

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**



# 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

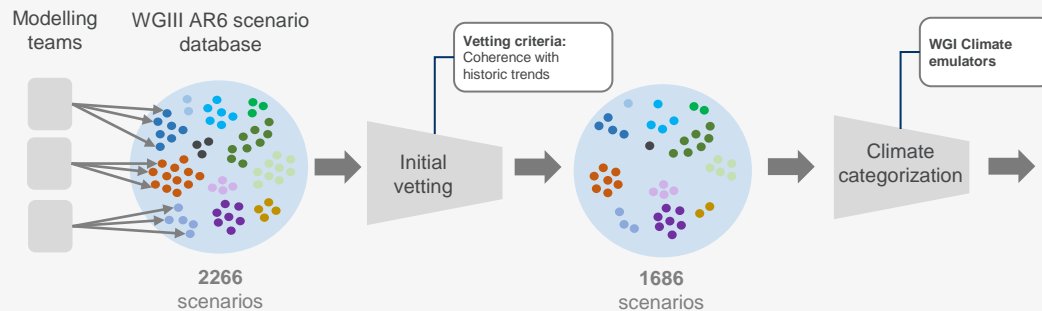


Table SPM1

path (category <sup>1,2,3,4</sup> ) (if pathway)	Global Mean Surface Air Temperature change	GHG emissions Gt CO <sub>2</sub> -eq/yr	GHG emissions reductions from 2019 %				Emissions milestones <sup>5,6,7</sup>				Cumulative CO <sub>2</sub> emissions Gt CO <sub>2</sub> -eq		Cumulative non-CO <sub>2</sub> emissions Gt CO <sub>2</sub> -eq		Temperature change 50% probability <sup>8,9</sup> °C	
			2020	2040	2050	2060	Peak CO <sub>2</sub> emissions	Peak GHG emissions	net-zero CO <sub>2</sub> (% net-zero pathway)	net-zero GHG <sup>10</sup> (% net-zero pathway)	2020 to net-zero CO <sub>2</sub>	2020 to 2100	year of net-zero CO <sub>2</sub> to 2100	year of net-zero GHG to 2100		
<b>C1 2050</b>	Below 1.0°C with no or limited overshoot	WGI SSP1 (Pa alignment)	51	37	9	43	69	84	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	1.4	1.3
			(12-38) (10-13)	(1-15)								110	320	110	1,400	(1.1-1.6)
<b>C2 2050</b>	Below 1.0°C with high overshoot	WGI SSP2 (Pa alignment)	42	29	14	28	31	35	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	1.7	1.4
			(30-54) (24-33)	(1-14)								720	400	720	1,400	(1.3-2.1)
<b>C3 2050</b>	Below 1.0°C with high overshoot	WGI SSP3 (Pa alignment)	44	29	20	24	46	64	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	1.7	1.6
			(12-35) (10-20)	(1-26)								[560]	800	1,400	1,400	(1.4-1.8)
<b>C3a 2050</b>	Intermediate action	WGI SSP3 (Pa alignment)	40	29	20	27	47	63	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	1.7	1.6
			(30-49) (25-33)	(1-26)								[560]	800	1,400	1,400	(1.4-1.8)
<b>C3b 2050</b>	WGI SSP3 (Pa alignment)	WGI SSP3 (Pa alignment)	52	29	18	3	46	68	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	1.8	1.6
			(47-55) (10-25)	(1-25)								[670]	1,100	1,400	1,400	(1.4-1.8)
<b>C4 2050</b>	Below 1.0°C	WGI SSP4 (Pa alignment)	50	38	20	10	31	48	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	1.9	1.6
			(40-58) (30-43)	(1-19)								[570]	1,100	1,400	1,400	(1.5-2.1)
<b>C5 2050</b>	Below 1.0°C	WGI SSP5 (Pa alignment)	52	40	20	6	18	29	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2.2	2.1
			(40-56) (30-52)	(1-45)								[1,400]	1,700	1,400	1,400	(1.5-2.5)
<b>C6 2050</b>	Below 1.0°C	WGI SSP5 (Pa alignment)	54	53	22	3	3	3	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2.2	2.1
			(40-68) (40-61)	(1-42)								[2,400]	2,700	1,400	1,400	(1.5-2.5)
<b>C7 2050</b>	Below 1.0°C	WGI SSP5 (Pa alignment)	62	67	20	11	19	24	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2.2	2.1
			(33-69) (29-76)	(1-30)								[4,200]	4,200	1,400	1,400	(1.5-2.5)
<b>C8 2050</b>	Below 1.0°C	WGI SSP5 (Pa alignment)	71	79	20	30	35	40	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2020-2025 (2020-2025)	2.2	2.1
			(58-88) (57-76)	(1-42)								[5,000]	5,000	1,400	1,400	(1.5-2.5)

