



PBL Netherlands Environmental  
Assessment Agency



**ELEVATE**  
supporting international climate policy

# Beyond the Global Stocktake to create feasible and just transitions

IIASA, Federal University of Rio de Janeiro, PBL Netherlands Environmental Assessment Agency,

4 December 2023, **11:30-13:00** (local time)

**COP28, Zone B6, Building 82, UNFCCC Side Event Room 9**

Livestreamed on YouTube, COP28 website, and UNFCCC website

This event presents a multi-model assessment of current implemented policies and ambitions on climate outcomes and proposes ways to strengthen ambition. We explore the effects of addressing feasibility concerns on climate scenarios and discuss how just transitions can be included in climate scenarios.

- **Implemented policies:** Detlef van Vuuren (PBL)
- **Increasing ambition beyond Glasgow:** Detlef van Vuuren (PBL) and Pedro Rua Rodriguez Rochedo (COPPE)
- **Implications of feasibility on mitigation:** Bas van Ruijven (IIASA)
- **Just Transition scenarios:** Elina Brutschin (IIASA)
- **Facilitated discussion:** Sonja Klinsky (iGST)



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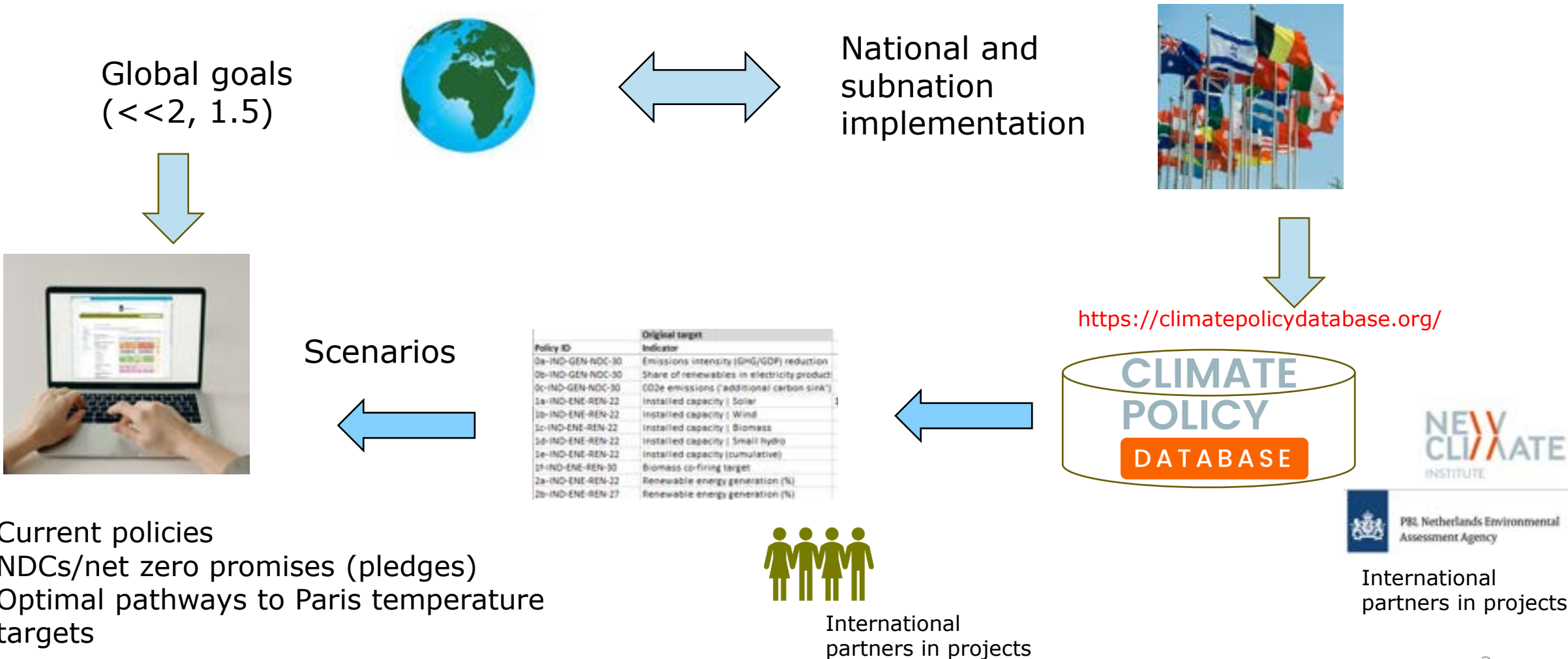


# The effects of implemented policies

**Detlef van Vuuren**, Ioannis Dafnomilis, Michel den Elzen, Elena Hooijschuur, Isabela Tagomori, Leonardo Nascimento, Niklas Hohne, Takeshi Kuramochi

4<sup>th</sup> December 2023

# Paris Agreement





# Greenhouse gas mitigation scenarios for major emitters

Analysis of current climate policies and mitigation commitments:  
2023 update

## Authors

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Ioannis Dafnomilis, Elena Hooijschuur, Michel den Elzen, Astrid Bos (PBL Netherlands Environmental Assessment Agency)

Nicklas Forsell, Zuelciady Araujo Gutiérrez, Mykola Gusti (International Institute for Applied Systems Analysis)

November 2023



# NDC evaluation

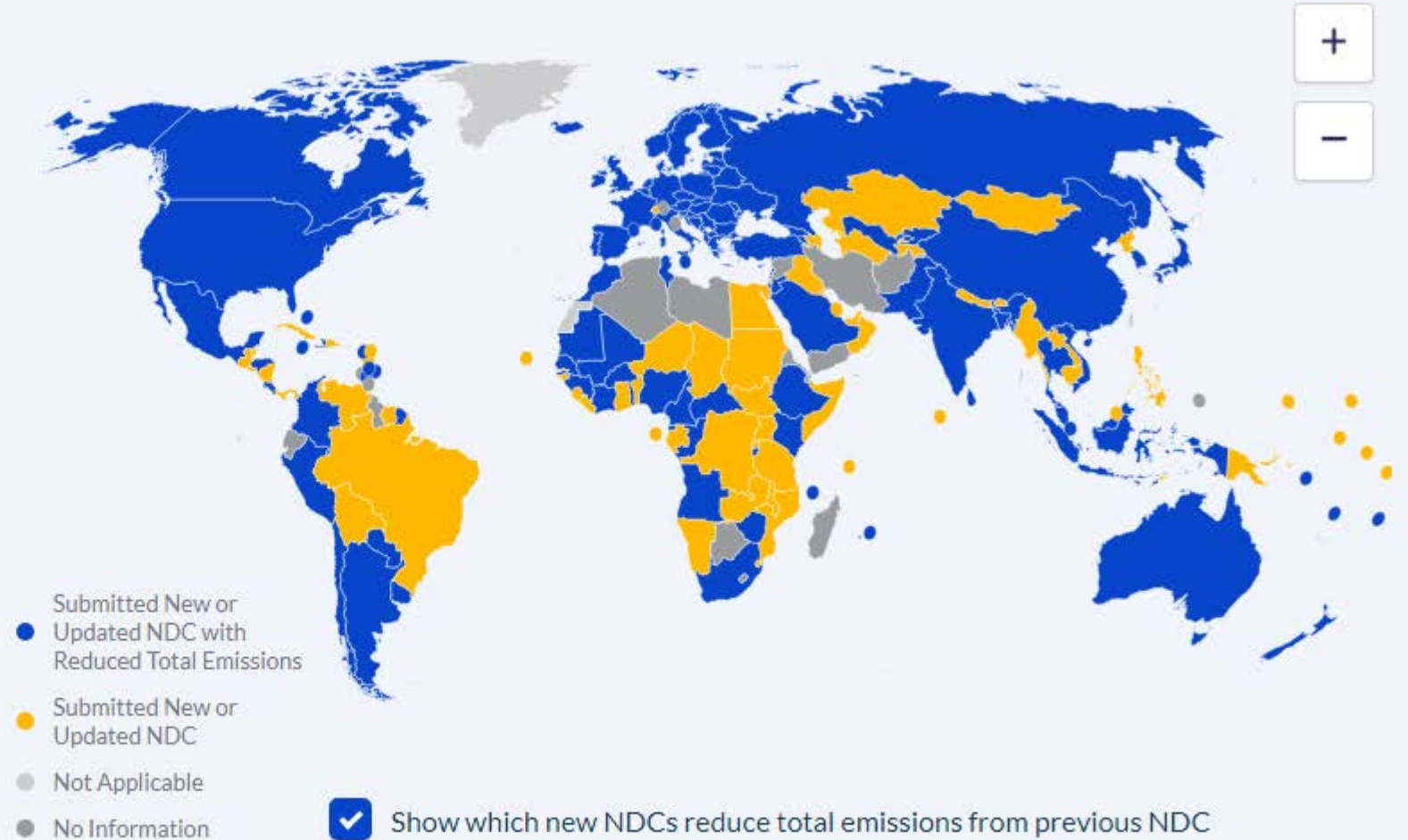
177

countries (94.0% of  
global emissions) have  
submitted a **new or  
updated NDC**

107

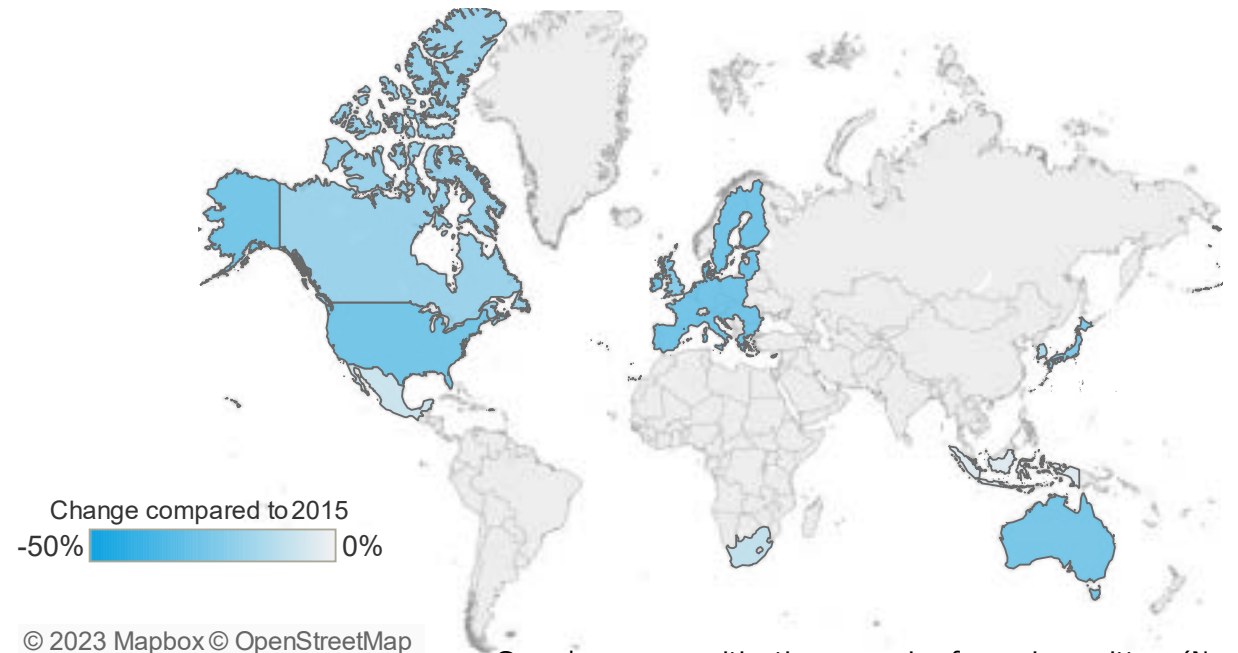
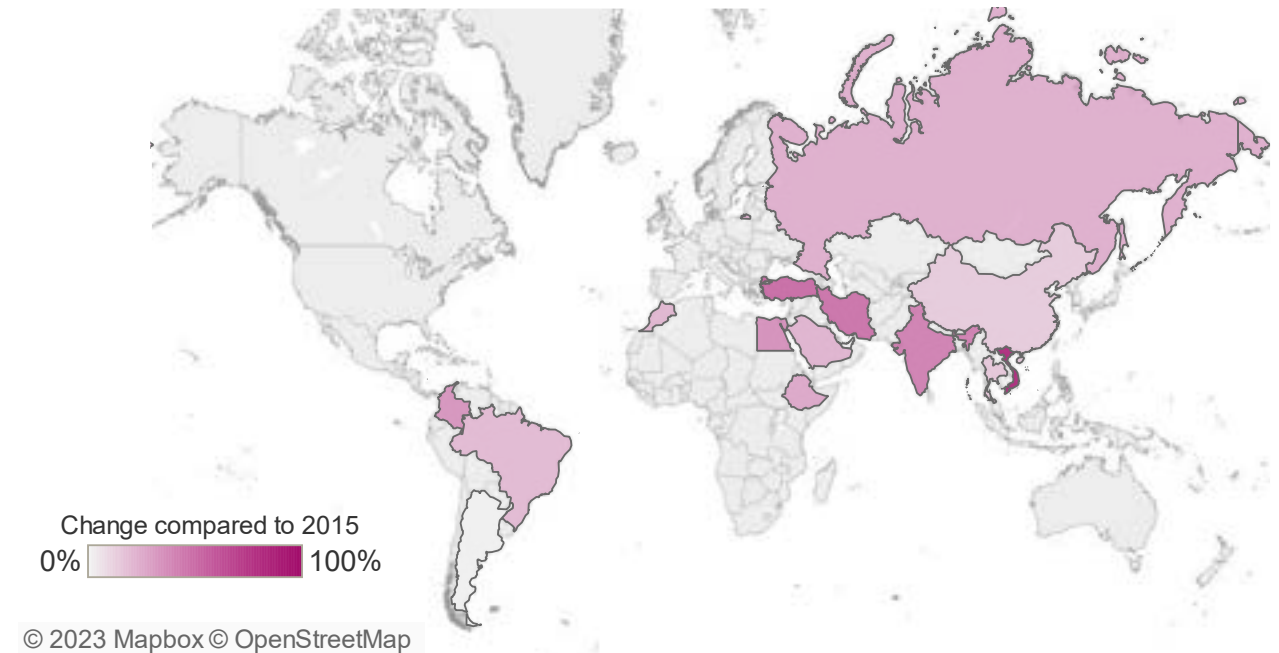
of the 177 countries  
(80.6% of global  
emissions) have  
submitted a **new or  
updated NDC with  
reduced total emissions  
compared to their initial  
NDC**

*Click on the country or see table below to compare with  
previous NDC*



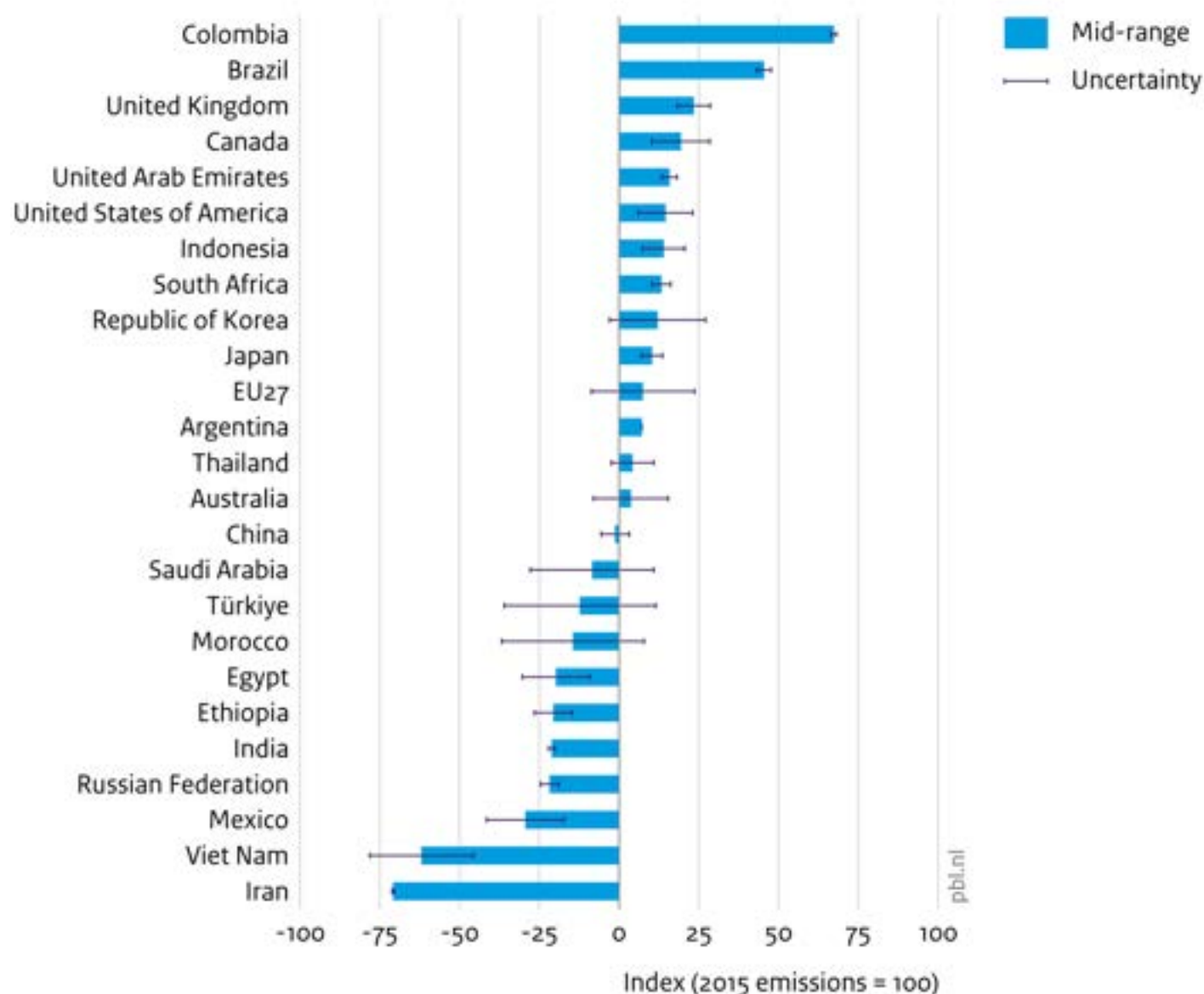
# Emission projections

- Emissions under current policies projected to reach 36.2 – 41.7 GtCO<sub>2</sub>e by 2030
  - -6% to +8% compared to 2019 levels
- 15 / 25 countries: emissions in 2030 at or above 2015 levels
  - USA, EU27, Canada and South Korea expanded climate policy adoption or advanced in the implementation of existing policies
  - Offset by changes in countries like UK, Russia, Indonesia



## Progress to NDC targets

- 13 countries likely on track to meet their current NDC targets
  - 11 clearly on track based on the middle of our projection's range
- A country that is likely to meet its NDC does not necessarily undertake more stringent action on mitigation than a country that is not on track
- Targets differ in their ambition levels across countries
- This study does not assess the level of ambition and fairness of the NDC targets. NDCs are nationally determined and heterogeneous by nature, so a fair comparison of progress across countries is not always straightforward



# EU27

NDC: -55% in 2030  
vs 1990

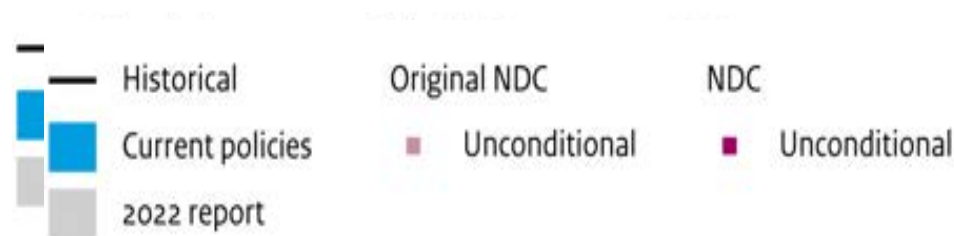
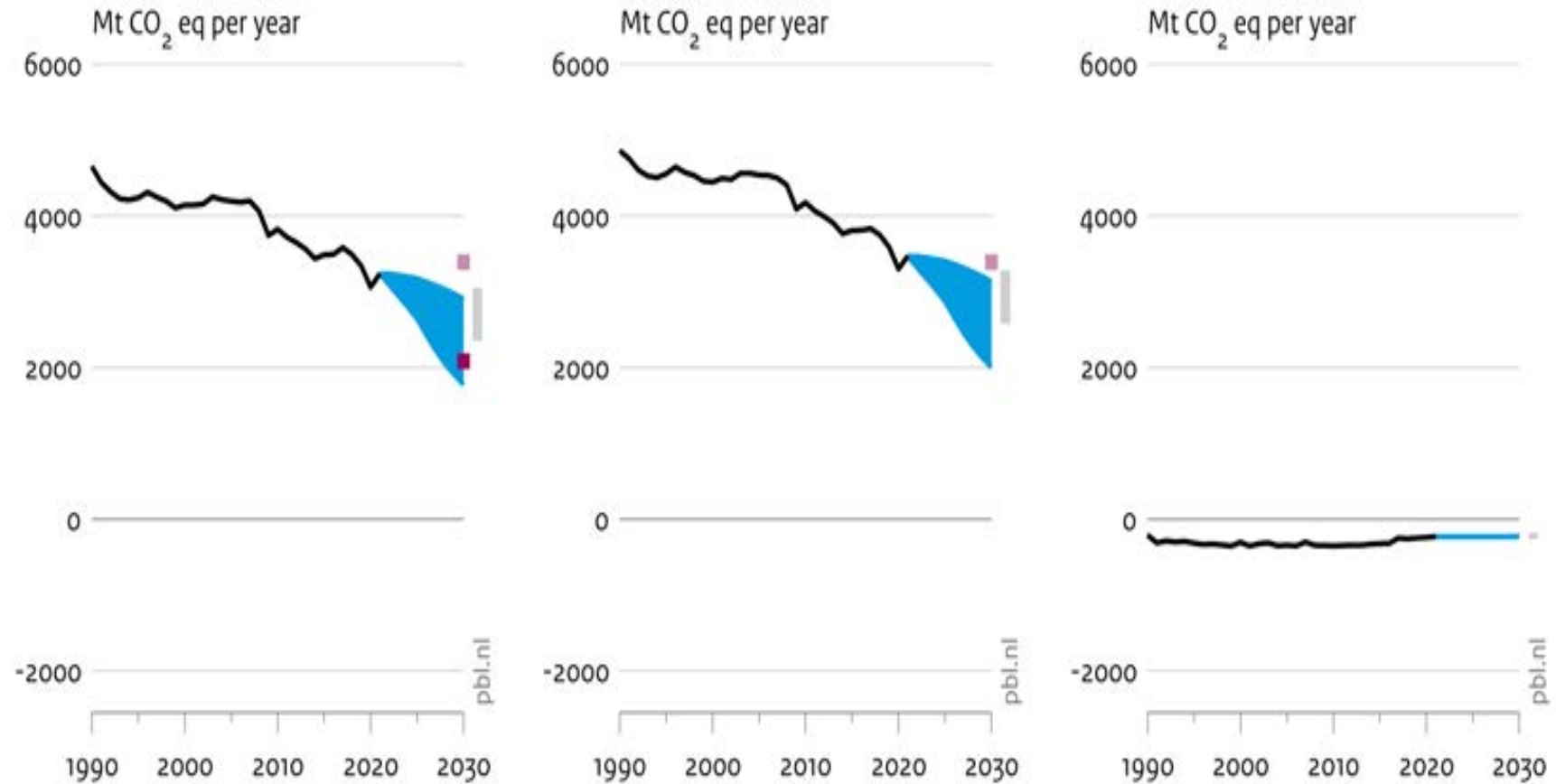
- On track: ~62% below 1990
  - Fit-for-55, REPowerEU
- EU level policies (lower range)  
vs MS level policies (upper range)

