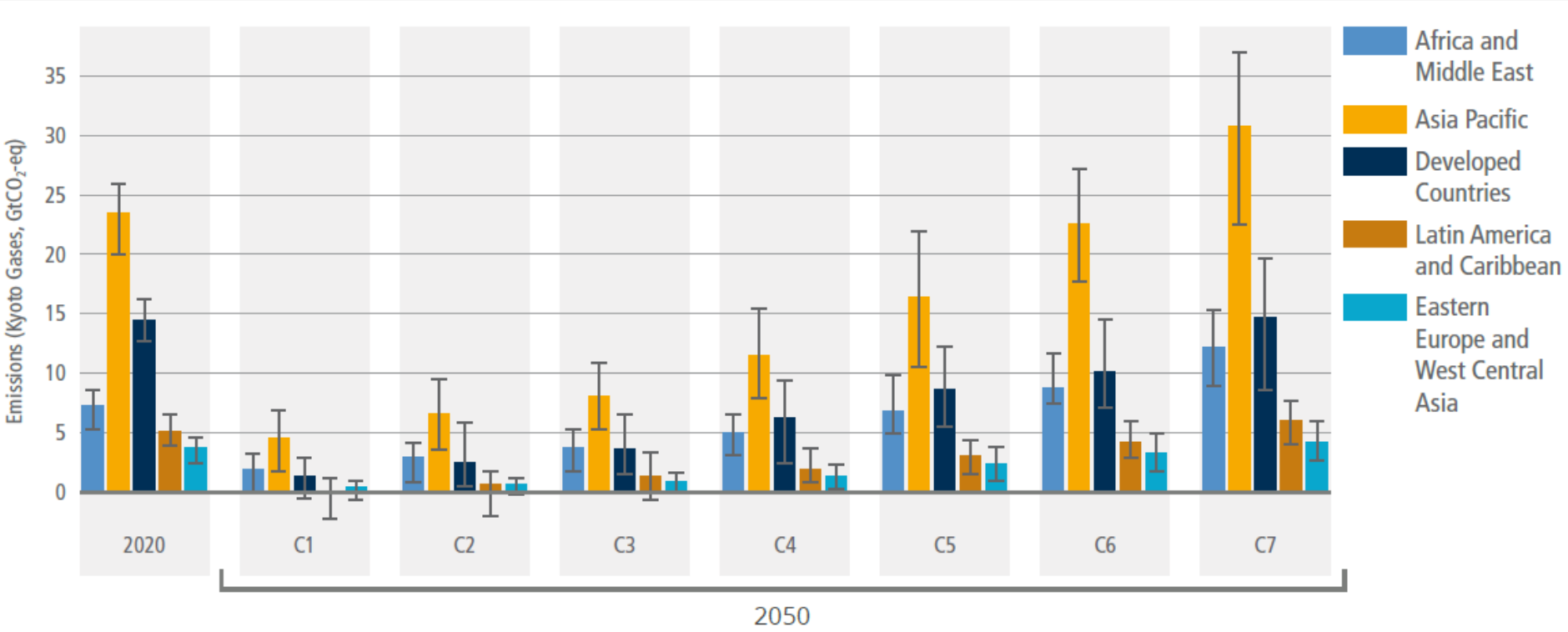
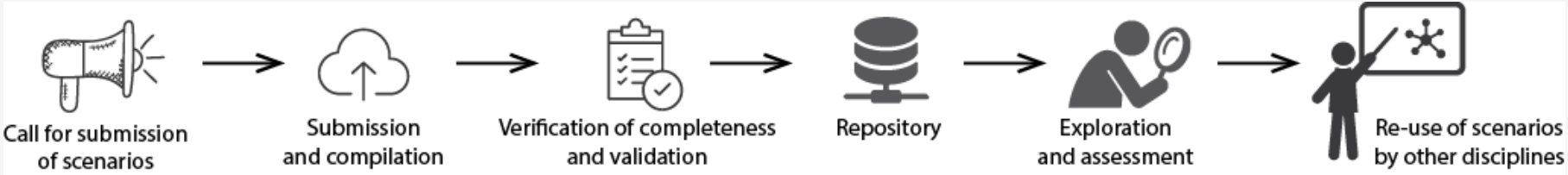



**Figure 3.17[11] | Emissions by region (including 5–95th percentile range).** Source: AR6 Scenarios Database.

# Truly a 3 year collaborative journey…




D. Huppmann et al. (2018). doi: 10.1038/s41558-018-0317-4

**3131 scenarios**
**1799 variables**
**220 million datapoints**

**188 models from 50+ model teams**

***An IPCC scenario database that integrates disciplines, scales and communities***

# Thank You

Roberto Schaeffer (COPPE/UFRJ)

**roberto@ppe.ufrj.br**