### 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
<b>C1: Limit warming to 1.5°C (&gt;50%) with no or limited overshoot</b>	Reach or exceed 1.5°C during the 21st century with a likelihood of $\leq 67\%$ , 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	<b>97</b>
<b>C2: Return warming to 1.5°C (&gt;50%) after a high overshoot</b>	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 <sup>a</sup>	<b>133</b>
<b>C3: Limit warming to 2°C (&gt;67%)</b>	Limit peak warming to 2°C throughout the 21st century with a likelihood of >67%.	SSP1-2.6	IMP-GS	<b>311</b>
<b>C4: Limit warming to 2°C (&gt;50%)</b>	Limit peak warming to 2°C throughout the 21st century with a likelihood of >50%.			<b>159</b>
<b>C5: Limit warming to 2.5°C (&gt;50%)</b>	Limit peak warming to 2.5°C throughout the 21st century with a likelihood of >50%.			<b>212</b>
<b>C6: Limit warming to 3°C (&gt;50%)</b>	Limit peak warming to 3°C throughout the 21st century with a likelihood of >50%.	SSP2-4.5	ModAct	<b>97</b>
<b>C7: Limit warming to 4°C (&gt;50%)</b>	Limit peak warming to 4°C throughout the 21st century with a likelihood of >50%.	SSP3-7.0	CurPol	<b>164</b>
<b>C8: Exceed warming of 4°C (<math>\geq 50\%</math>)</b>	Exceed warming of 4°C during the 21st century with a likelihood of $\geq 50\%$ .	SSP5-8.5		<b>29</b>
<b>C1, C2, C3: limit warming to 2°C (&gt;67%) or lower</b>	All scenarios in Categories C1, C2 and C3			<b>541</b>



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## WGIII AR6 scenario assessment process