## Impact of climate policies on greenhouse gas emissions in EU27

Including GHG emissions from land use

Excluding GHG emissions from land use

GHG emissions from land use



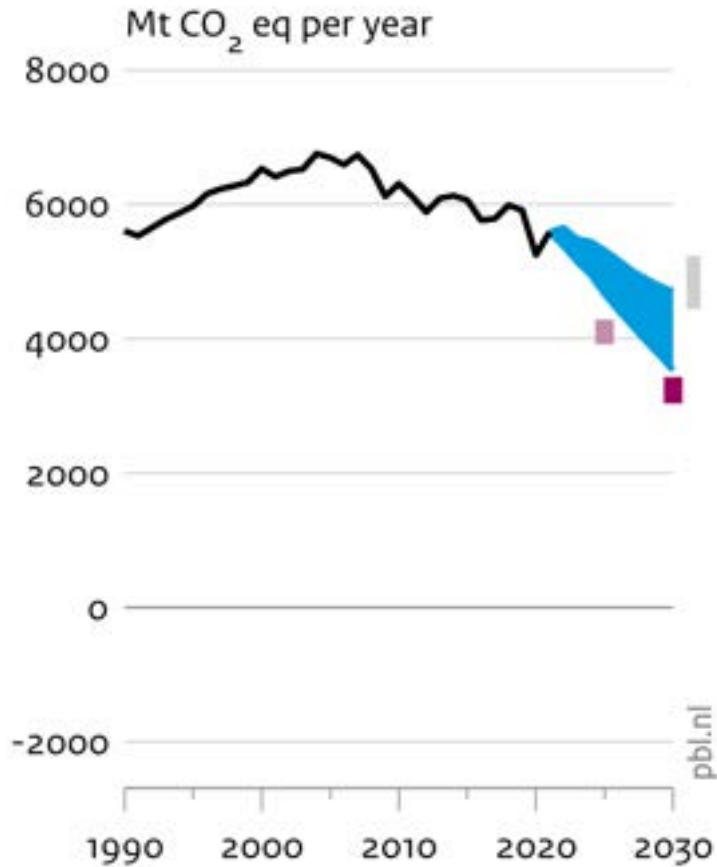
So

Source: PBL IMAGE model; NewClimate Institute calculations; IIASA CLOBIOM/GCM model (2022)



# USA

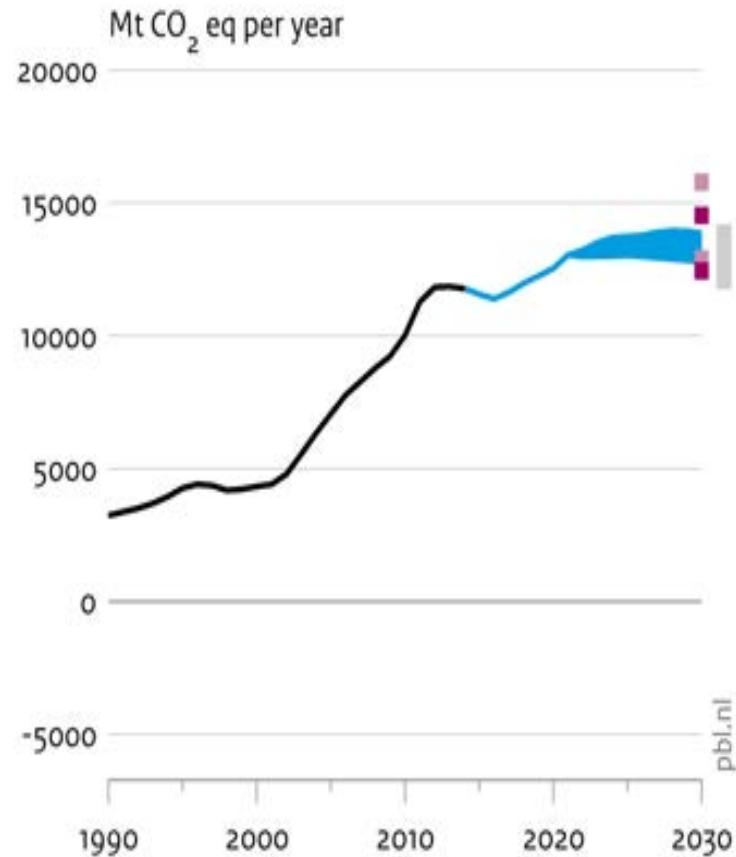
- Likely miss: uncertainty regarding the rate of decline



— Historical  
■ Current policies  
■ 2022 report  
— PBL land-use emissions

# China

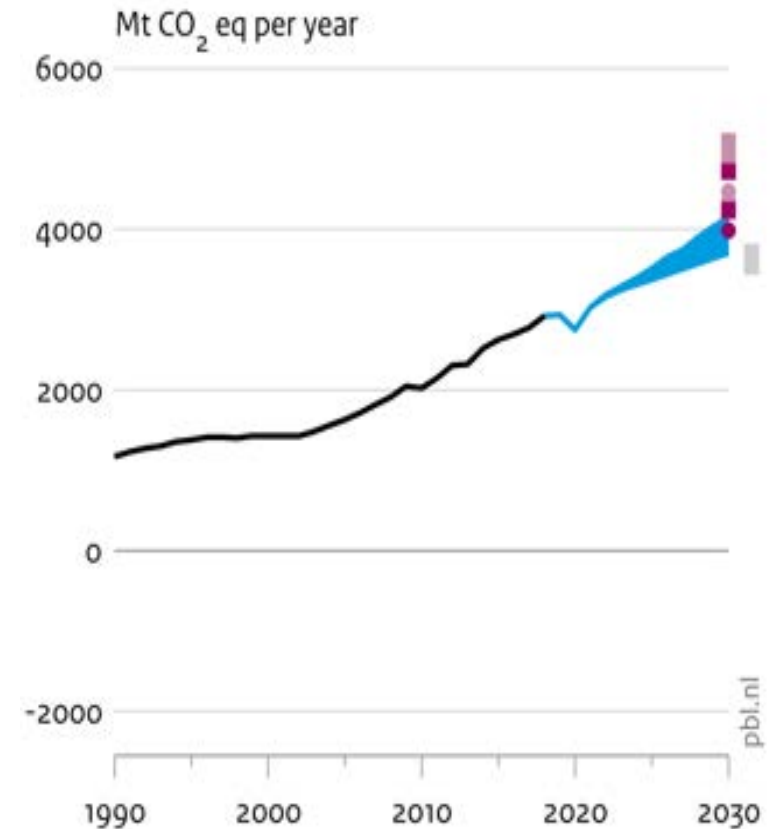
- Likely on track: uncertainty regarding the range
- Peak between 2025 and 2030



Original NDC      NDC  
■ Unconditional      ■ Unconditional

# India

- Likely overachieve unconditional NDC targets
- Targets do not drive reductions



Emissions Gap Report 2023

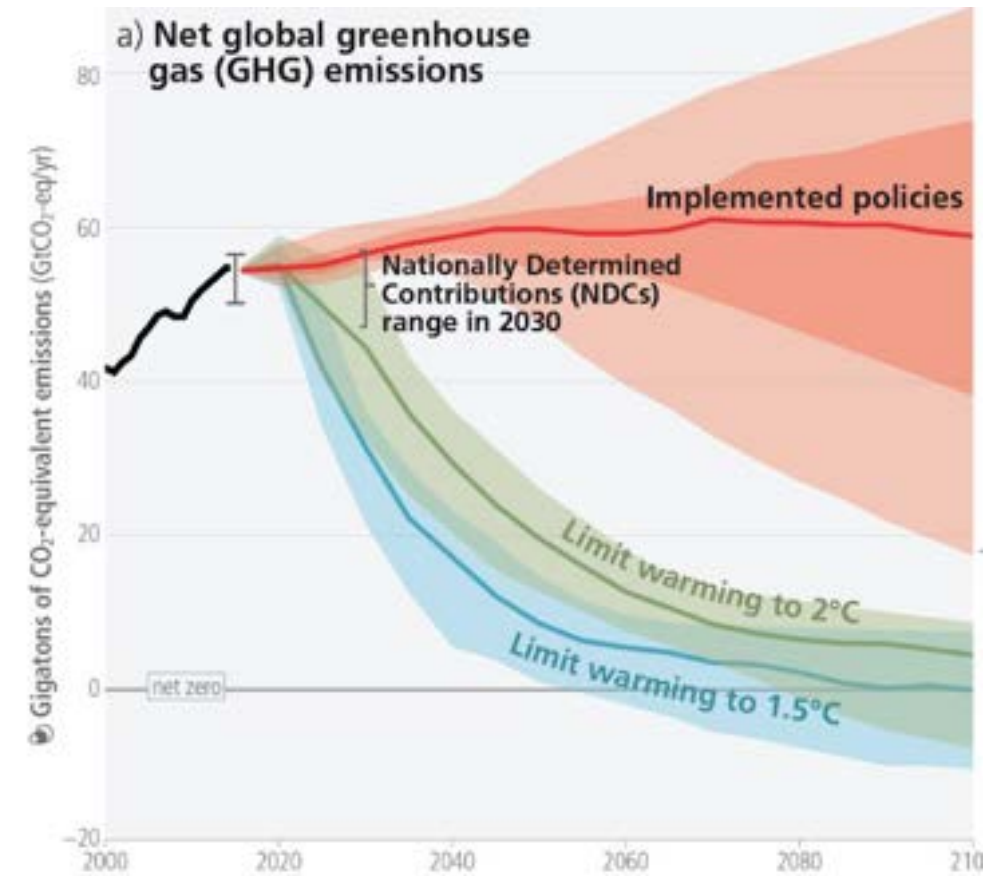
## Broken Record

Temperatures hit new  
highs, yet world fails to cut  
emissions (again)

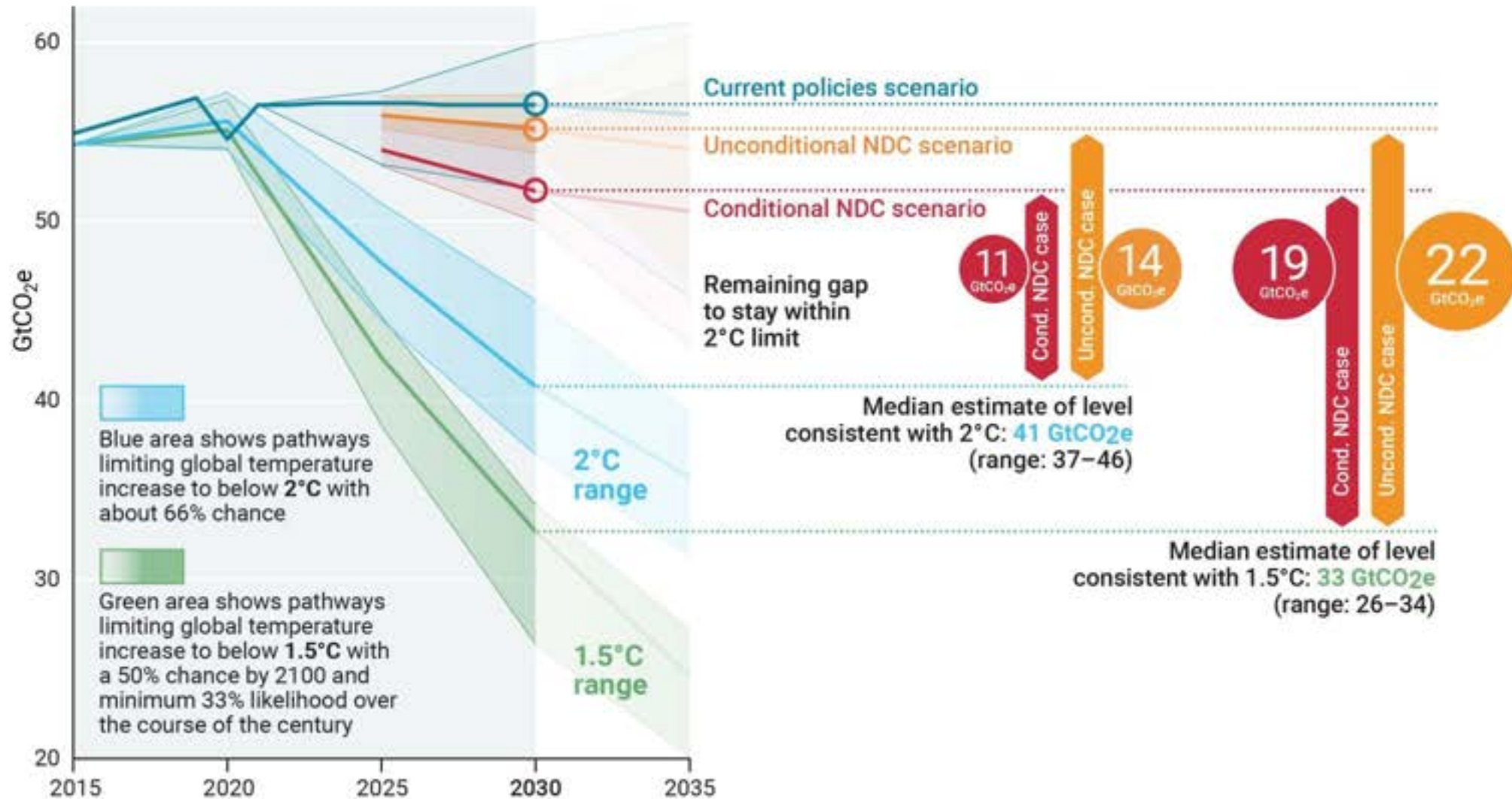
UN  
environment  
programme



#EmissionsGap



# The emissions gap in 2030 remains high



# Conclusions

- Current policies are projected to more-or-less stabilize emissions – which still leaves a gap with the NDCs (implementation gap) and 1.5/ << 2 trajectories (ambition gap)
- In the short term, narrowing of 2030 gap needed: current policies will make it impossible to limit warming to 1.5°C and strongly increase the challenge of limiting warming to 2°C.





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**Thank you!**



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# PROMISING CLIMATE PROGRESS

**Net-zero pledges could take the world a long way towards meeting the Paris climate goals, but a gap remains**

Detlef van Vuuren et al. (on behalf of all contributing global modelling teams)

COP28 – UNFCCC Beyond the global stocktake to create feasible and just transitions

*December 4th, 2023 – Dubai, UAE*

# Climate goals

- The **Paris Agreement** aims to limit the increase of global mean temperature to well below 2°C and preferably 1.5°C.
- Countries should set their own Nationally Determined Contributions (NDCs), including 2030 emissions targets and plans of action to achieve those targets.
- Since the Conference of the Parties (COP26), in Glasgow, in 2021, many nations have also set long-term goals, notably the **net-zero emissions targets**.

**How close do these ambitions take us toward the Paris goals?**

**How can we increase ambition to close the gap?**

# Evaluating the net-zero pledges

The **ENGAGE project** aims to answer this question, through a collaboration of global and national modelling groups assessing how current targets and policies affect emissions.

Integrated Assessment Models (IAMs) are useful to calculate plausible emissions pathways, globally and regionally, including an overview of mitigation options that could bring us closer to the Paris goals.



# Scenarios

***Current policies scenario:*** assuming all climate policies that are already implemented

***NDC scenario:*** fully implementing all NDCs to 2030, with ambition levels remaining constant after that

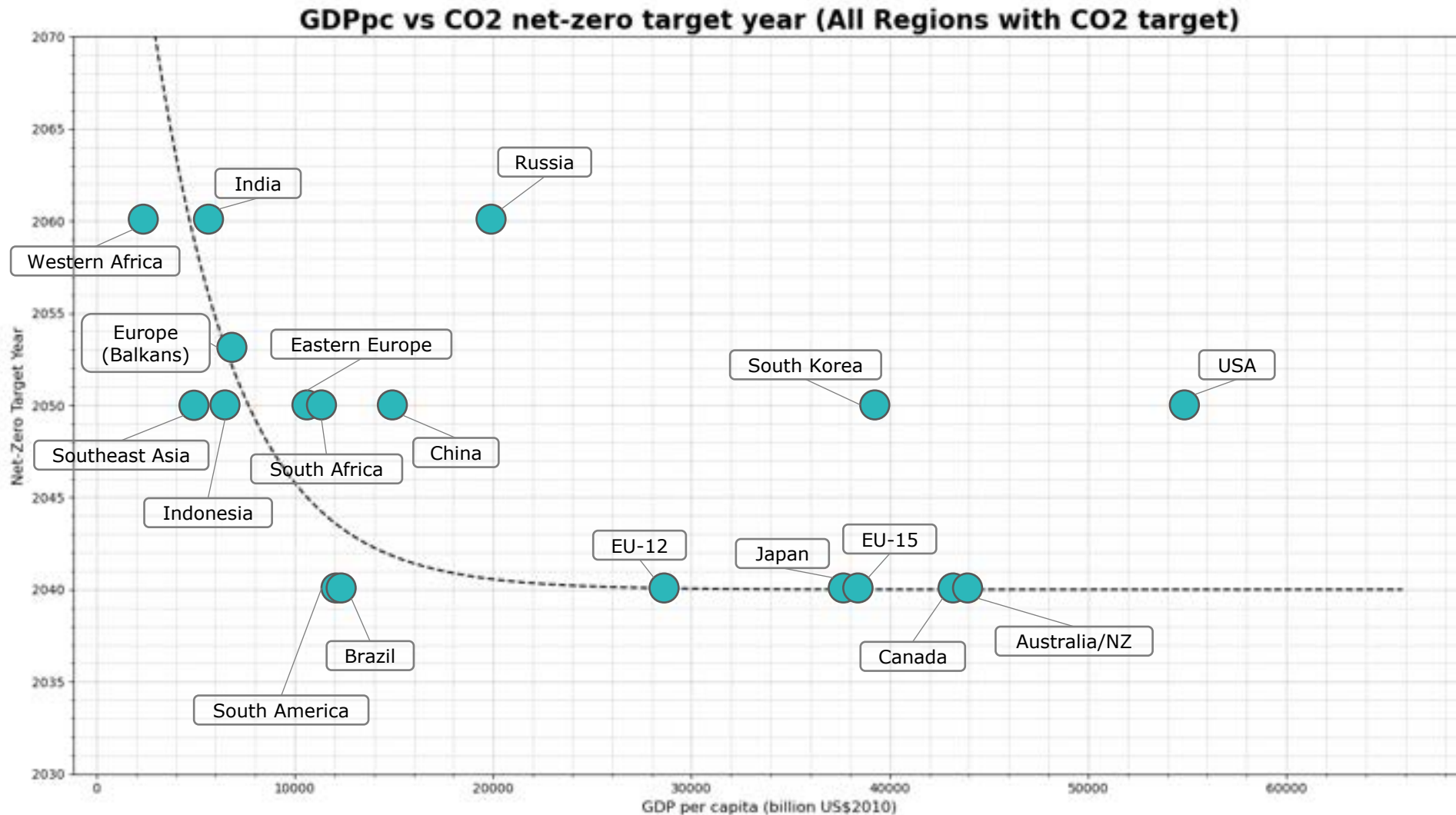
***Glasgow scenario:*** fully implementing NDCs and the net-zero pledges

***Glasgow+ scenario:*** fully implementing and expanding the net-zero pledges to all countries/regions

***Glasgow++ scenario:*** fully implementing and expanding the net-zero pledges to all countries/regions, and anticipating climate action by 10 years

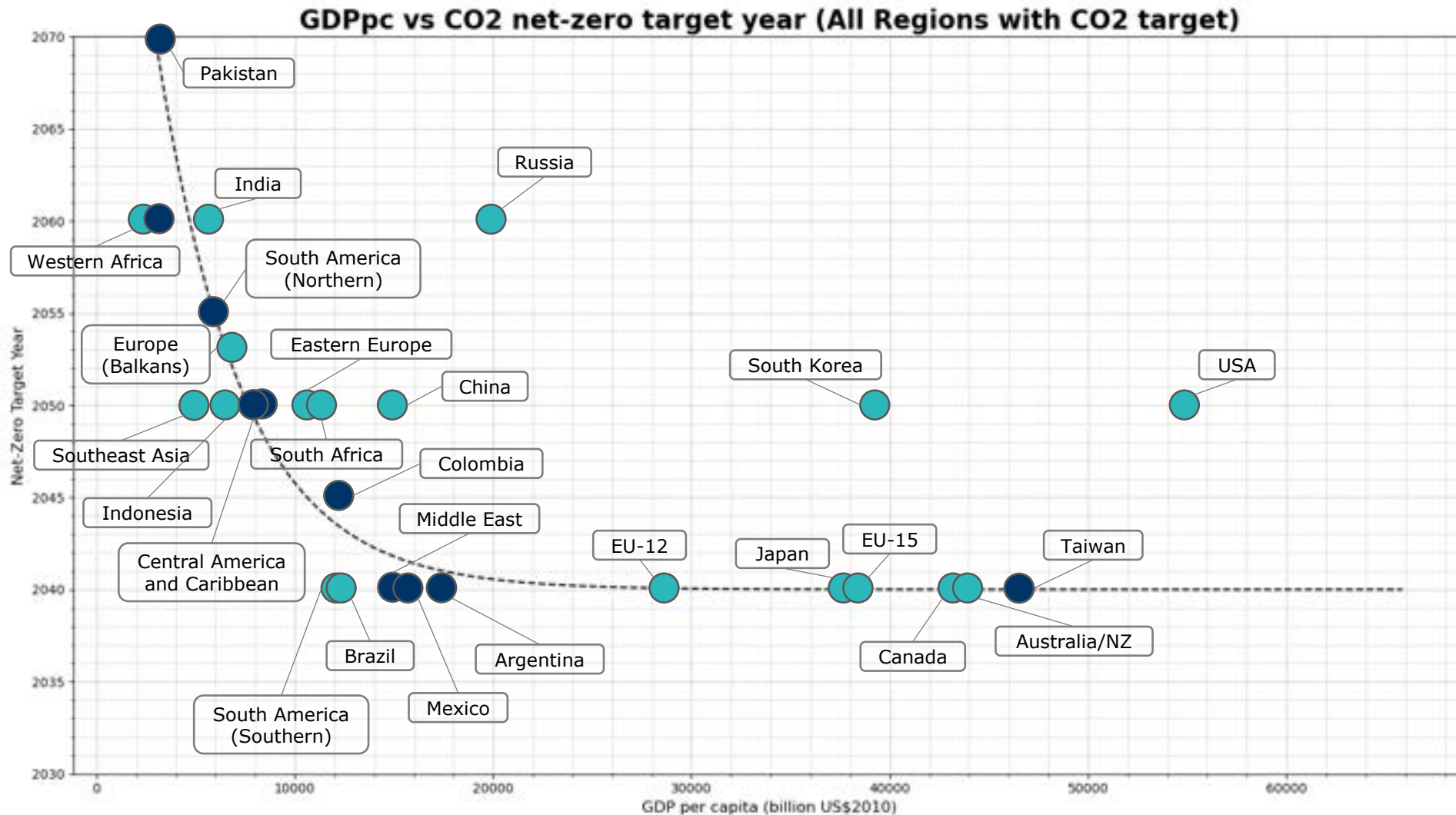
***2°C and 1.5°C scenarios:*** models calculate global cost-optimal ways of meeting these temperature goals in 2100.

# Expanding the net-zero coverage



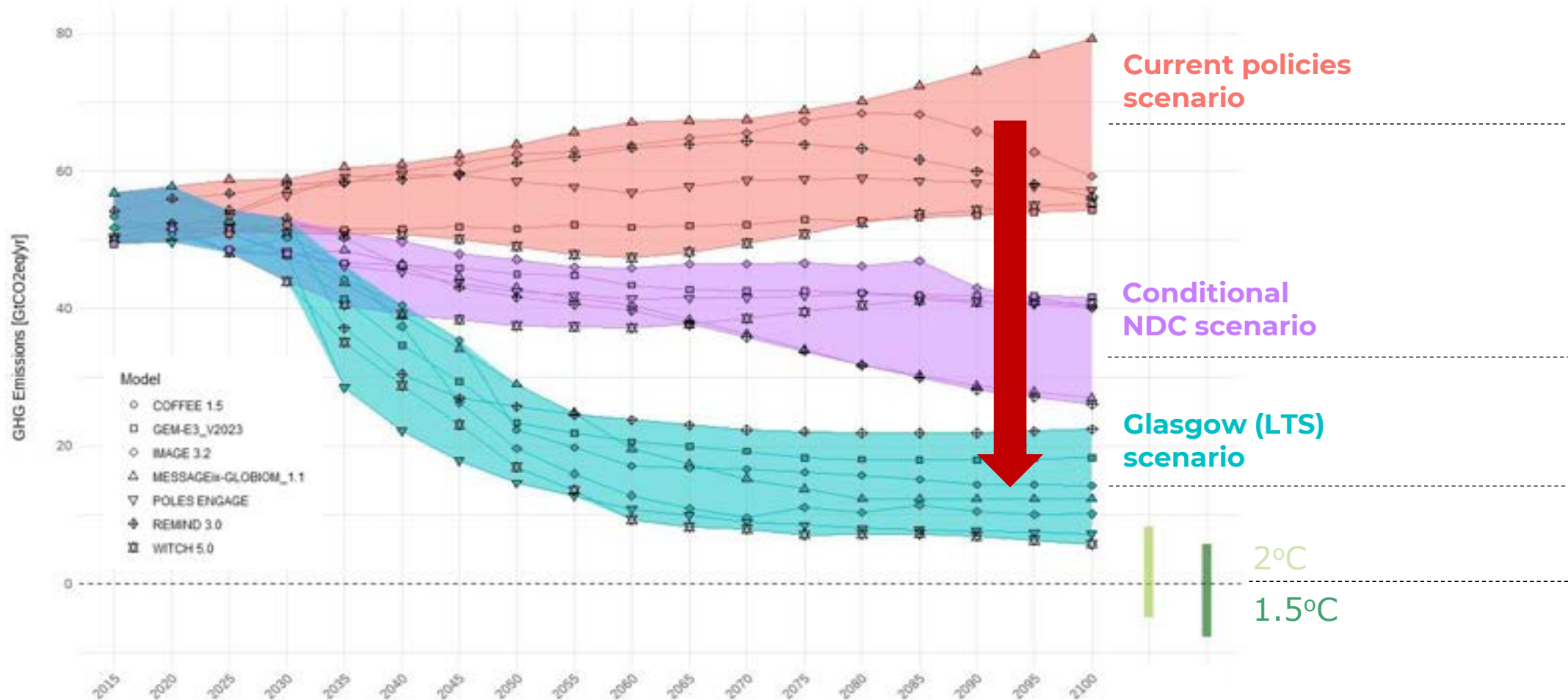
# Expanding the net-zero coverage

● Glasgow  
● Glasgow+



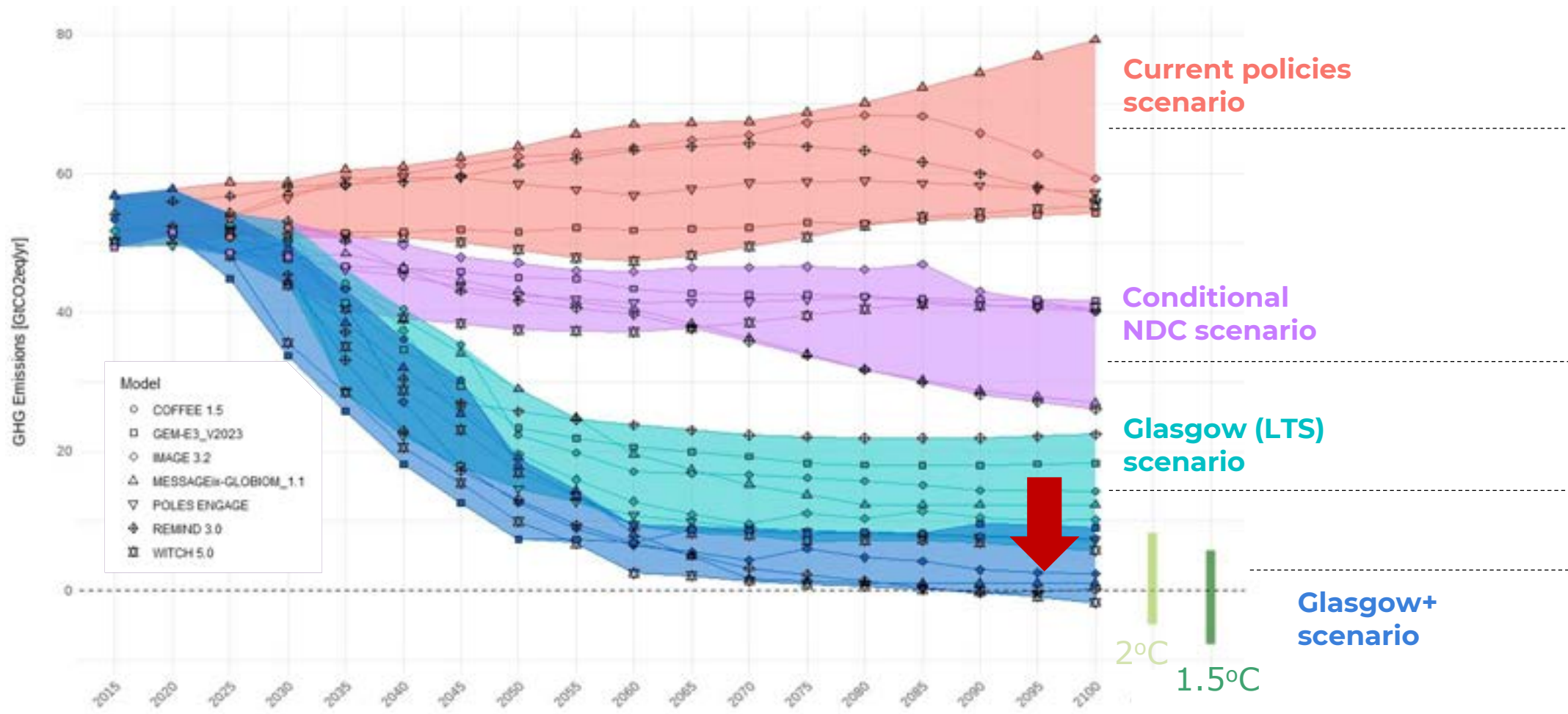
# Possible futures

Implementing net-zero targets could make a difference!

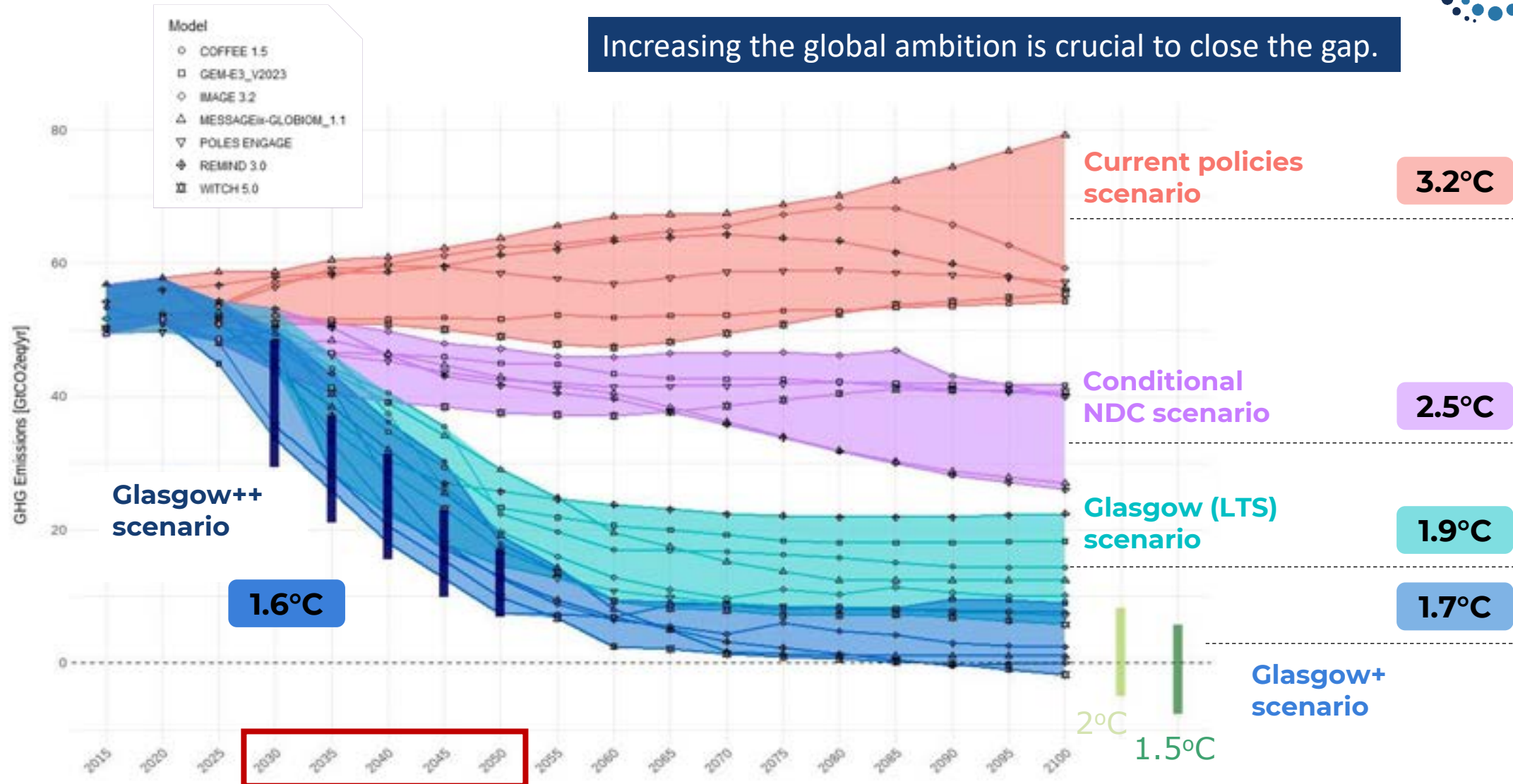


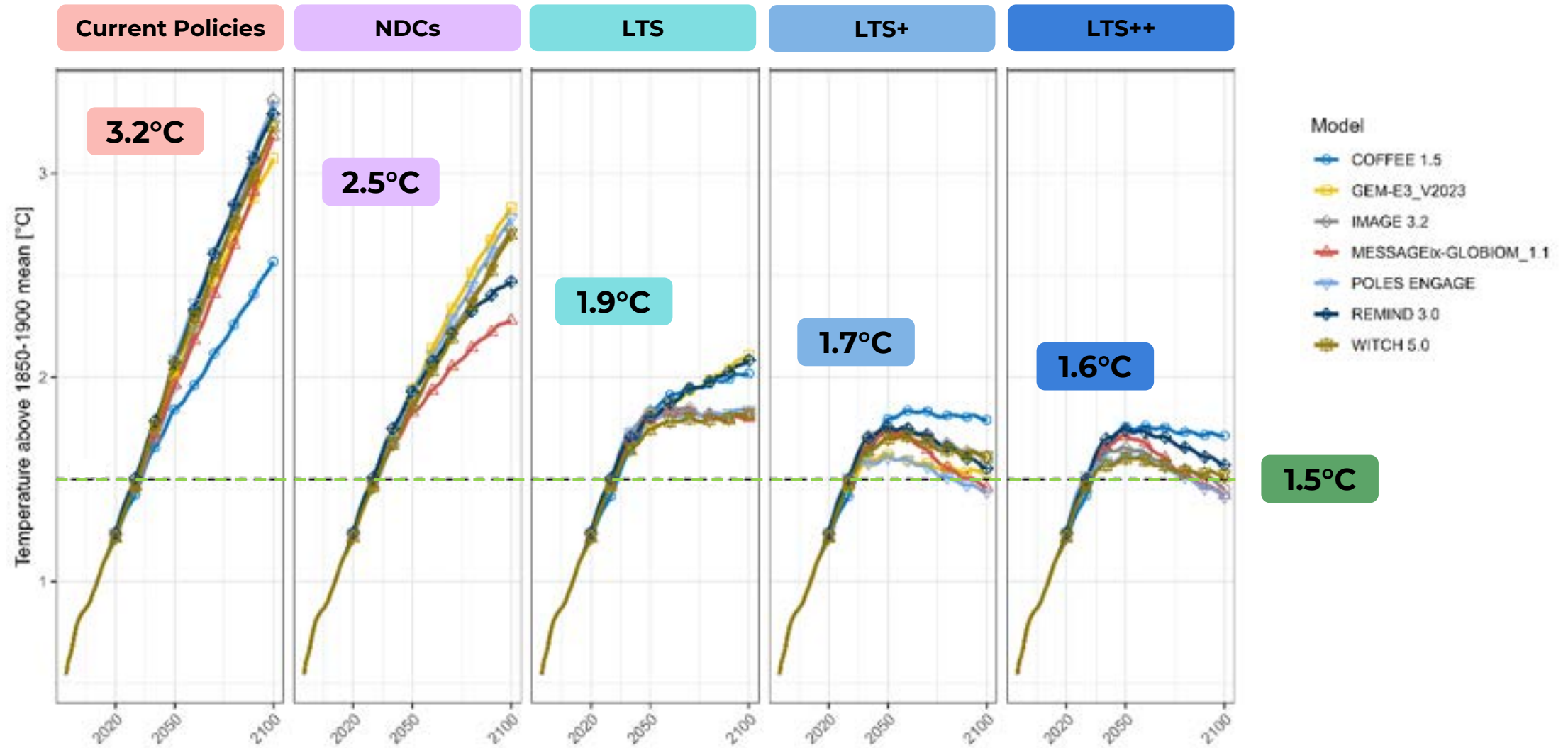


# Possible futures

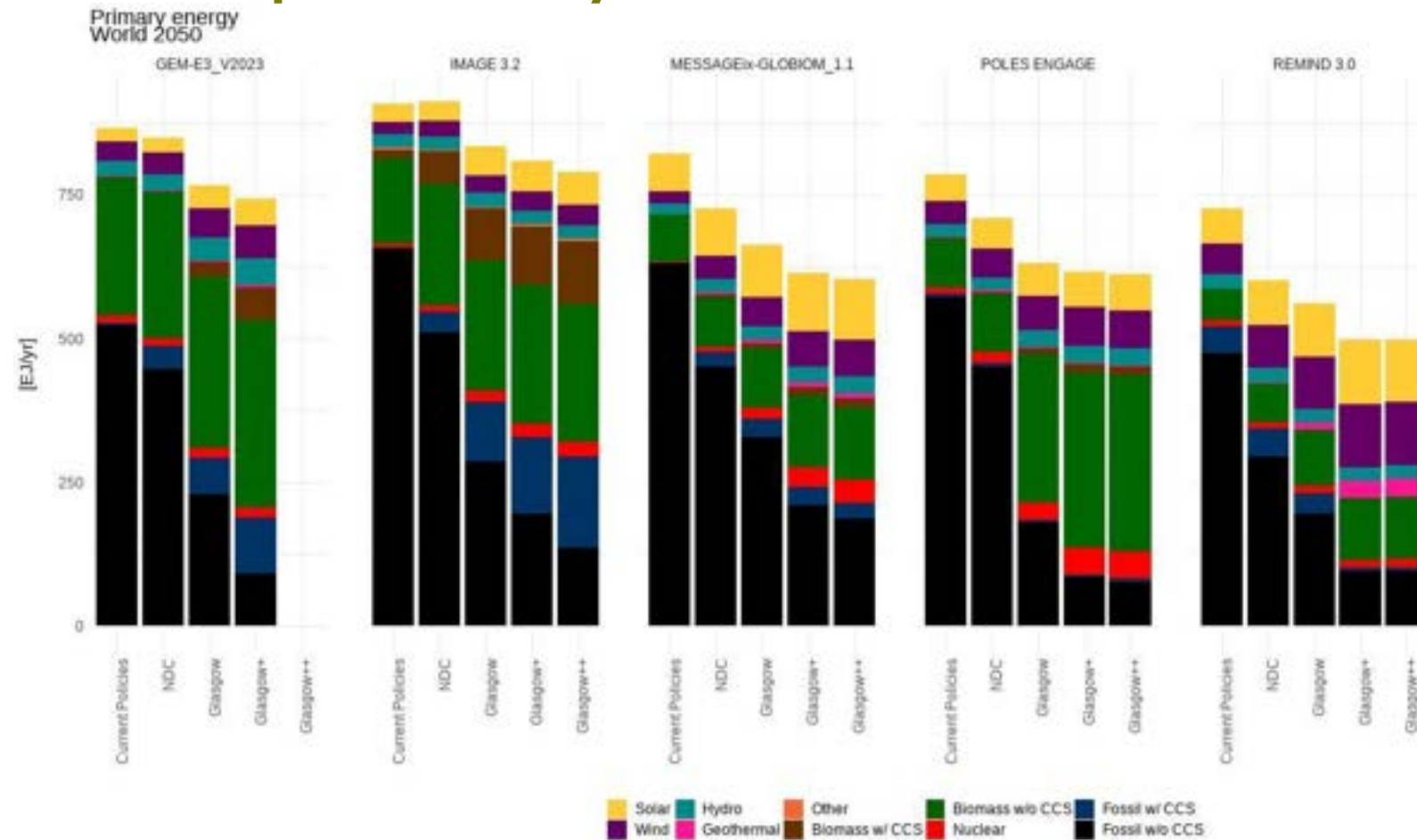


Increasing the global ambition is crucial to close the gap.