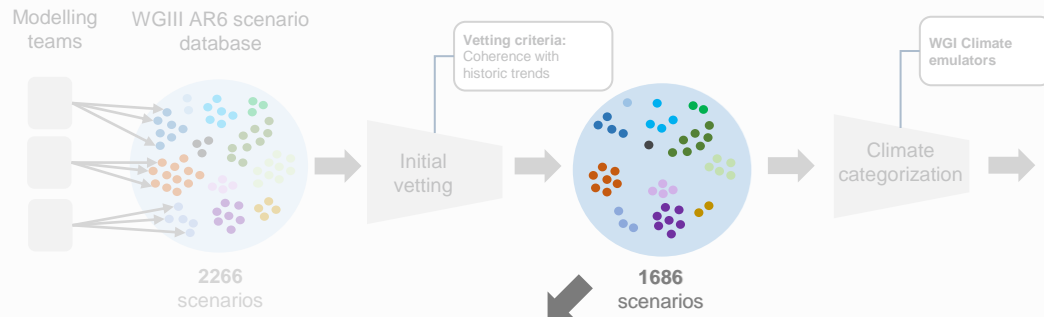
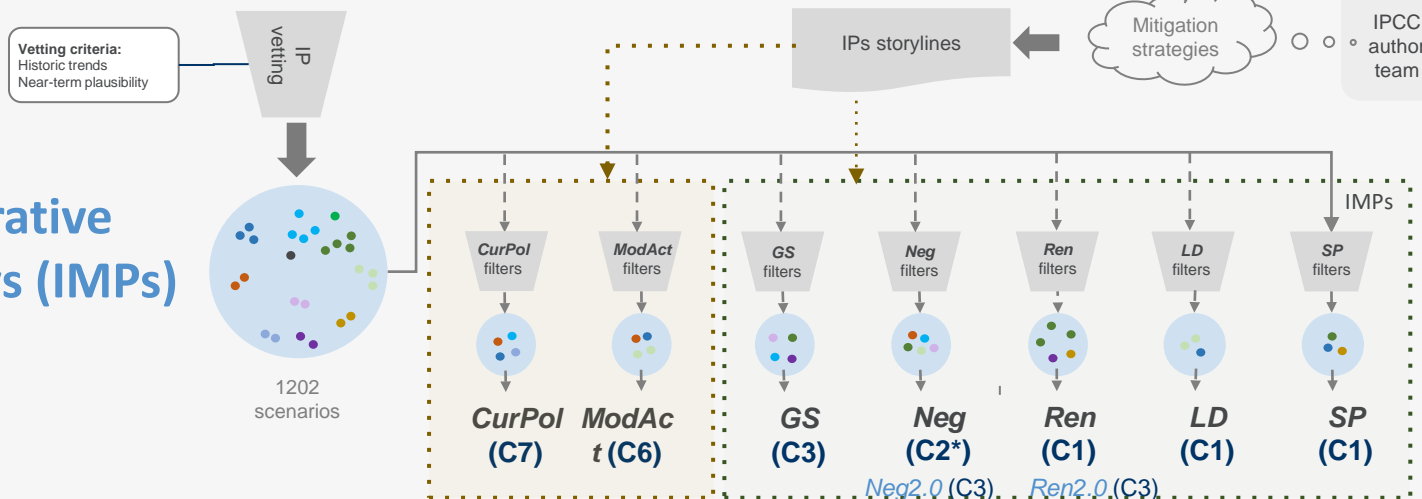
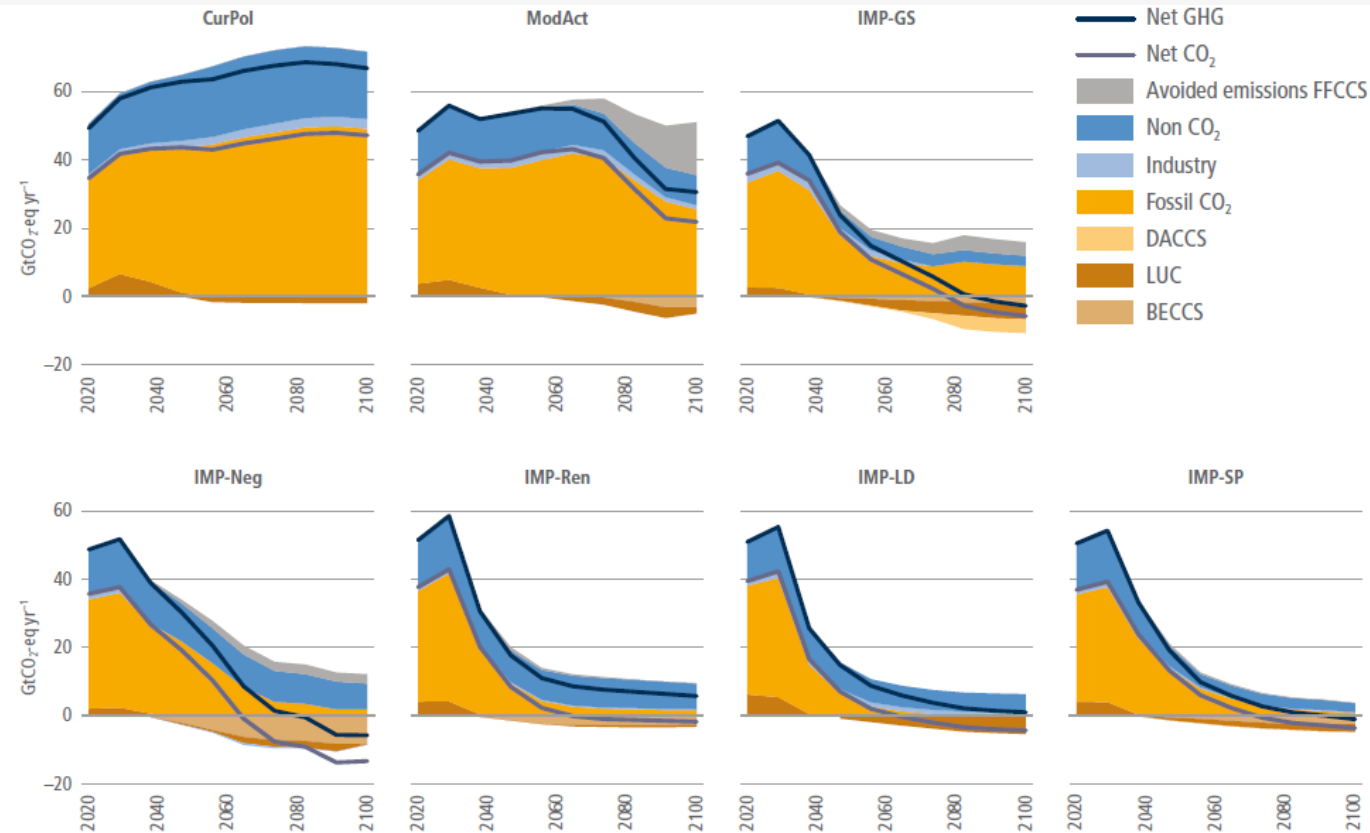