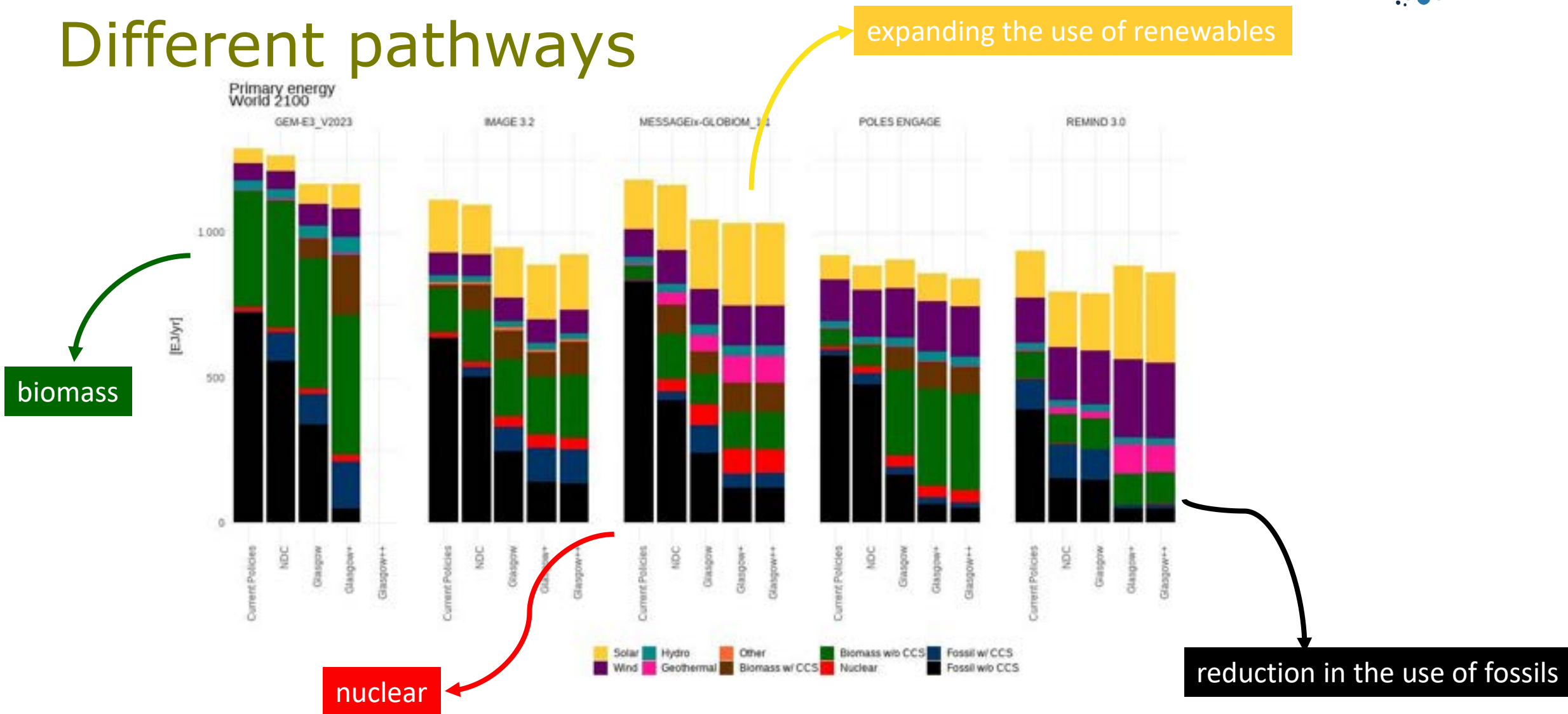




# Different pathways



# Different pathways

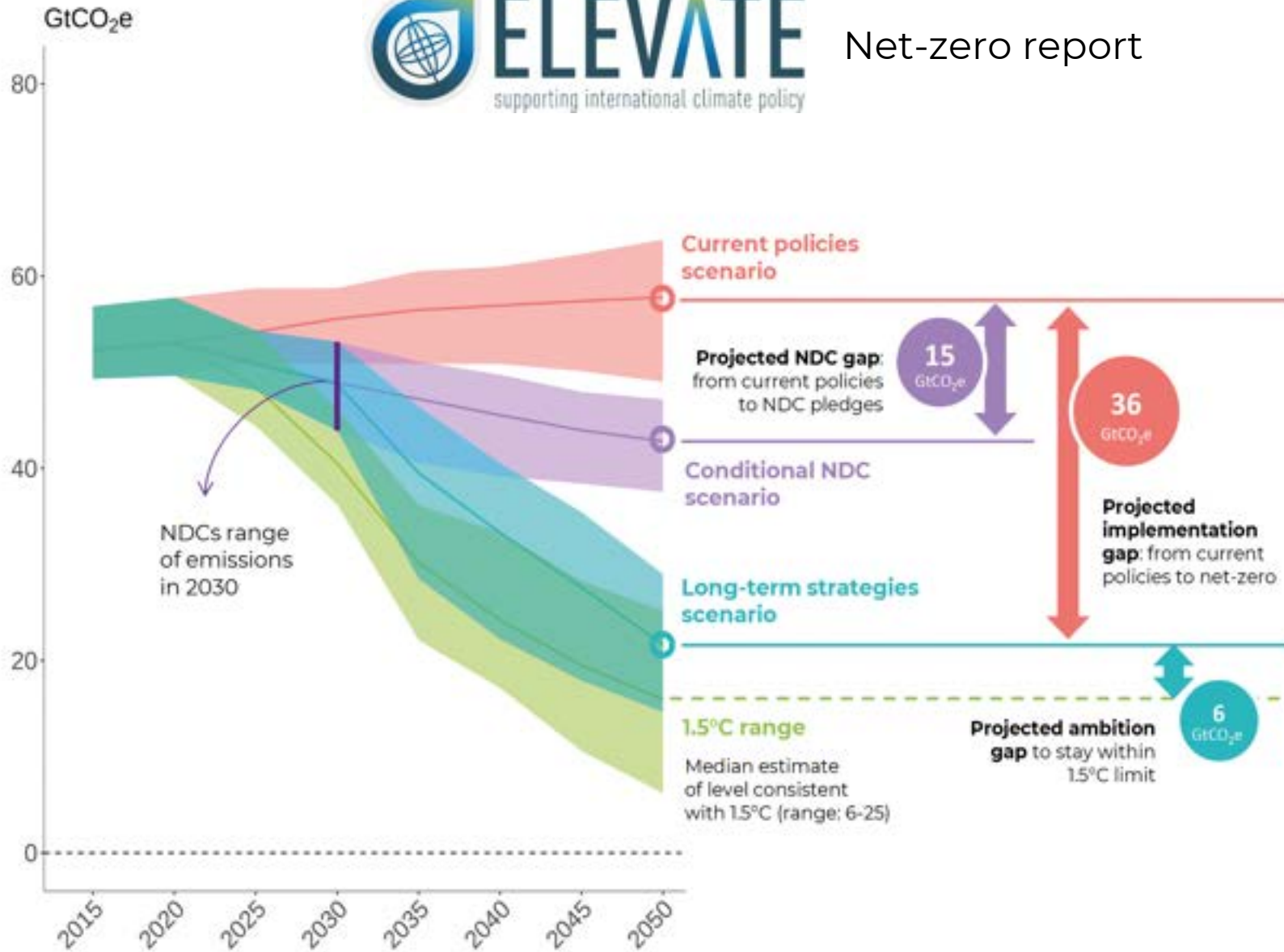




## Total GHG emissions



## Net-zero report



- If countries start implementing pathways towards the self-selected net-zero targets immediately, this would significantly reduce expected warming. But further effort is still required.
- Implementation of current climate policies is not enough to achieve the net-zero targets on a global level — Countries need to increase their effort in implementing policies and underpinning their long-term goals, if they want to achieve their targets.
- Timing of net-zero is strongly dependent on the emission pathway towards and following the target year. This means that if emission levels are higher earlier in the century (such as in 2030), they will need to be compensated
- Further clarity on net-zero targets is often needed.



# Carbon Budget Explorer

Exploring fair climate policy in three  
steps

1.

*Set global targets*

*Defining the global carbon budget and emissions pathway*

2.

*Choose your effort-sharing principle*

*Implicating each country's "fair" emissions*

3.

*Observe individual country results*

*Indicating the pathway for each country in more detail*



Global carbon budget

**1060**

Gt CO<sub>2</sub>

That amounts to

**28x**

the current annual emissions

### Global budget

How much do we have left?

Limit global warming to (°C)



Acceptable risk of exceeding global warming limit



### Global pathway

How do we spend these emissions over time?

End-of-century negative emissions



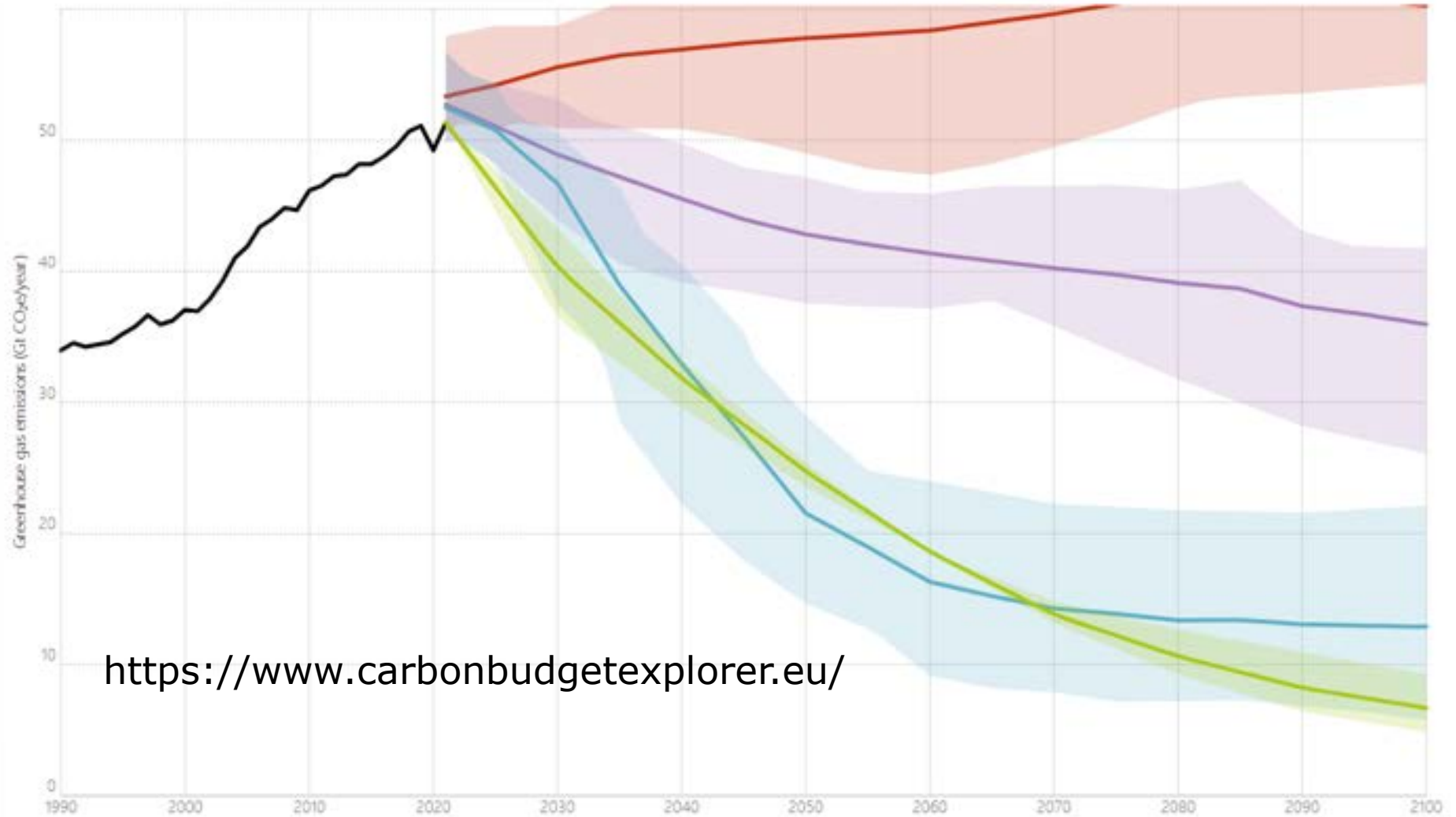
### Reference pathways

Use the checkboxes below to compare your pathway with common references. Of particular interest is the implementation gap.

- ☒ Your pathway
- ☒ Projections of current policies
- ☒ Projections of nationally determined contributions (NDCs)
- ☒ Projections of net-zero pledges

Global budget

World map with shares



<https://www.carbonbudgetexplorer.eu/>

# Closing the gap

- **To close the remaining gap, we must cut fossil fuels sharply, and further extend the reach of renewables.**
- **The optimum mix of mitigation approaches differs a lot for each country, with varying combinations of solar, wind, biomass, hydro, geothermal, carbon capture, wave and tide power.**



# Thank you!

More info can be found at:

**ENGAGE** (<http://www.engage-climate.org/>)

@Engage-Climate

**ELEVATE** (<http://www.elevate-climate.org/>)

@ElevateClimate



# Increasing ambition beyond Glasgow:

## What do the net-zero ambitions mean for the Paris Agreement goals? A country-based analysis

Pedro Rochedo - Cenergia, COPEE and Khalifa University  
*(on behalf of all contributing national modelling teams)*

*December 4th, 2023 – Dubai*



# National Climate goals

- National climate goals were defined based on results from a global IAM
- There is a global common carbon budget that must be respected to increase the probability to keep global warming below 1.5°C or 2°C
- The global IAM aims to distribute this global carbon budget among the different countries
  - Most global IAMs do it based on least-cost, meaning that other allocation criteria were not considered in this exercise
- Different national teams used their defined carbon budgets

# Approach followed in ENGAGE

Based on global carbon budgets aligned with 1.5°C and 2.0°C, runs developed under the ENGAGE project were used to define the carbon budgets for each country considered here

National Teams	CO <sub>2</sub> Budget 2020-2050 in GtCO <sub>2</sub>			
	full century 1.5°C	full century 1.5°C (excl. LULUCF)	full century 2°C	full century 2°C (excl. LULUCF)
Brazil	9.6	2.3	14.2	8.7
China	155.5	160.7	232.7	237.6
India	34.0	32.3	58.7	56.4
Indonesia	9.4	-0.6	20.6	10.9
Japan	11.0	11.9	17.6	18.5
Mexico	5.5	5.4	9.4	8.7
South Korea	4.1	4.5	11.2	11.6
Thailand	6.9	4.9	10.2	8.8
Vietnam	4.8	3.4	7.2	5.7

# National climate goals

- At the same time countries have set their own NDCs, including 2030 emission targets and plans of action to achieve those targets
- Many nations have also set long-term goals, notably **net-zero targets** proposed before and during the Conference of the Parties (COP26) in Glasgow in 2021
- Net-zero pledges were not defined by all countries nor following the same criteria
  - Some are based on GHG and others on net-zero CO<sub>2</sub> emissions

# Evaluating net-zero pledges

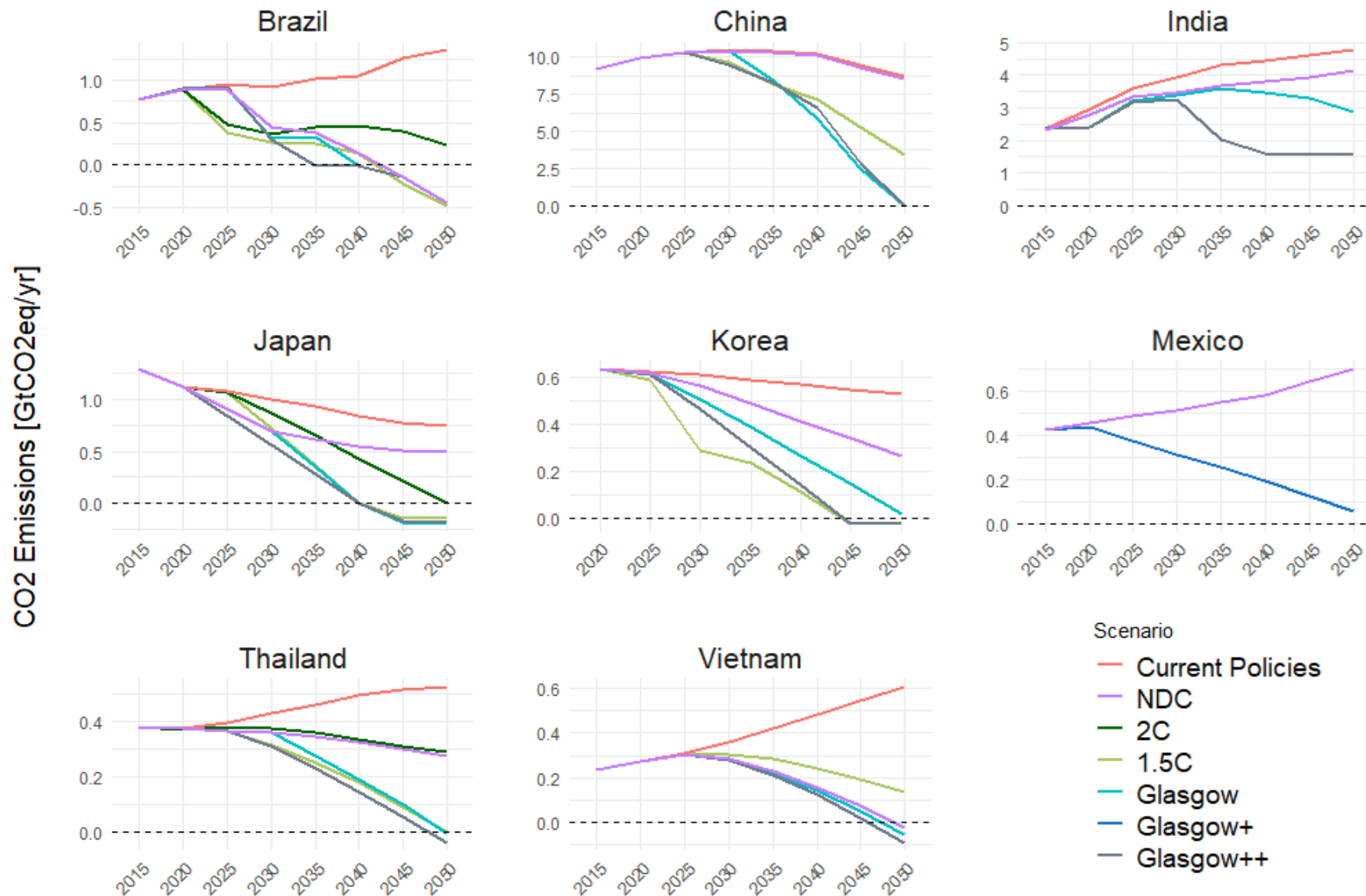
The study aims to understand the possible gap that might exist between current national targets and policies and carbon allowances defined under cost optimal criteria allocation from global IAM runs



# Scenario Design:

- **Current policies scenario:** assuming all climate policies that are already implemented
- **NDC scenario:** fully implementing all NDC policies to 2030, with ambition levels remaining constant after that
- **Glasgow scenario:** fully implementing NDC and the net-zero pledges announced by the end of COP26
- **Glasgow+ scenario:** fully implementing and expanding net-zero target year in case the country has no pledge
- **Glasgow++ scenario:** fully implementing and anticipating net-zero target year
- **2°C and 1.5°C scenarios:** countries must respect carbon budgets allocated by global IAMs based on global cost-optimal ways of meeting these temperature goals by 2100

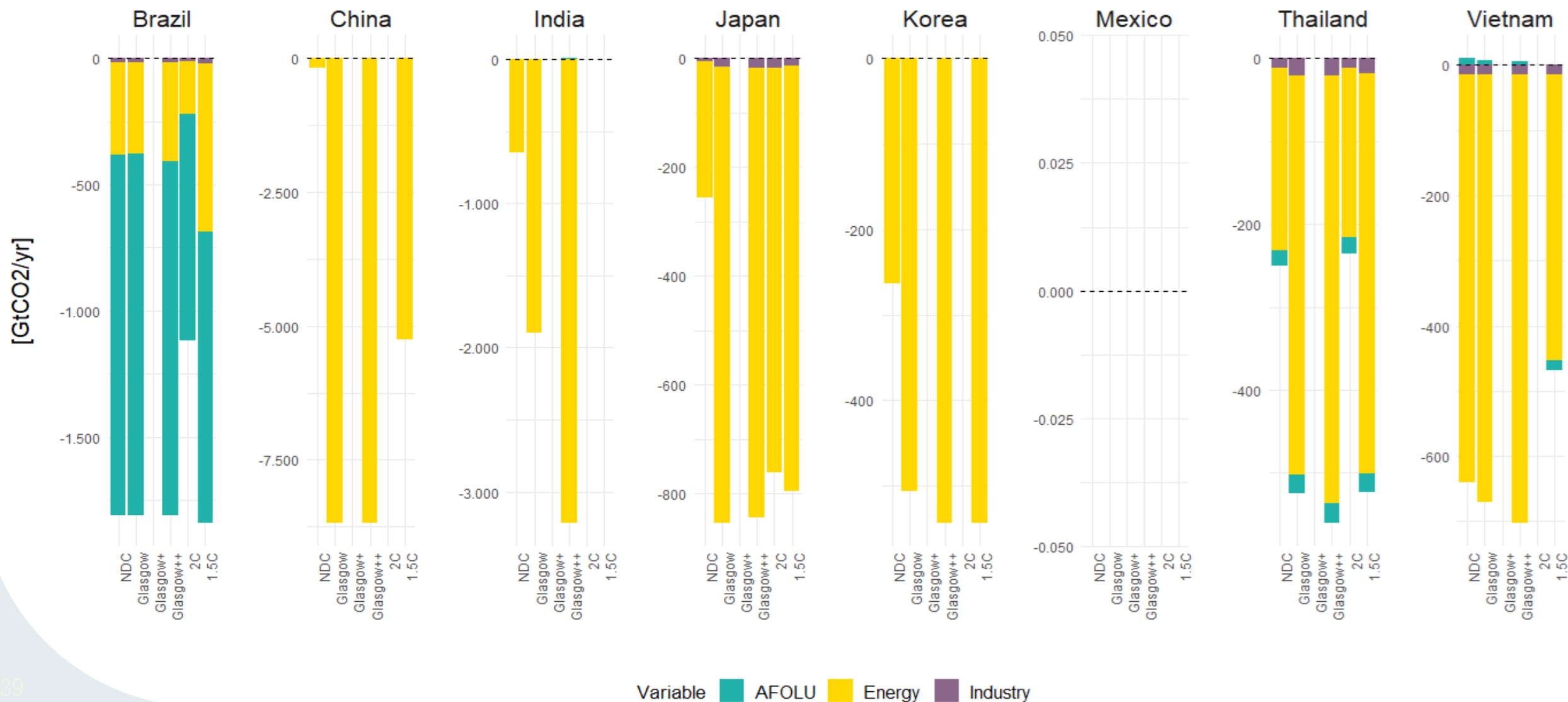
# Seven futures



# Different pathways



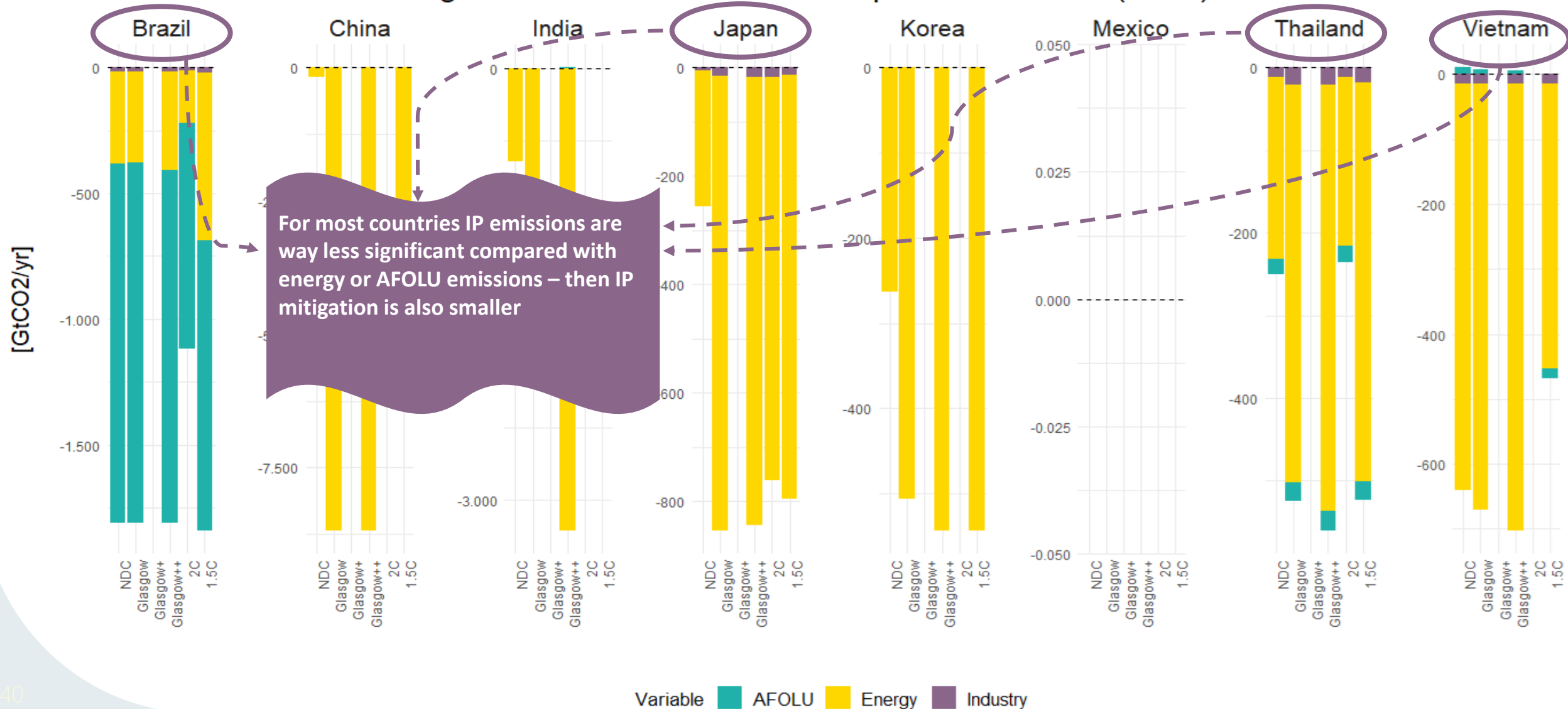
Change in sectoral emissions compared to CurPol (2050)



# Different pathways



Change in sectoral emissions compared to CurPol (2050)



# Different pathways



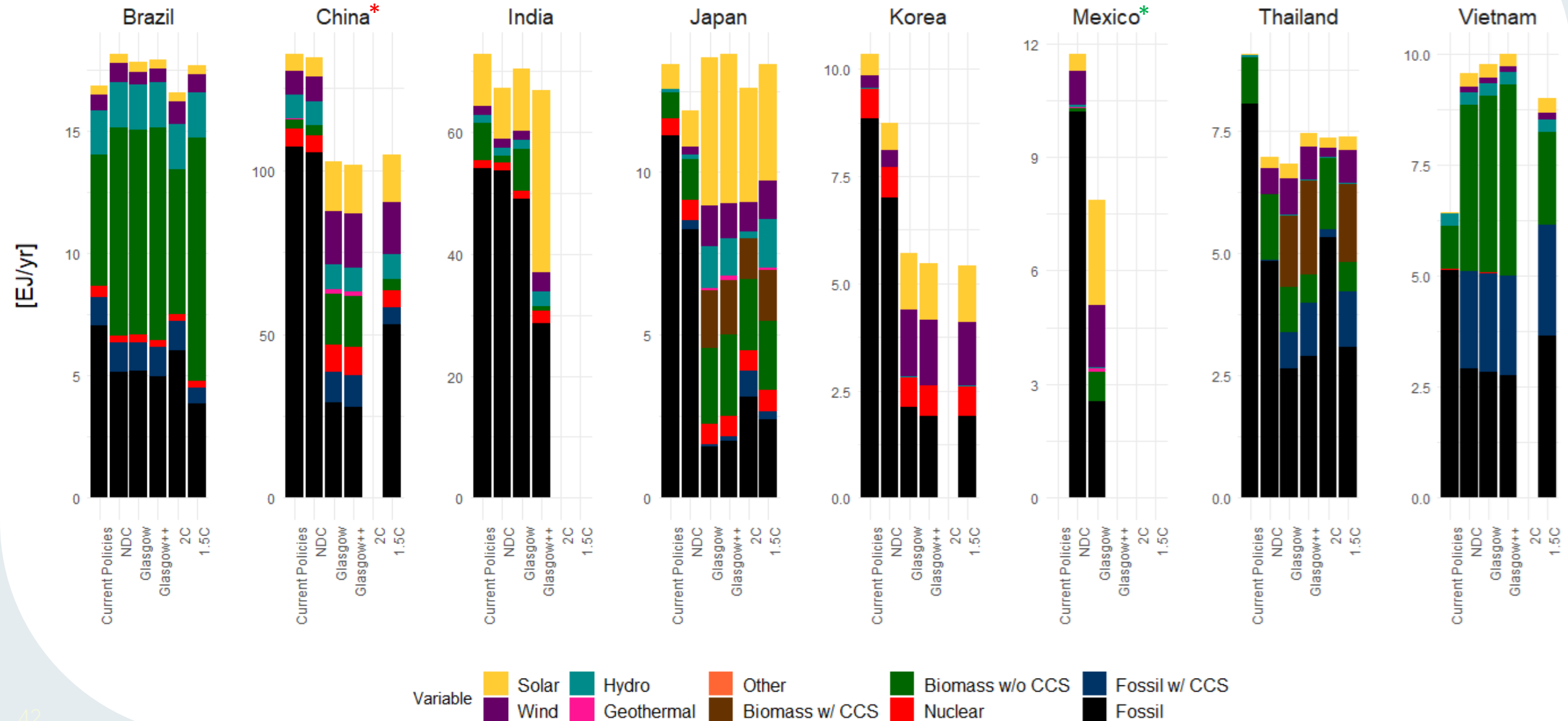
Change in sectoral emissions compared to CurPol (2050)





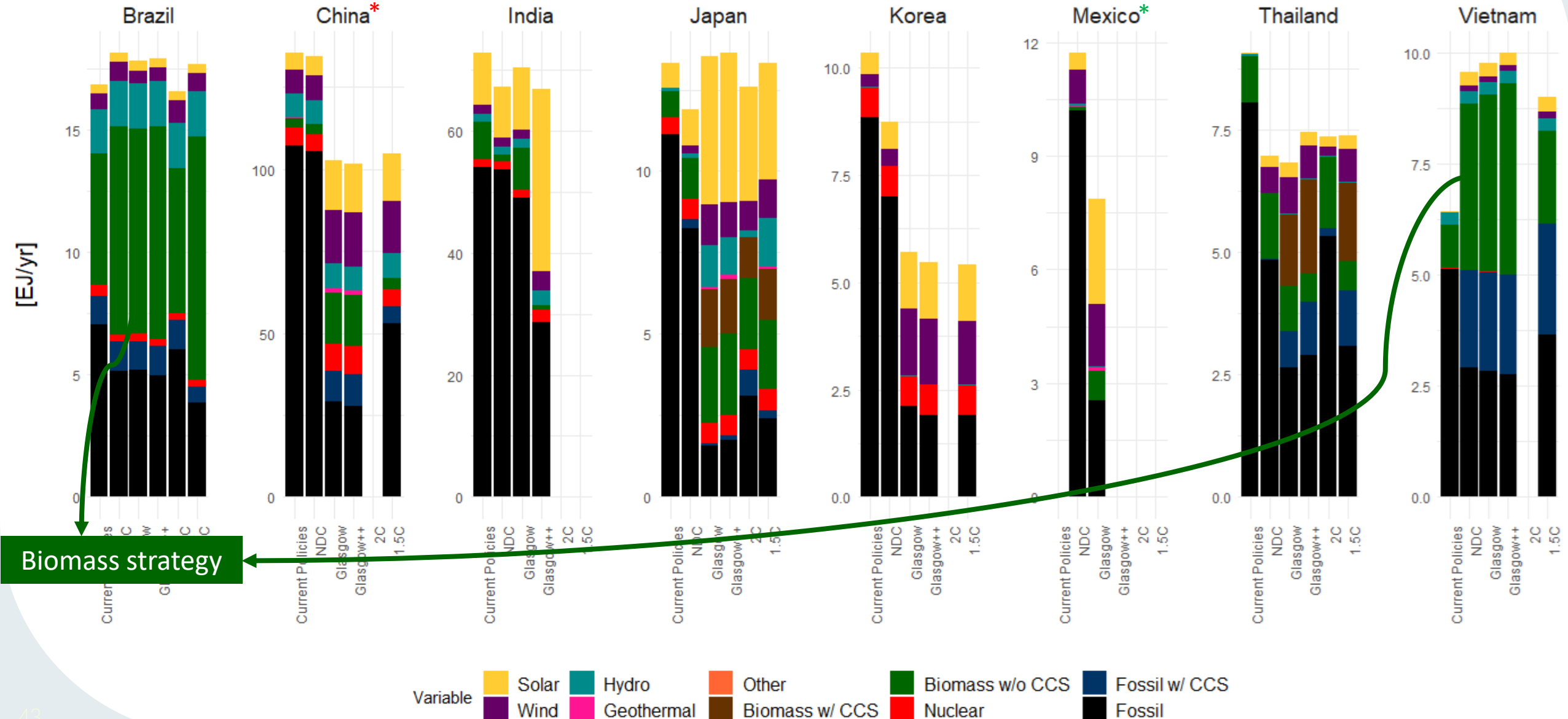
# Different pathways

## National Primary Energy in 2050



# Different pathways

## National Primary Energy in 2050



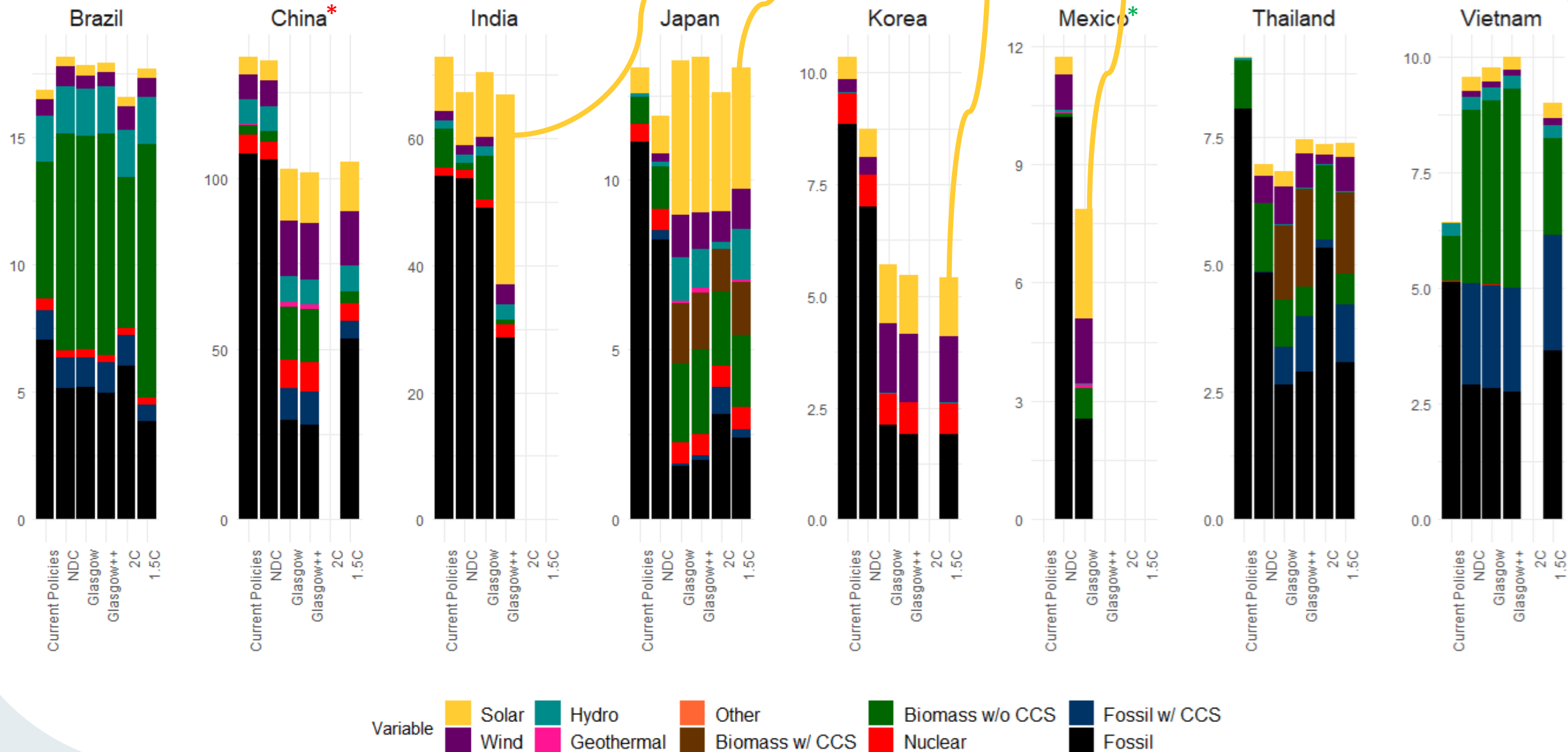
# Different pathways



## National Primary Energy in 2050

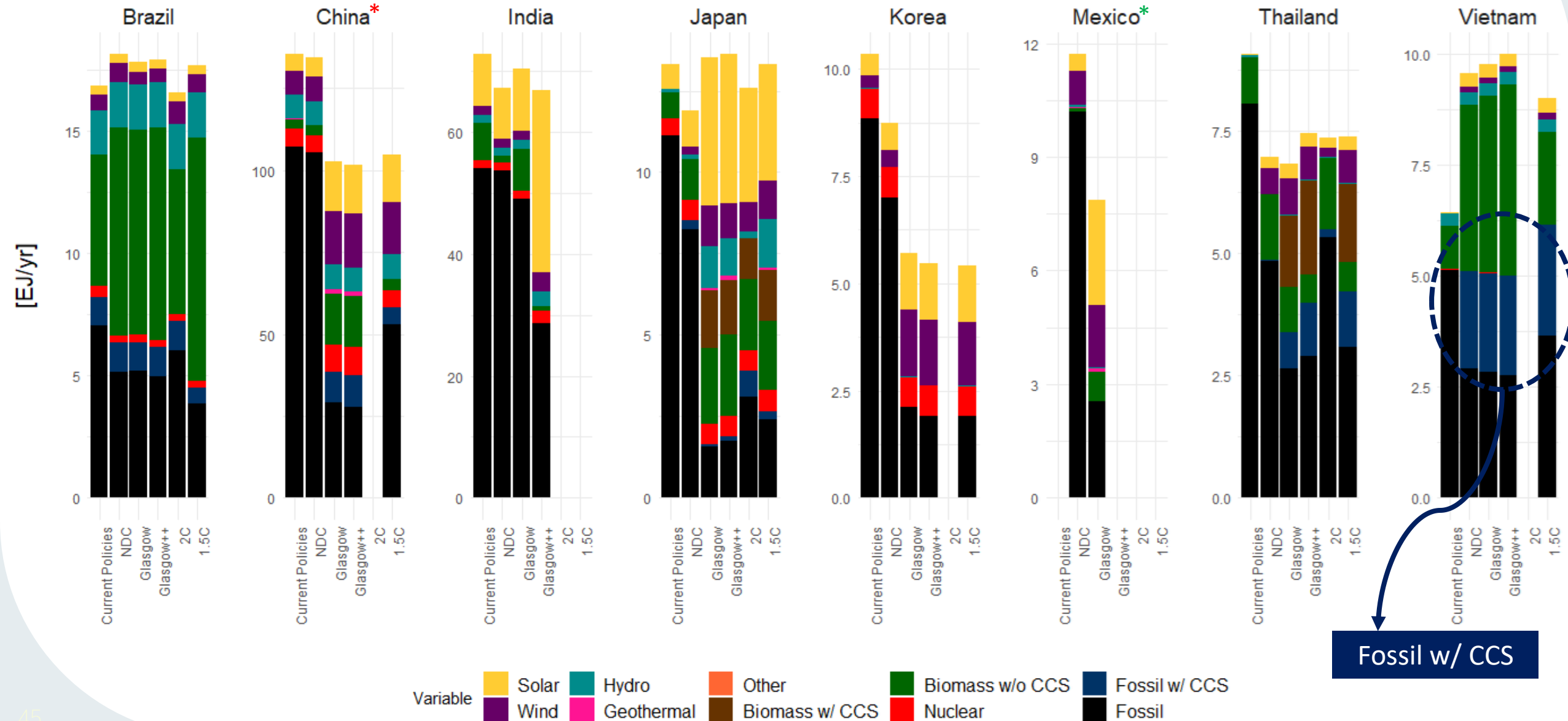
expanding the use of renewables

[EJ/yr]