Table SPM1

Category <sup>1,2,3</sup> (IP pathways)	Global Mean Surface Air Temperature change <sup>4</sup>	GHG emissions (Gt CO <sub>2</sub> -eq) <sup>5</sup>	GHG emissions reductions <sup>6</sup> (%)				Emissions milestones <sup>7,8</sup>				Cumulative CO <sub>2</sub> emissions <sup>9</sup> (Gt CO <sub>2</sub> )		Cumulative non-CO <sub>2</sub> emissions <sup>10</sup> (Gt CO <sub>2</sub> -eq)		Temperature change 50% probability <sup>11</sup> (°C)	
			2020	2040	2050	2055	Peak CO <sub>2</sub> emissions	Peak GHG emissions	net-zero CO <sub>2</sub> (pathways)	net-zero GHG <sup>12</sup> (pathways)	2020 to net-zero CO <sub>2</sub>	2020 to net-zero GHG	year of net-zero CO <sub>2</sub> to 2050	year of net-zero GHG to 2050	at peak	2100
<b>C1</b> (2020)	Scenario 1.2% with net-zero emissions	WGI SSP 1 (IP alignment)	52	37	9	43	89	84	2020-2025 (2020-2025)	2020-2025 (2020-2025)	500	500	2050	2050	1.4	1.3
<b>C2</b> (2020)	Scenario 1.2% with net-zero emissions	WGI SSP 1 (IP alignment)	46	28	24	25	81	75	2020-2025 (2020-2025)	2020-2025 (2020-2025)	500	500	2050	2050	1.5	1.4
<b>C3</b> (2020)	Scenario 1.2% with net-zero emissions	WGI SSP 1 (IP alignment)	44	29	20	21	86	84	2020-2025 (2020-2025)	2020-2025 (2020-2025)	500	500	2050	2050	1.7	1.6
<b>C3a</b> (2020)	Intermediate action	WGI SSP 1 (IP alignment)	46	29	20	22	87	85	2020-2025 (2020-2025)	2020-2025 (2020-2025)	500	500	2050	2050	1.5	1.4
<b>C3b</b> (2020)	WGI	WGI	52	29	35	35	86	84	2020-2025 (2020-2025)	2020-2025 (2020-2025)	500	500	2050	2050	1.6	1.5
<b>C4</b> (2020)	Scenario 1.2%	WGI SSP 1 (IP alignment)	46	29	20	22	87	85	2020-2025 (2020-2025)	2020-2025 (2020-2025)	500	500	2050	2050	1.5	1.4
<b>C5</b> (2020)	Scenario 1.2%	WGI SSP 1 (IP alignment)	52	40	29	30	92	90	2020-2025 (2020-2025)	2020-2025 (2020-2025)	500	500	2050	2050	1.8	1.7
<b>C6</b> (2020)	Scenario 1.2%	WGI SSP 1 (IP alignment)	54	39	30	31	93	91	2020-2025 (2020-2025)	2020-2025 (2020-2025)	500	500	2050	2050	1.9	1.8
<b>C7</b> (2020)	Scenario 1.2%	WGI SSP 1 (IP alignment)	60	67	70	71	100	100	2020-2025 (2020-2025)	2020-2025 (2020-2025)	500	500	2050	2050	2.0	1.9
<b>C8</b> (2020)	Scenario 1.2%	WGI SSP 1 (IP alignment)	70	75	82	83	100	100	2020-2025 (2020-2025)	2020-2025 (2020-2025)	500	500	2050	2050	2.2	2.1

## Illustrative Pathways (IMPs)





**Figure 3.7 | The residual fossil fuel and industry emissions, carbon dioxide removal (CDR) (LUC, DACCS, BECCS), and non-CO<sub>2</sub> 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).**

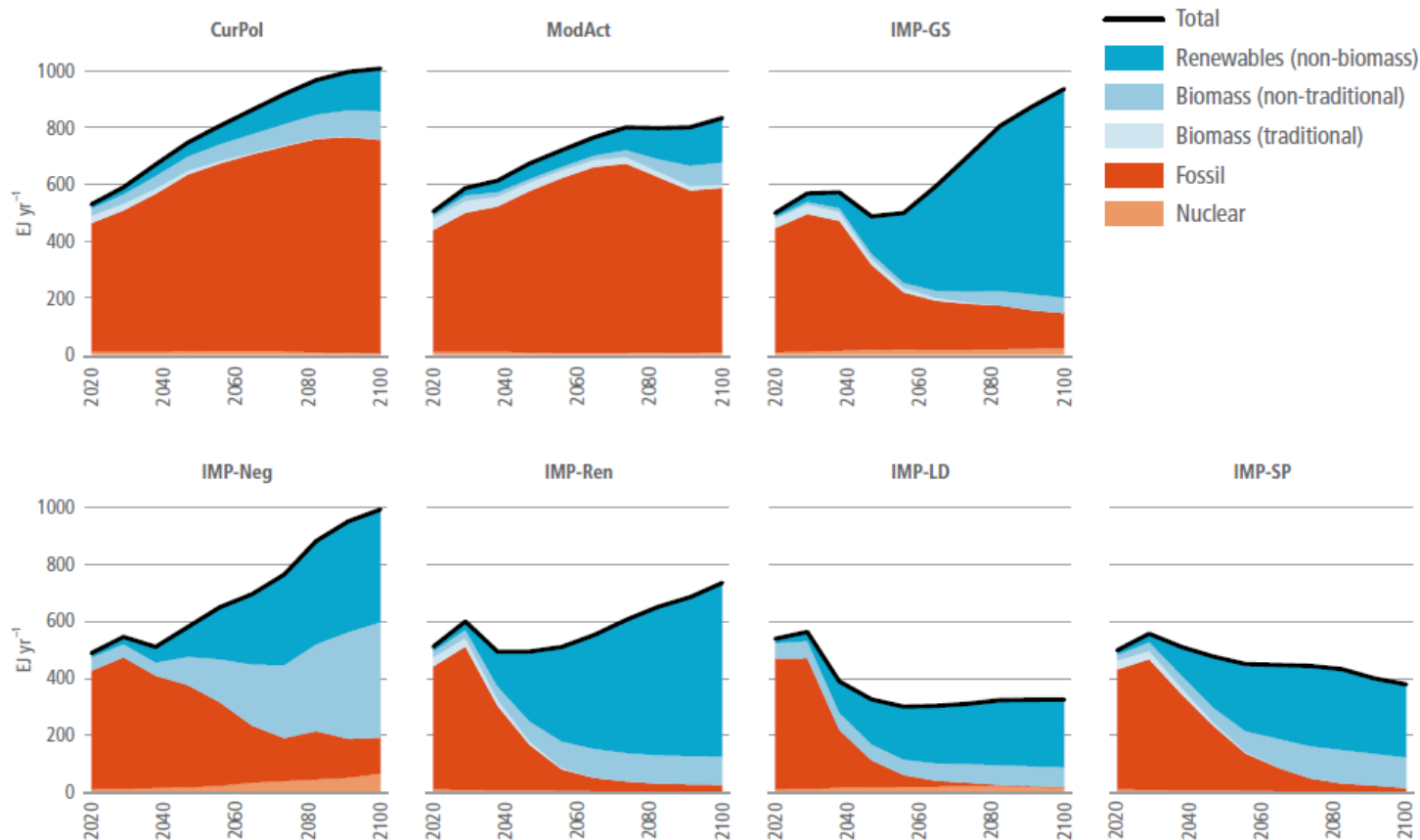


Figure 3.8 | The energy system in each of the illustrative pathways (IPs).



## Number of scenarios from each model family

Vetted scenarios in database (n=1686)