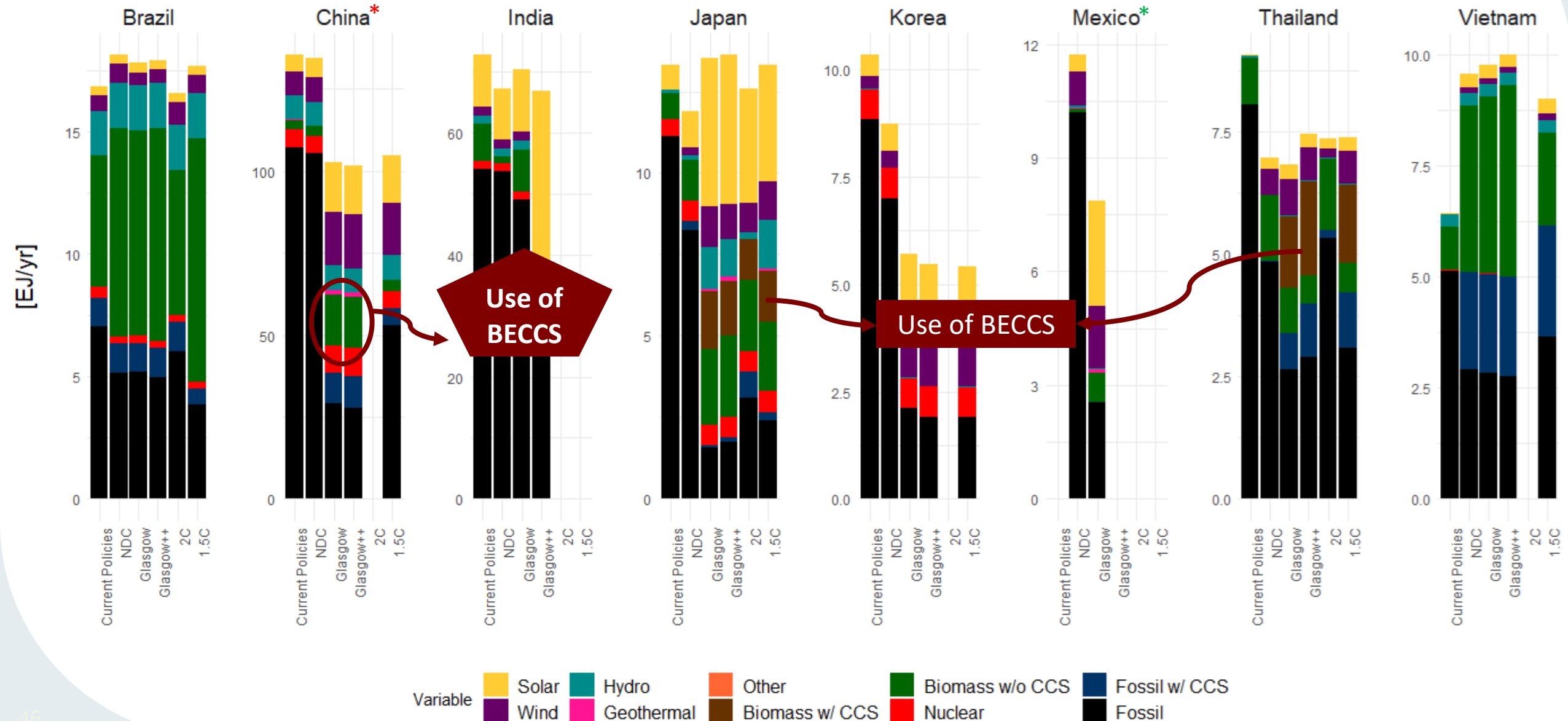
# Different pathways

## National Primary Energy in 2050



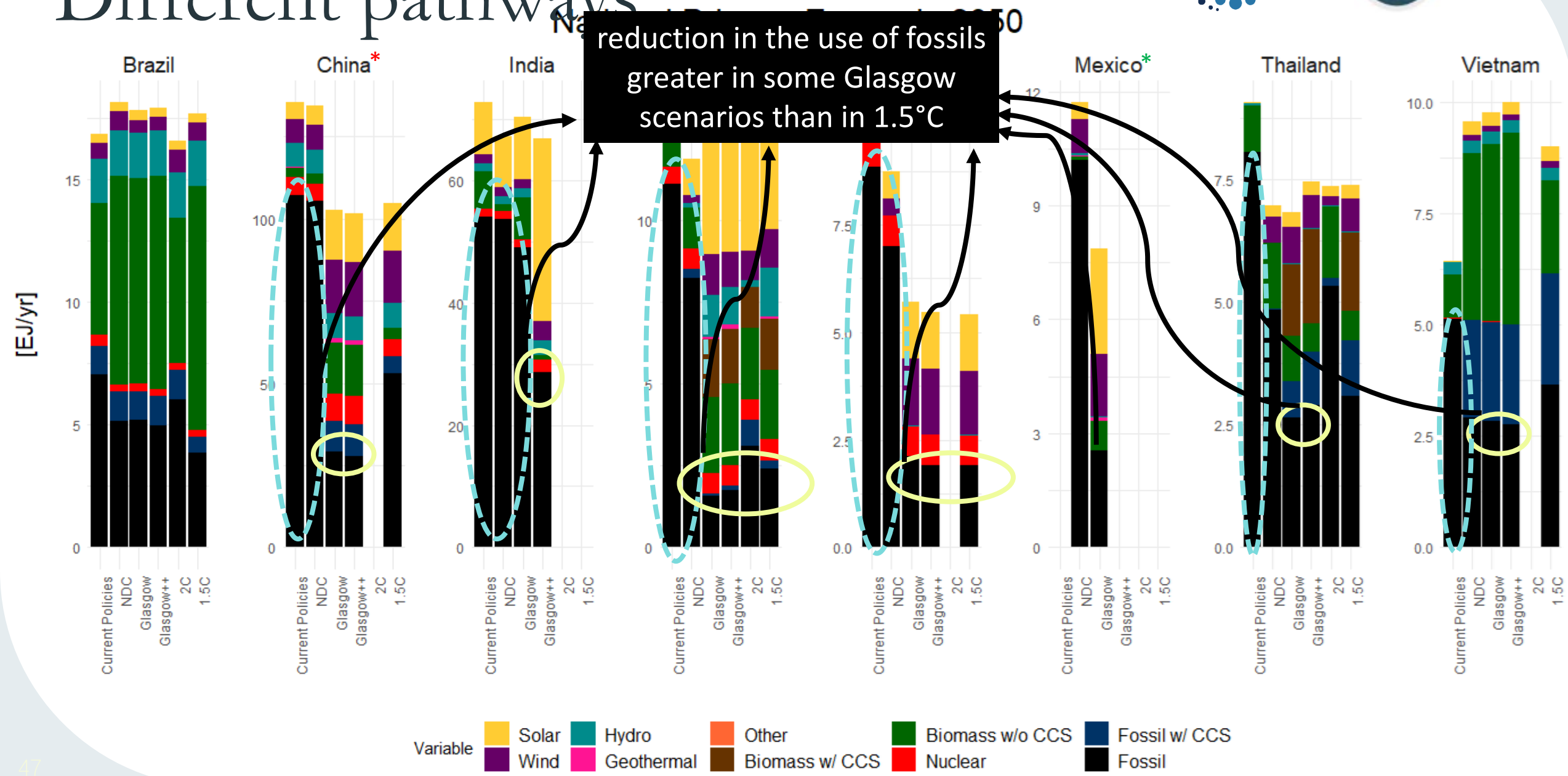
# Different pathways

## National Primary Energy in 2050





# Different pathways



# Closing the gap

- **No Current Policies scenarios come close to Paris goals.** At best they stabilize GHG emissions whereas deep cuts are needed
- Some existing **NDCs** reach emission values in 2050 close to those observed in Paris Goal scenarios (e.g. **Brazil and Vietnam**), but none have satisfactory **cumulative carbon budgets**
- **Announced net-zero targets are a big step forward.** For some countries these pledges would even lead to **emissions lower** than global cost-optimal (e.g. **China and Korea**)

# Closing the gap

- **Different strategies are indicated by each country**
- **Brazil** reduces most of its emissions by **land use change and forestry mitigation**
- **All other countries** reduce emissions by **improving energy efficiency**
- **When**
  - Fossil fuels
  - Biomass
  - Renewable energy
  - CCS → Vietnam
  - BECCS → China, Thailand

The understanding of the **best strategy** that might be adopted by **each country** to reduce their emissions and fulfill Paris Agreement expectations is crucial to **promote and incentivize the right sectors** and measures

# Thank you!



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More info can be found at:

ENGAGE (<http://www.engage-climate.org/>)

@Engage-Climate

ELEVATE (<http://www.elevate-climate.org/>)

@ElevateClimate



# Peak temperatures and regional mitigation considering feasibility constraints

December 4, 2023

**Work in progress!**  
**Preliminary results!**  
**Please do not cite or quote!**

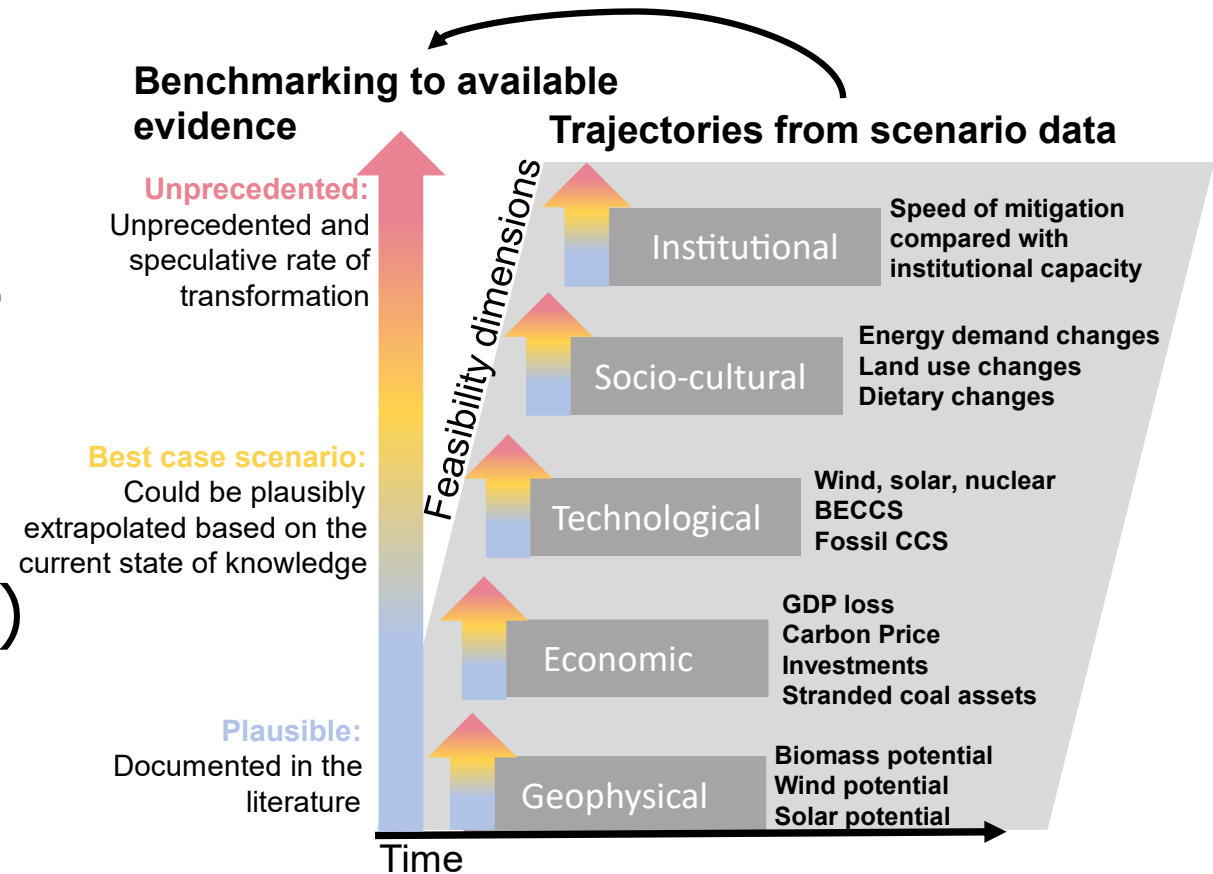
Christoph Bertram (UMD / PIK), Elina Brutschin (IIASA), Keywan Riahi (IIASA), **Bas van Ruijven (IIASA)**, Laurent Drouet (EIEE), Gunnar Luderer (PIK), Rahel Mandaroux (PIK), Florian Fosse (JRC), Zoi Vrontisi (E3M), Dimitris Fragkiadakis (E3M), Shinichiro Fujimori (KU), Diego Silva (NIES), Isabela Tagomori (PBL), Vassilis Daioglou (PBL), Roberto Schaefer (COPPE), Luiz Baptista (COPPE) and others



# Motivation

- Mitigation literature: wide range of technological pathways towards global net-zero
- Evaluation of feasibility showed multiple concerns.
- Limited action and rising emissions increased doubts about limited overshoot 1.5°C pathways (C1 category)

## Scenarios considering feasibility concerns

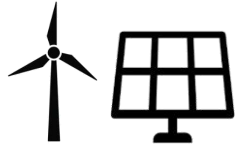


- What characteristics do more feasible scenarios have?
- What is the lower limit of peak temperature under feasibility constraints?
- How can regions with strong institutional capacity respond?

# IPCC report findings inform our approach:

Dimensions:

- Technological



- Bio-/Geo-physical



- Institutional



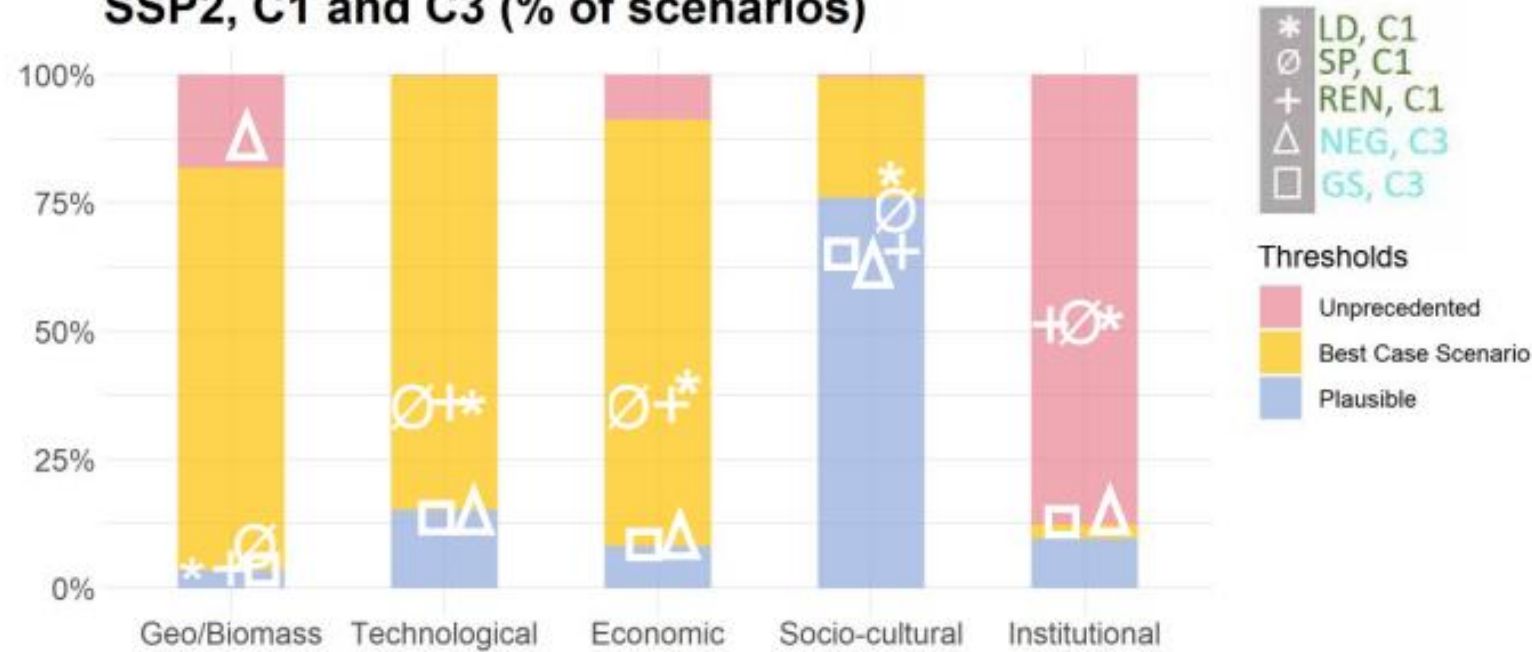
- *Socio-cultural*



- *Economic*



**SSP2, C1 and C3 (% of scenarios)**



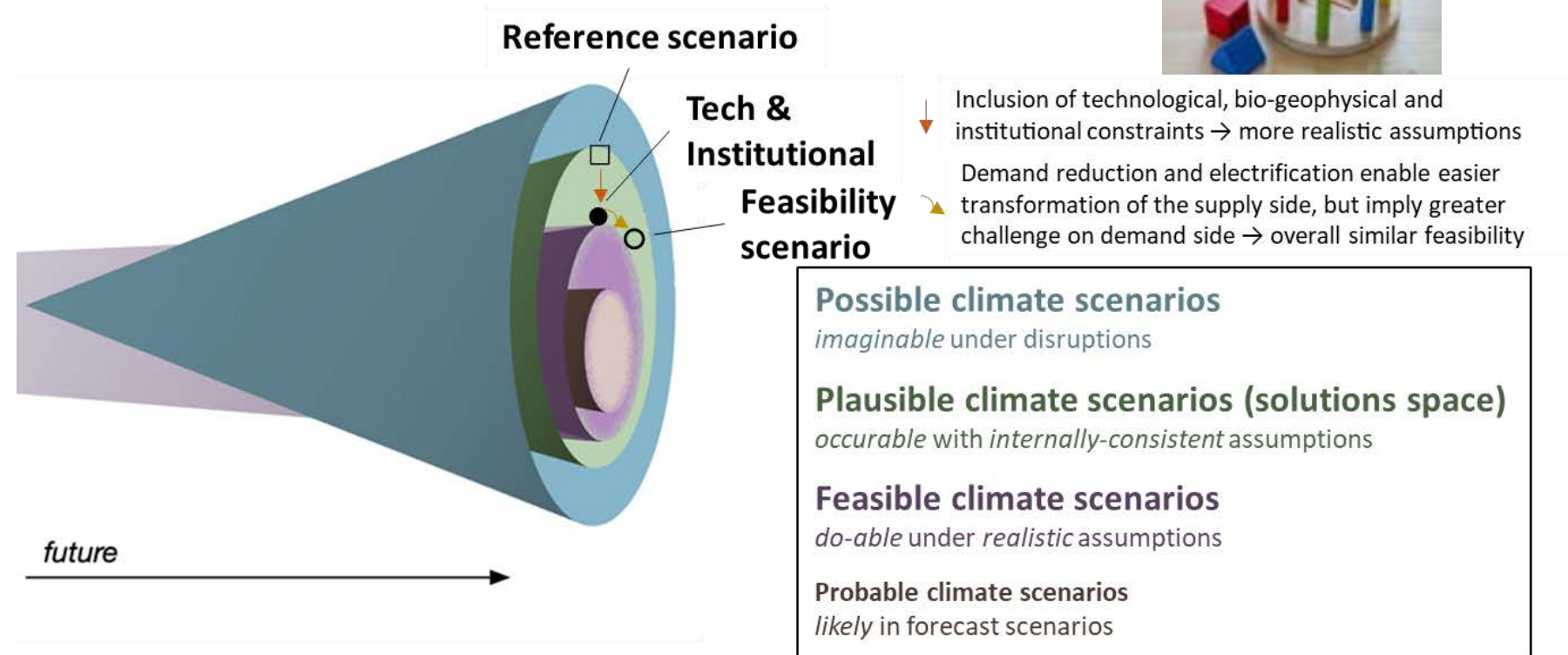
IPCC AR6 WG III, Chapter 3 Figure 3.43 and Technical Summary TS.32

# Approach: focus on most pressing concerns

→ Not lowest cost, but higher likelihood of being feasible



Feasibility:  
 ≠ Desirability  
 ≠ Equity  
 ≠ Probability



Adapted from:  
 Jewell and Cherp 2023: The feasibility of climate action: Bridging the inside and the outside view through feasibility spaces

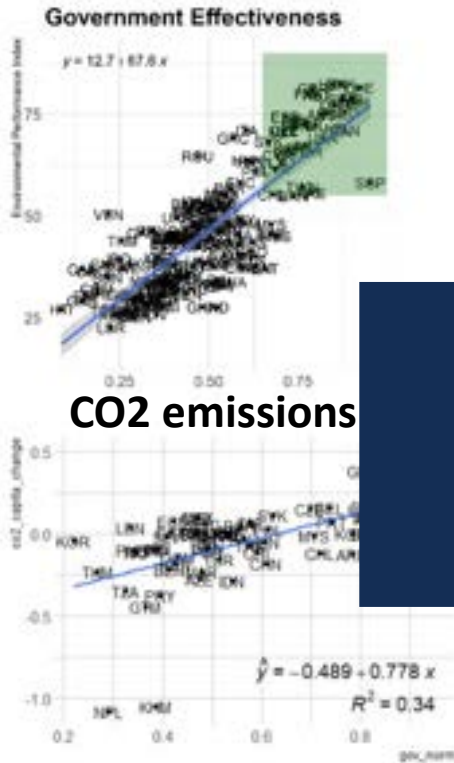
# Focus on “near-term”



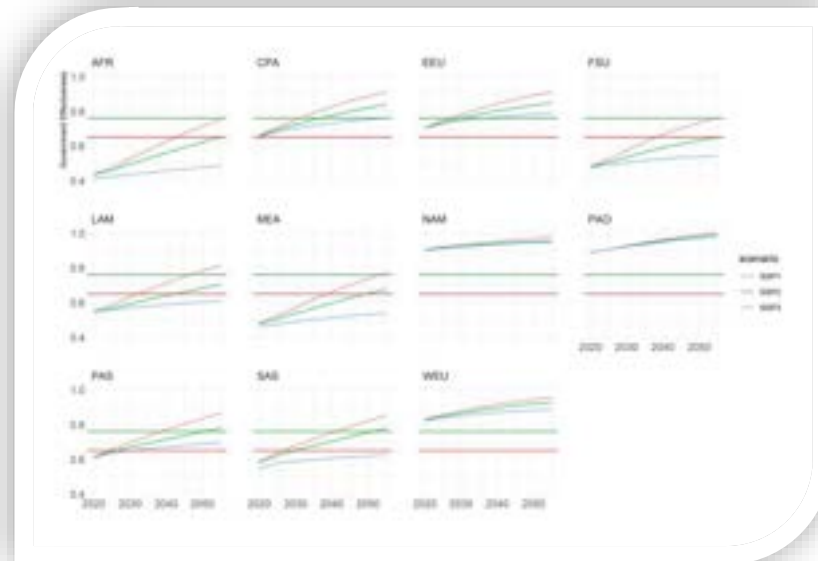
- Only about **peak temperature, reaching net-zero CO<sub>2</sub> globally** (not on what happens thereafter)
- Constraining **ramp-up of all technologies**, but differentiated by specific challenges:
  - ⇒ Wind and solar: updated constraint based on most recent experiences, each 2% per year of existing market, plus any demand growth
  - ⇒ Nuclear: current pipeline of projects until 2030, then optimistic growth
  - ⇒ Carbon capture and storage: current pipeline of projects until 2030 (~300 Mt CO<sub>2</sub>/yr), then optimistic growth → 5 Gt CO<sub>2</sub>/yr in 2050
  - ⇒ Biomass: Limit to sustainability limit of 100 EJ/yr

# Empirical basis for implications of institutional capacity

## Empirical analysis (Brutschin et al, 2021)



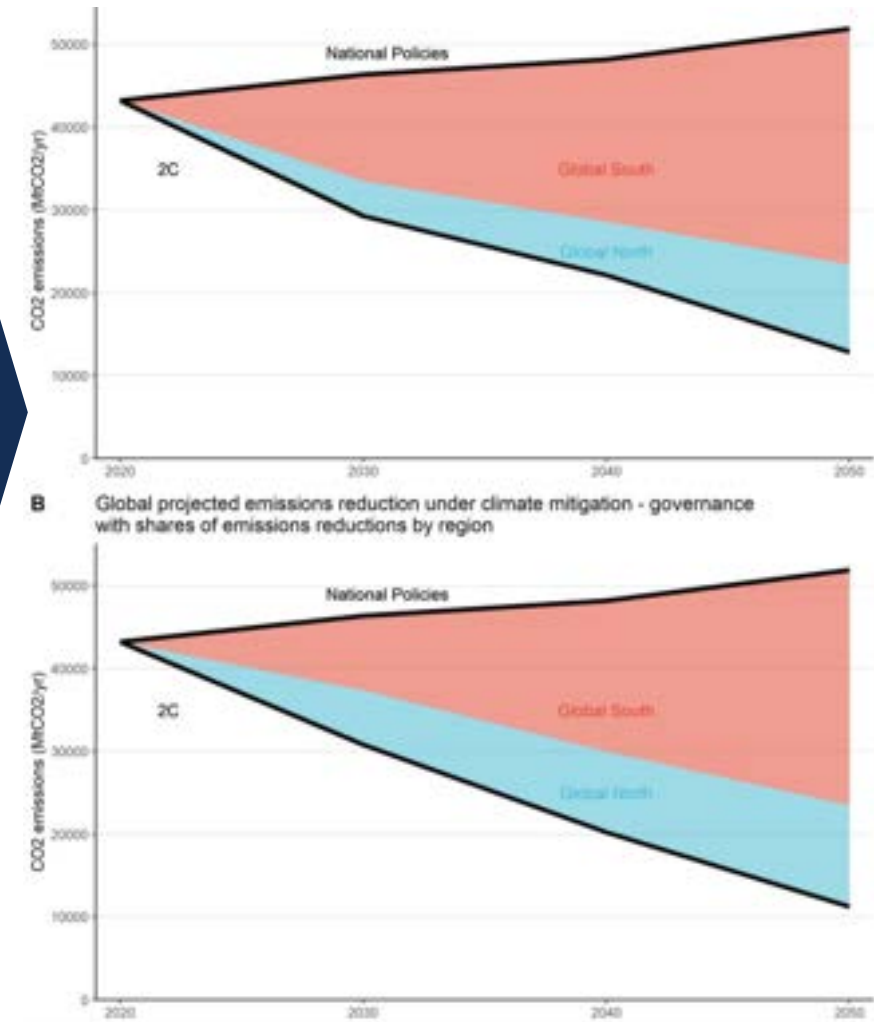
## Governance projections along SSPs based on Andrijevic et al. (2020)



## Model Formulation

Governance level	Upper bound on total CO2 emission reductions for a given decade
<0.65	20% (below red)
0.66-0.7	25%
0.71-0.75	40%
0.76	Unconstrained (above green)

## Regional Emissions reductions (Gidden et al, 2023)





# FEASI-MIP – model comparison for systematic feasibility assessment of 1.5 and 2C warming goals

## Feasibility concerns

- ⇒ Technological
- ⇒ Geophysical
- ⇒ Economic
- ⇒ Governance and Institutional



## Enabler conditions regions with strong institutional capacity

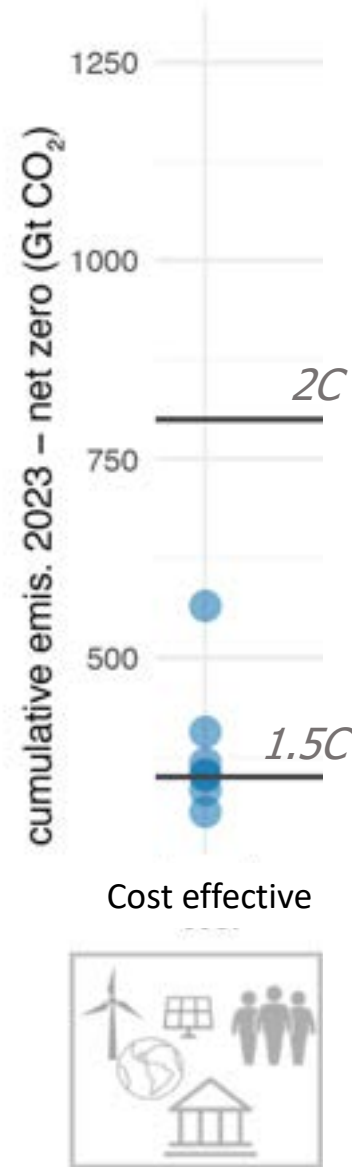
- ⇒ Demand reduction
- ⇒ Electrification
- ⇒ Renewable scale-up



**Multiple models** (MESSAGE, GEMe3, IMAGE, REMIND, WITCH, POLES, AIM)

# Impact of feasibility concerns on limiting the carbon budget (for 1.5°C and 2°C)

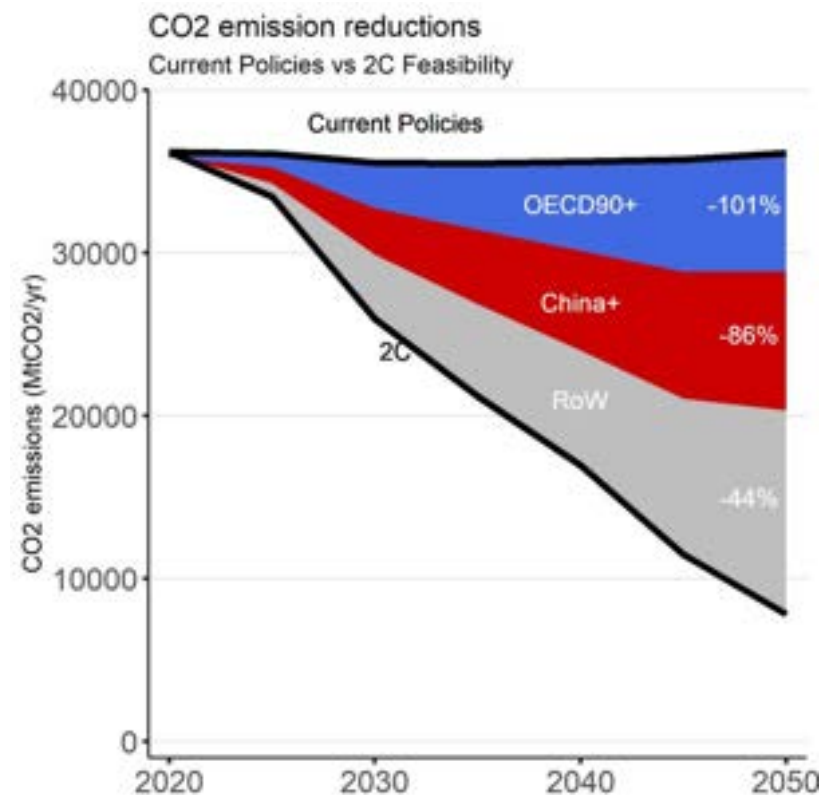
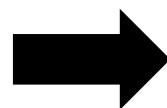
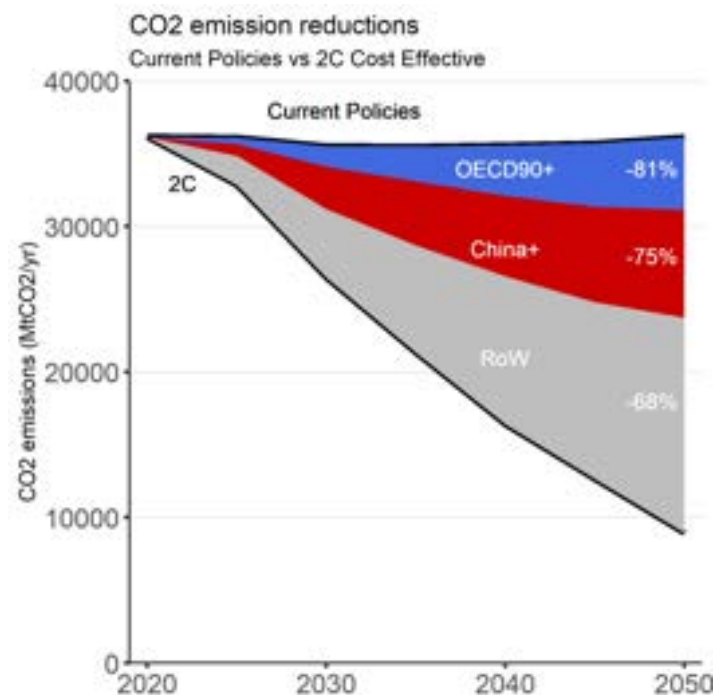
- Cost-effective mitigation potential is large and would in theory permit limiting warming to below 1.5°C (consistent with IPCC)
- Taking into account feasibility concerns reduces the chances to limit warming to 1.5°C considerably
- Enablers (demand and electrification) increases 1.5°C chances (~consistent with well below 2°C)



# Regional implications of **feasibility** concerns



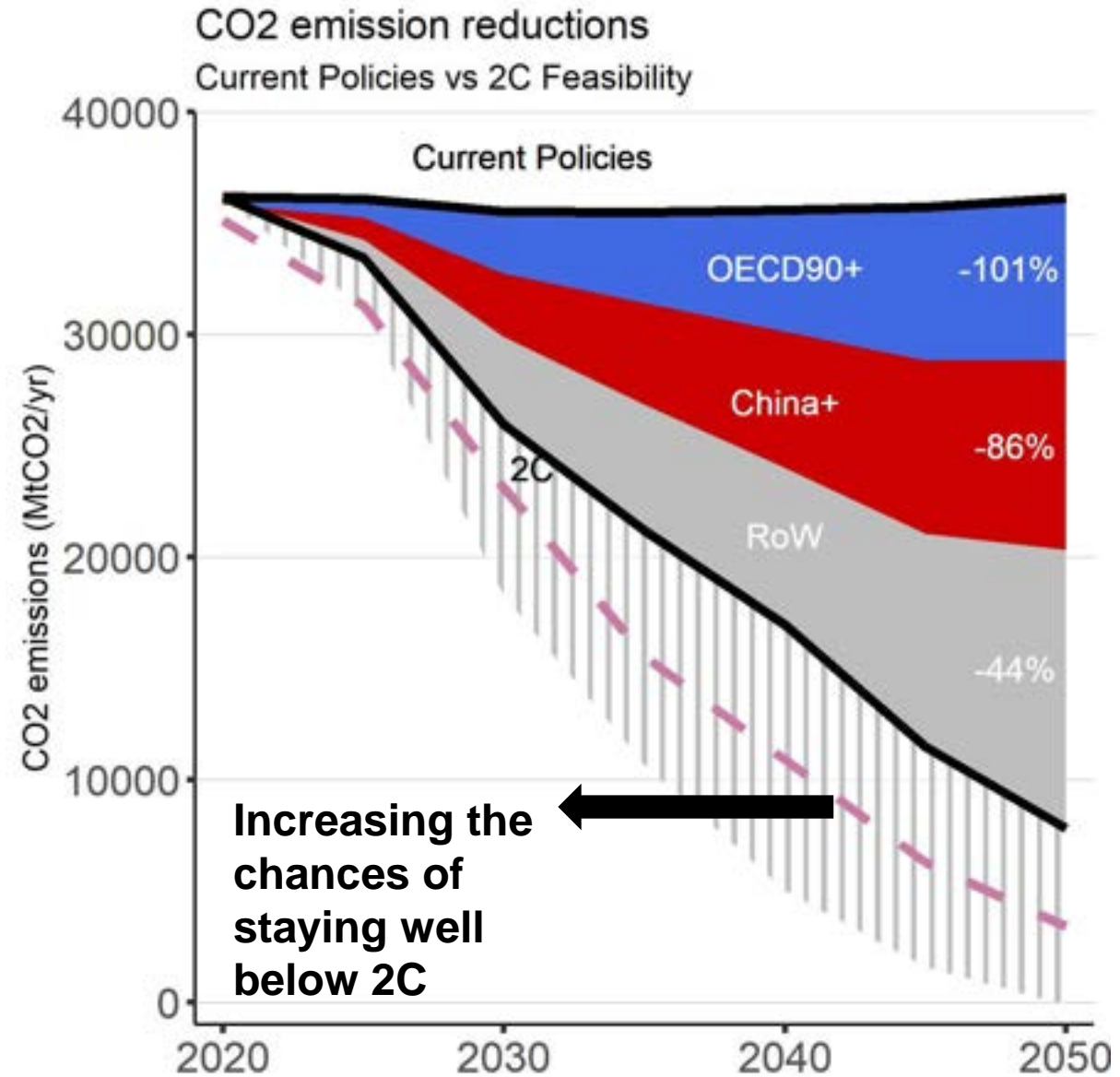
With these constraints there is a regional shift in efforts but reaching more ambitious climate targets becomes more challenging



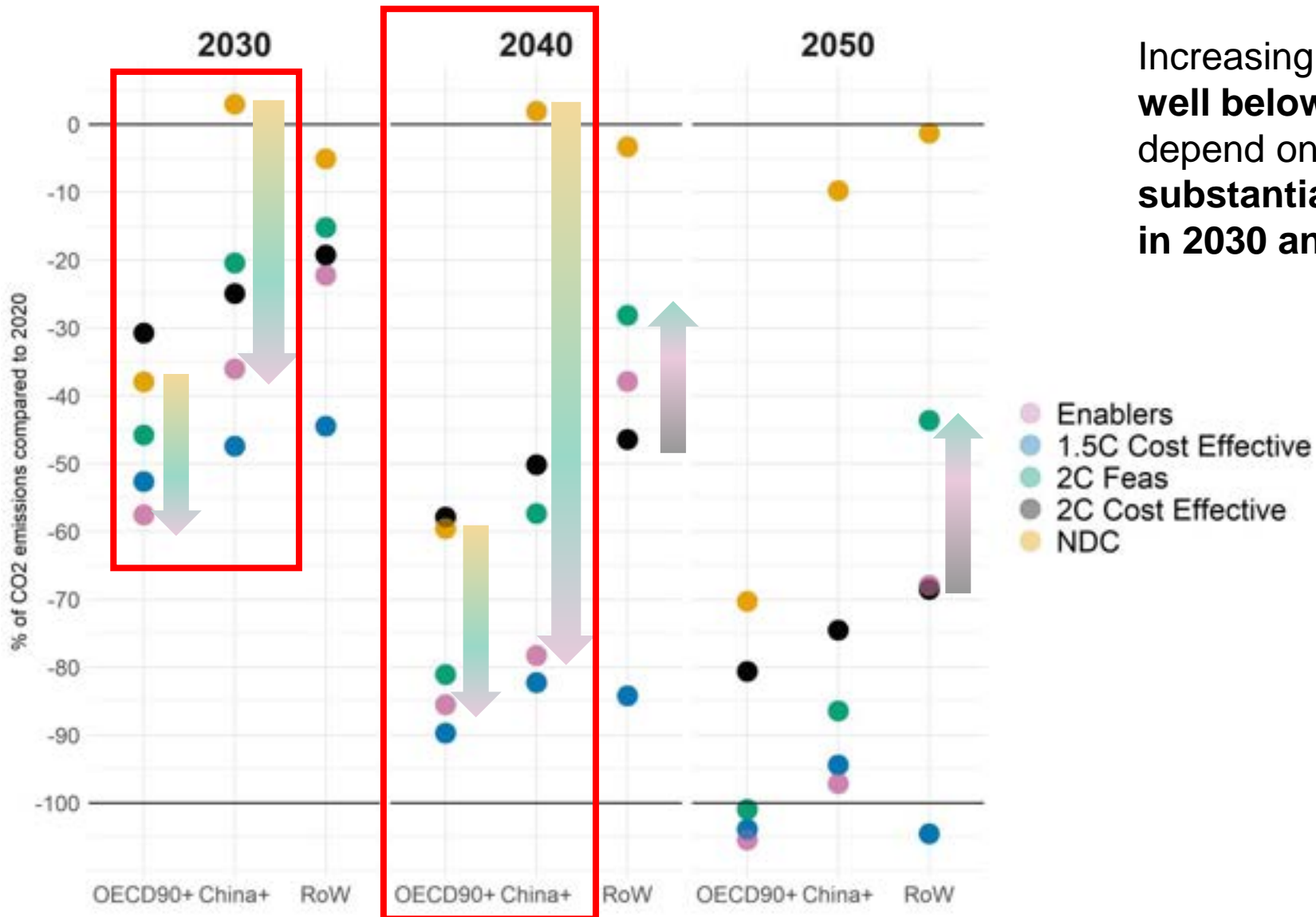
# Enabler scenario

High capacity regions:

- demand side reductions
- electrification
- no constraints on solar and wind upscaling



# Key Policy Implications

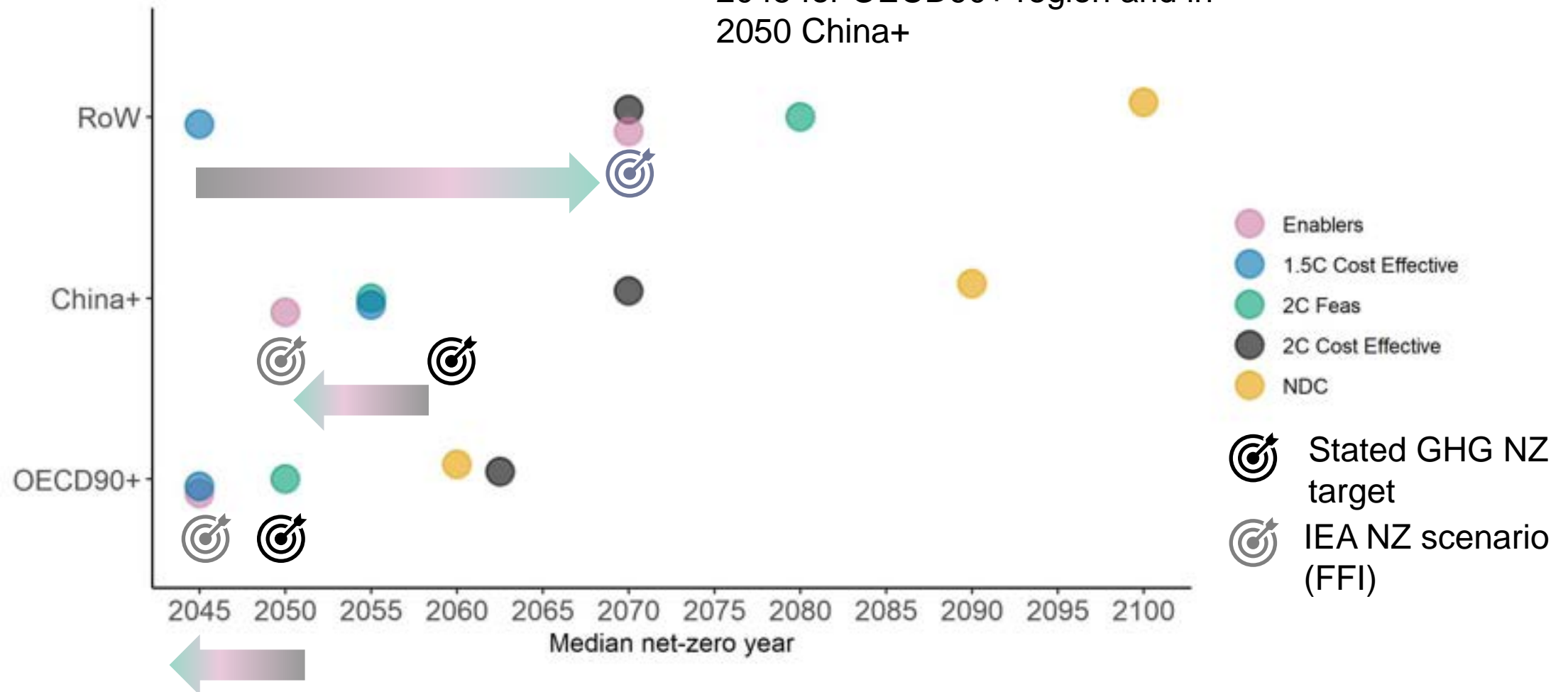


Increasing the chances of **staying well below 2C** will critically depend on whether it is possible to **substantially increase ambition in 2030 and 2040**



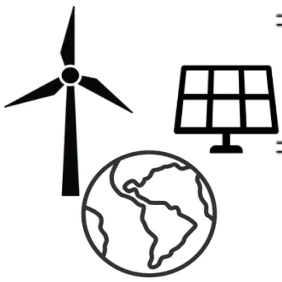
# Key Policy Implications

Increasing the chances of **staying well below 2C** will require reaching CO2 net zero year in 2045 for OECD90+ region and in 2050 China+



# Key take-aways

- **Technological feasibility** is not the most important bottleneck



- ⇒ Near-term priorities: fast scaling up low-carbon power, and electrification, scaling down fossils, to bring down emissions
- ⇒ Up-scaling of more novel solutions (green hydrogen, batteries, direct air capture, carbon storage) required for net-zero



- To increase the chances for staying well below 2C OECD90+ region needs continued efforts to increase its near-term ambition
- A decisive role is played by China+ where increase in near-term ambition could make a major difference



- Emission trajectories with 50% likelihood of staying below 1.6°C at peak (low overshoot, C1) cannot be achieved when accounting for feasibility concerns, even if assuming relatively optimistic enablers; 20 - 40% still feasible



*Thank you very much for your attention!*

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ENGAGE SPM



Feasible Futures

[www.engage\\_climate.org](http://www.engage_climate.org)



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For more information, you can also contact: [engage.secretariat@iiasa.ac.at](mailto:engage.secretariat@iiasa.ac.at)



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PBL Netherlands Environmental  
Assessment Agency



**ELEVATE**  
supporting international climate policy

# Just Transition scenarios

Elina Brutschin

**Beyond the Global Stocktake to create feasible and just transitions**

# 1510

other terms for justice - words and phrases with similar meaning



*Based on Zimm et al. (forthcoming in Nature Climate Change)*

## The conceptual challenge...

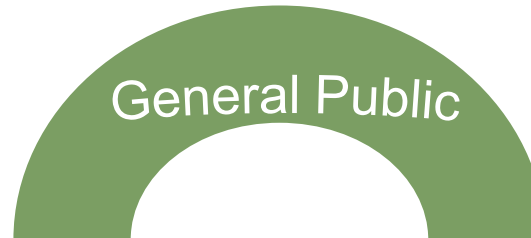
# Many different communities...