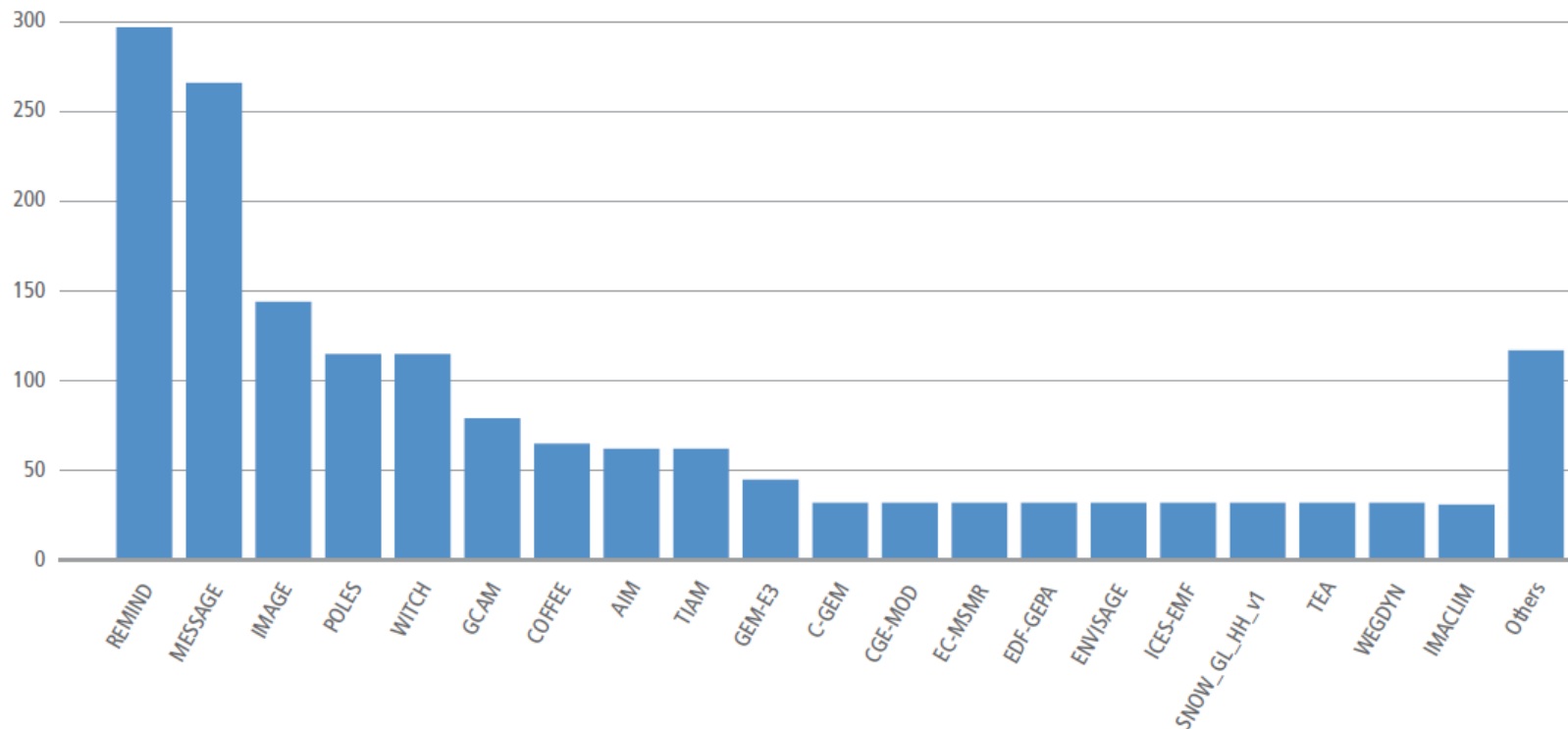


Figure 3.1 | Scenario counts from each model family defined as all versions under the same model's name.





## Number of scenarios from each project

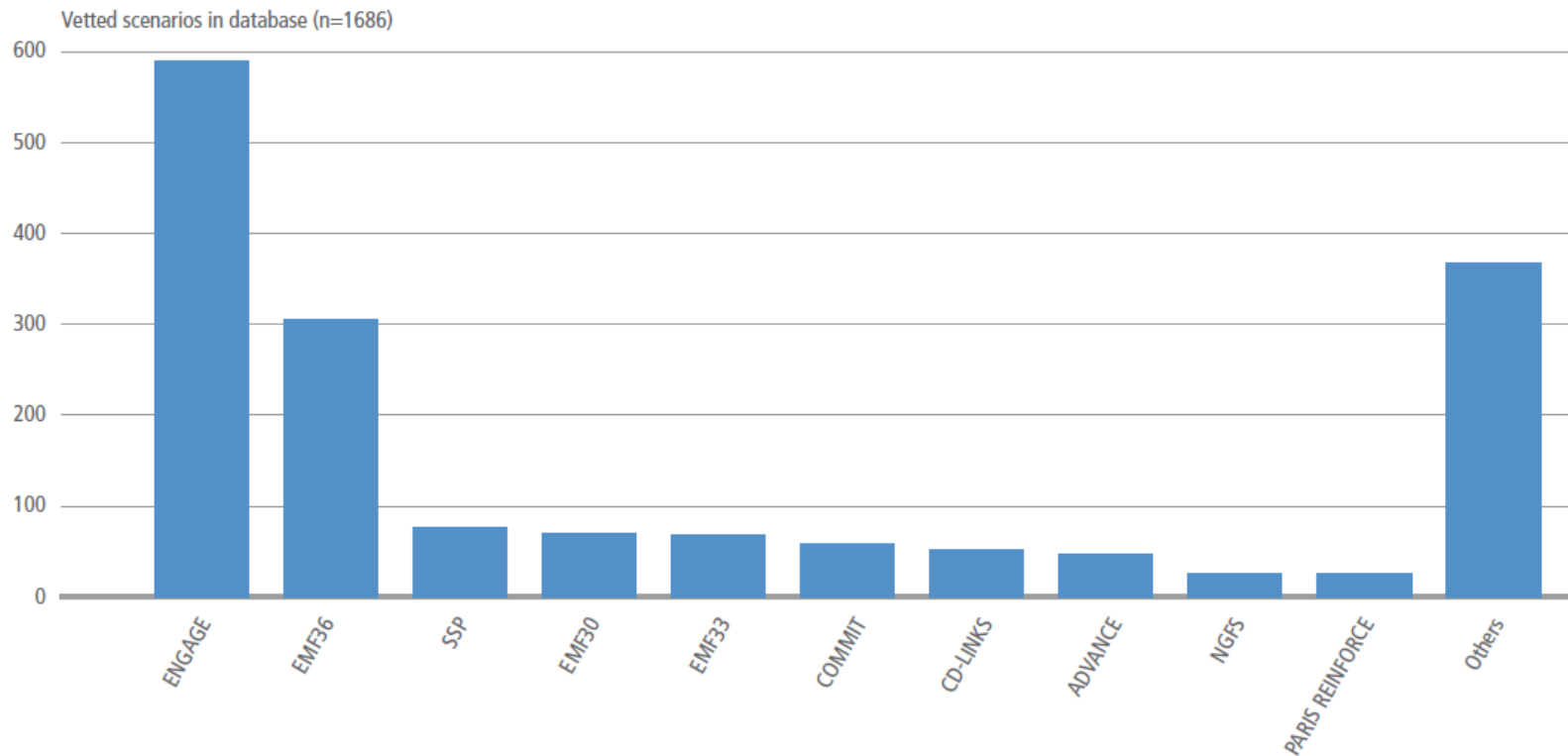
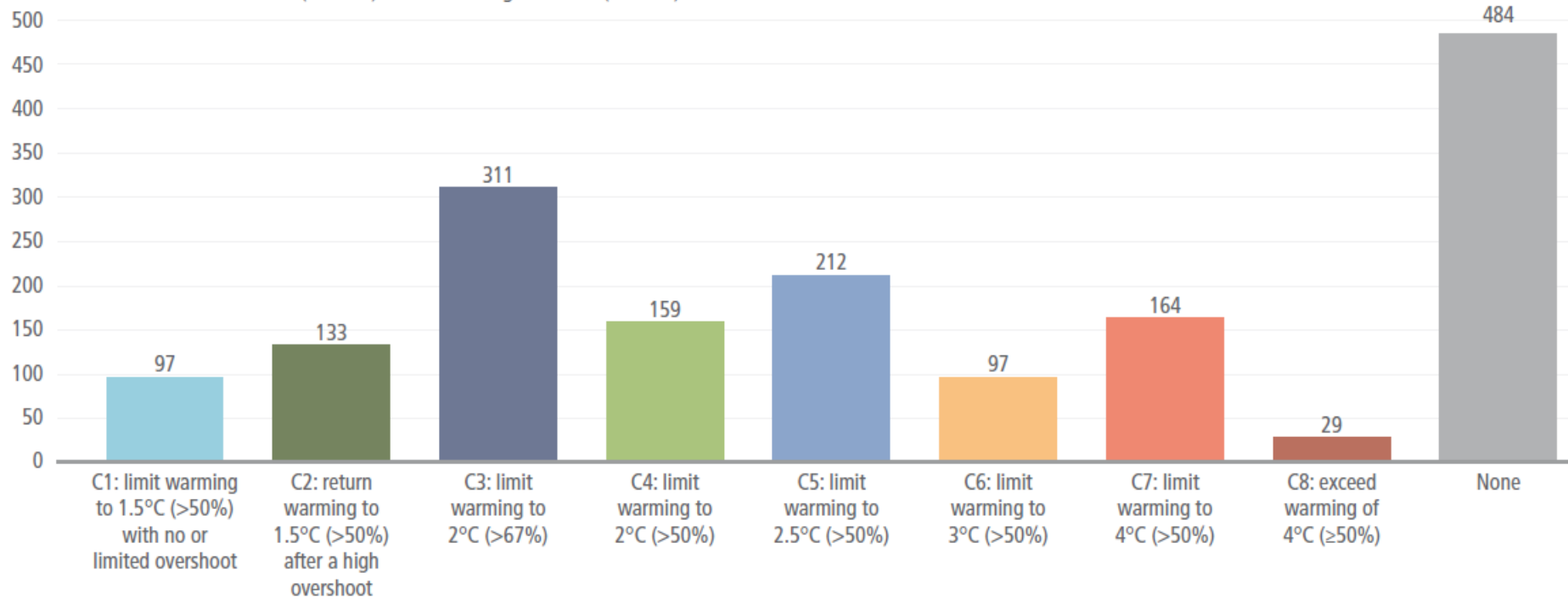


Figure 3.2 | Scenario counts from each named project.



## Number of scenarios in each climate category

Vetted scenarios in database (n=1686) ...with warming estimates (n=1202)



**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.**

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## Scenario categories

## GHG emissions

## Emissions milestones

## Cumulative emissions

## Temperature outcomes

p50 (p5-p95) <sup>(8)</sup>			Global Mean Surface Air Temperature change			GHG emissions Gt CO <sub>2</sub> -eq/yr			GHG emissions reductions from 2019 % <sup>(5)</sup>			Emissions milestones <sup>(6,7)</sup>				Cumulative CO <sub>2</sub> emissions Gt CO <sub>2</sub> <sup>(9)</sup>		Cumulative net- negative CO <sub>2</sub> emissions Gt CO <sub>2</sub>	Temperature change 50% probability <sup>(10)</sup> °C		Likelihood of staying below (%) <sup>(11)</sup>		
Category <sup>(1, 2, 3, 4)</sup> [# pathways]	Category description	WG1 SSP & IPa alignment	2030	2040	2050	2030	2040	2050	Peak CO <sub>2</sub> emissions	Peak GHG emissions	net-zero CO <sub>2</sub> [% net-zero pathways]	net-zero GHGs <sup>(8)</sup> [% net-zero pathways]	2020 to netzero CO <sub>2</sub>	2020-2100	year of net-zero CO <sub>2</sub> to 2100	at peak warming	2100	<1.5°C	<2.0°C	<3.0°C			
C1 <sup>[97]</sup>	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 <sup>[133]</sup>	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 <sup>[311]</sup>	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 <sup>[204]</sup>	Immediate action	GS	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 <sup>[97]</sup>	NDCs		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 <sup>[153]</sup>	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 <sup>[212]</sup>	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 <sup>[97]</sup>	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 <sup>[164]</sup>	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 <sup>[29]</sup>	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