*Forms of justice,  
patterns of justice,  
etc.*



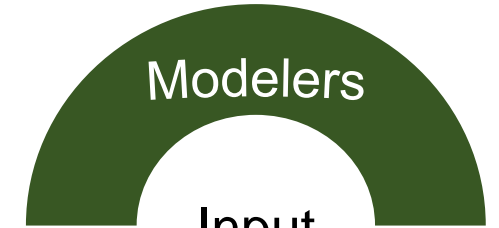
*Sustainable  
Development,  
CBDR, Loss &  
Damages, etc.*



*Fairness*

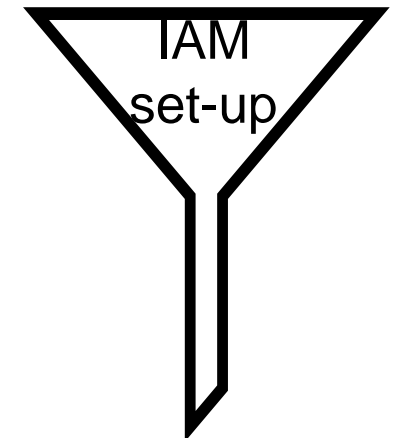
***Is justice considered in  
scenarios?***

**Temperature goals**



**Input**

*Assumptions about  
population growth,  
GDP,  
etc..*

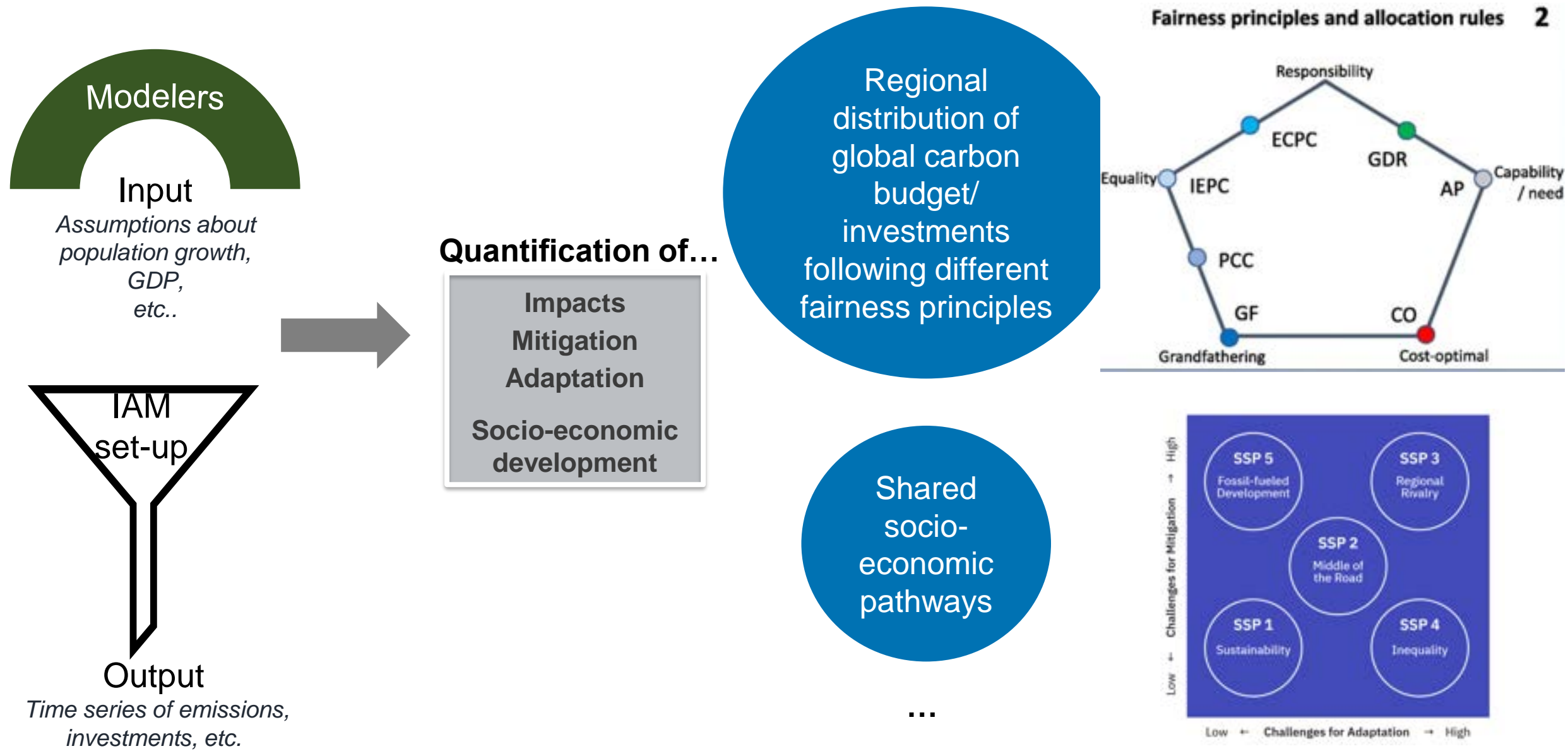


**Output**

*Time series of emissions,  
investments, etc.*

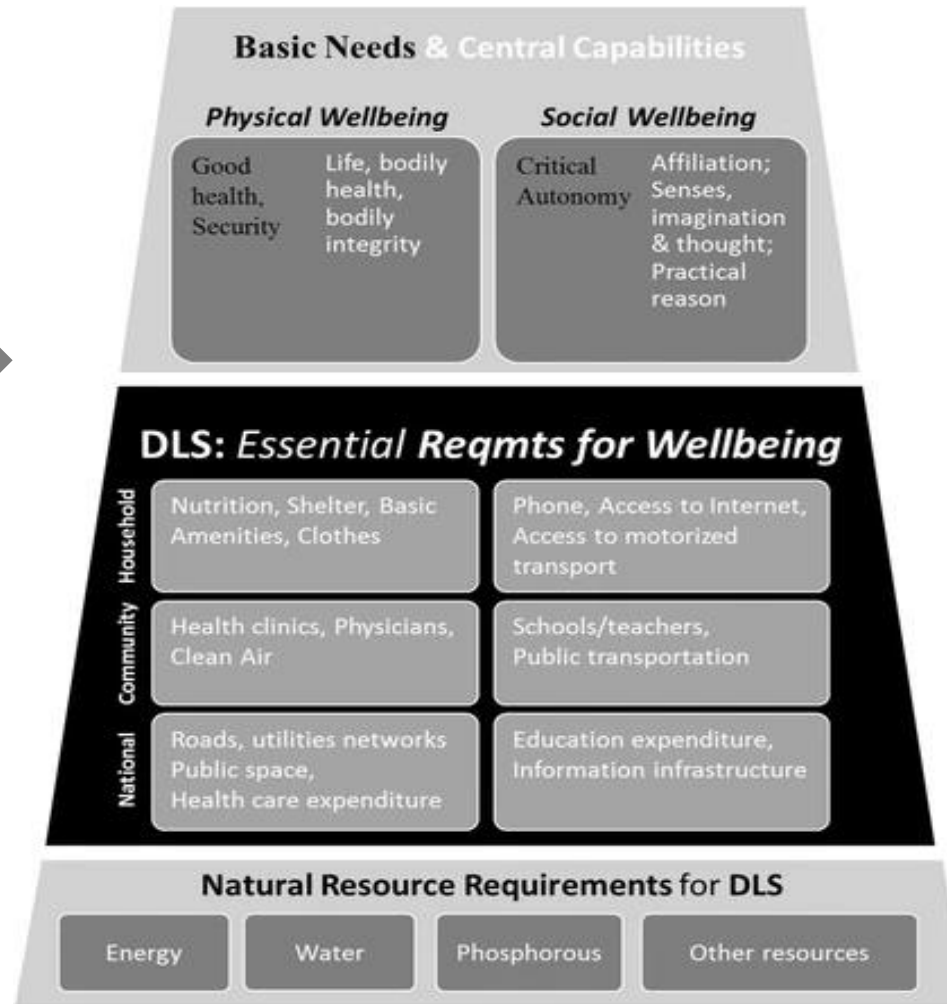
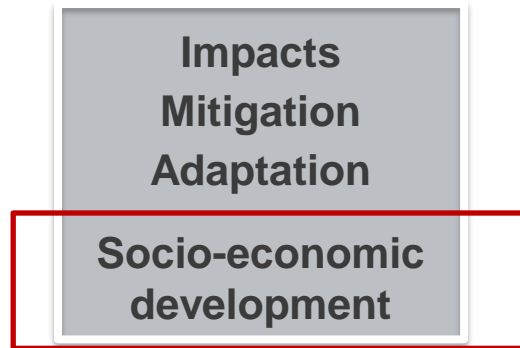


# Justice has always been at the core of IAMs...



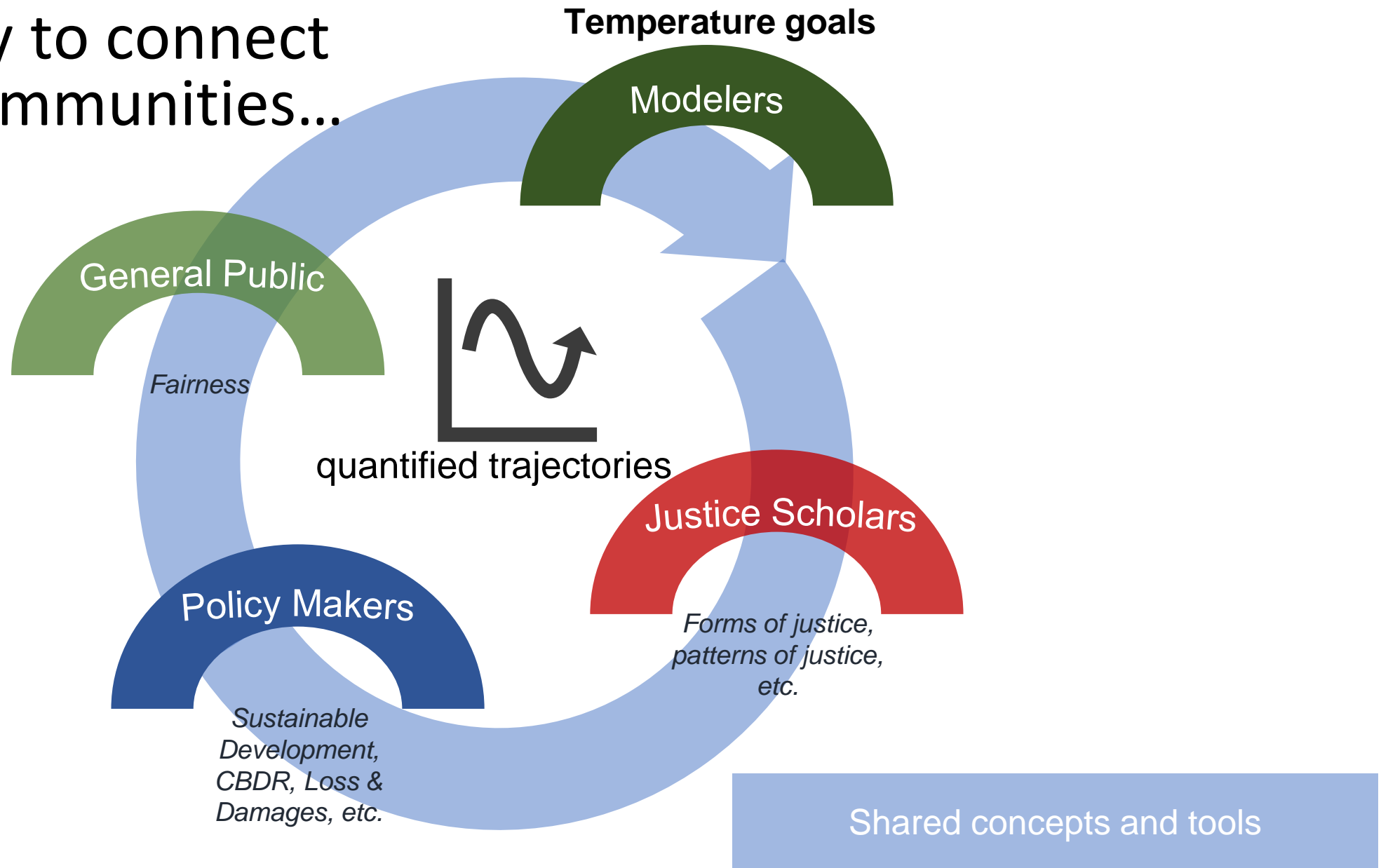
# Focus on provision of services in energy models allows going beyond GDP as a measure of development...

Quantification of...

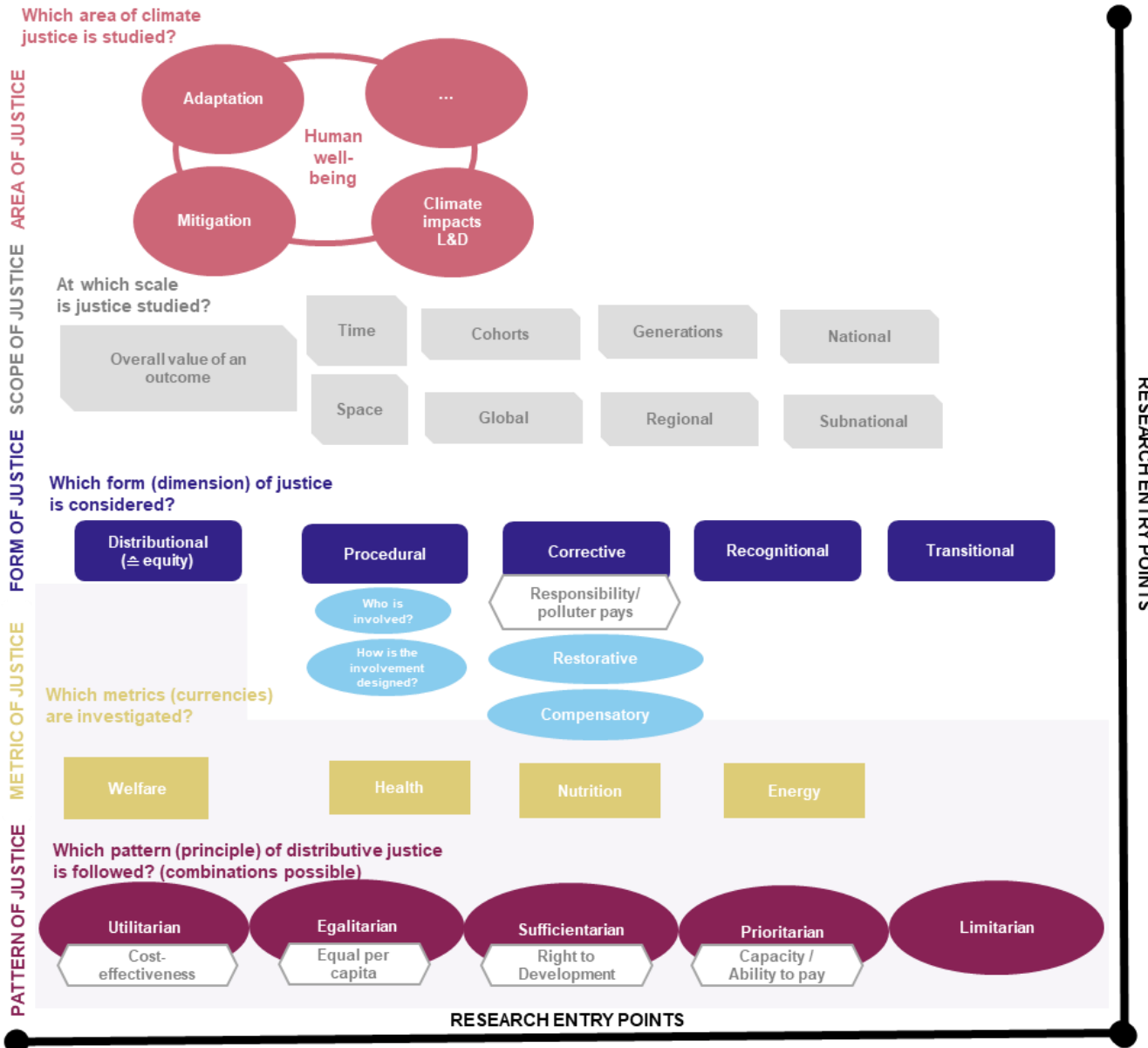


Rao & Min (2018).

# Opportunity to connect different communities...



# Unifying framework



- Which area of climate justice is studied?
- At which scale?
- Which dimension of justice?
- Which metrics are investigated?
- Which patterns are followed?

# Example implementation...

- Which area of climate justice is studied?

*Access to services*

- At which scale?

*IAM regions over time*



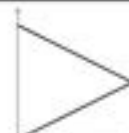
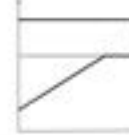
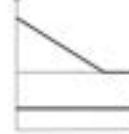
- Which dimension of justice?

*Distributional*

- Which metrics are investigated?

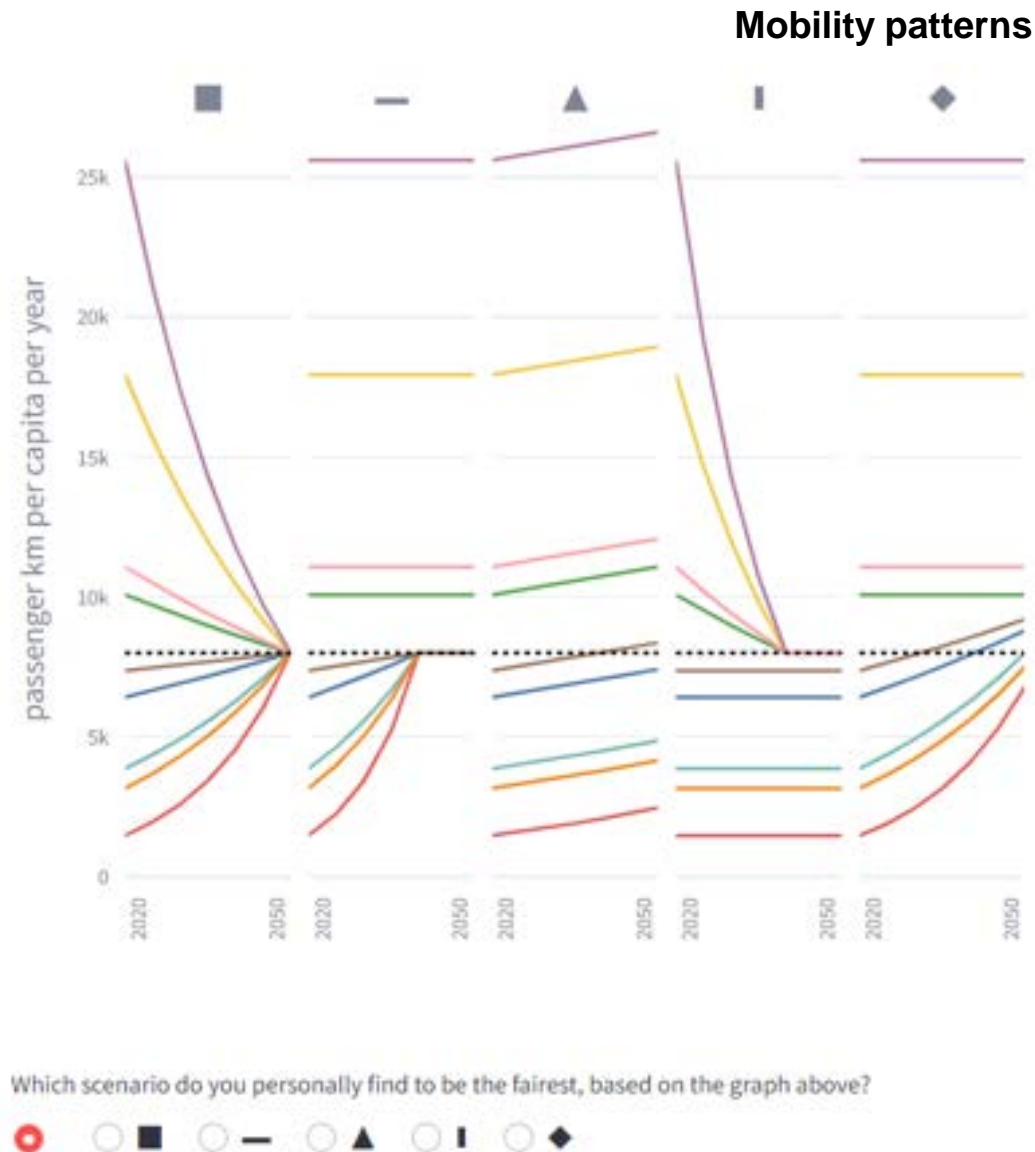
*Consumption levels*

***Which patterns are perceived as fair?***

Justice Pattern	Core idea	Observed IAM trajectory	Examples
Aggregate Utilitarian	Overall consumption increased	All regions grow	
Prioritarian	Those worse off have gained most	Lower regions catch up	
Egalitarian	Everyone has the same	All regions converge to same point	
Sufficientarian	Everyone is above a certain threshold	Lower regions grow to floor	
Limitarian	Everyone is below a certain threshold	Higher regions reduce to ceiling	

*Based on Scheifinger et al. (in preparation)*

# Creating a tool to connect general public with quantified trajectories...



Questions that can be explored using this tool:

- Which patterns are preferred and why?
- Which patterns are missing from the current scenario narratives?
- How does inclusion of new patterns interact with other key mitigation indicators?



Access to the interactive tool:



<https://tinyurl.com/COPIIASA>