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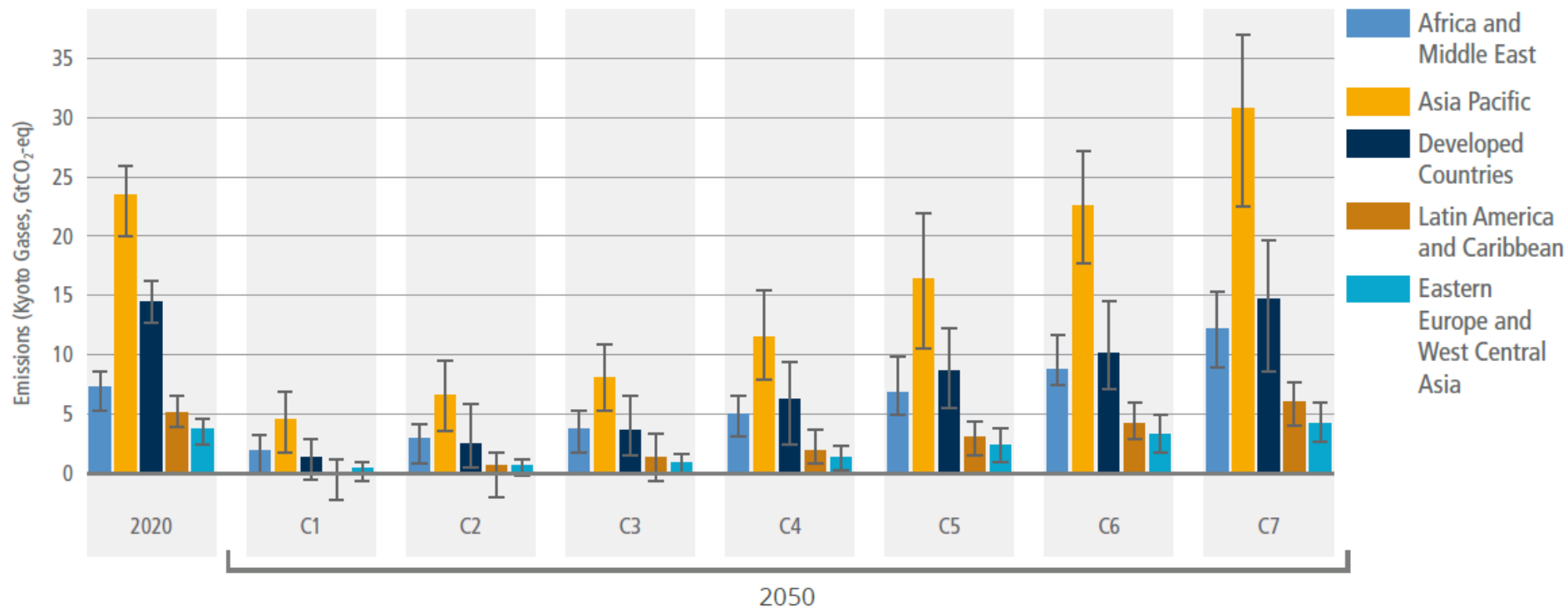
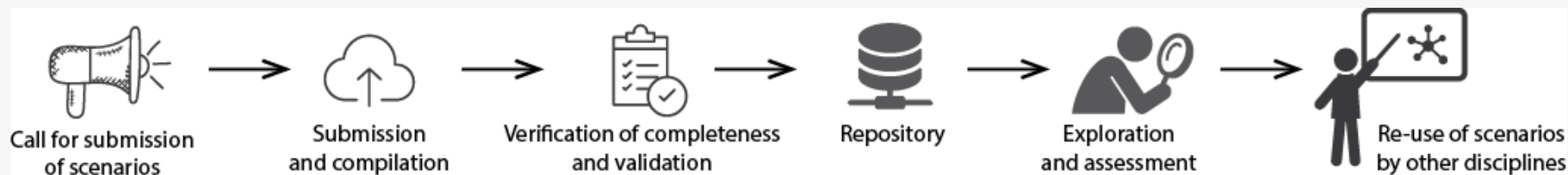


Figure 3.17<sup>11</sup> | Emissions by region (including 5–95th percentile range). Source: AR6 Scenarios Database.

# Truly a 3 year collaborative journey...



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

**188 models from 50+  
model teams**

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

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





# Thank You

Roberto Schaeffer (COPPE/UFRJ)

**roberto@ppe.ufrj.br**