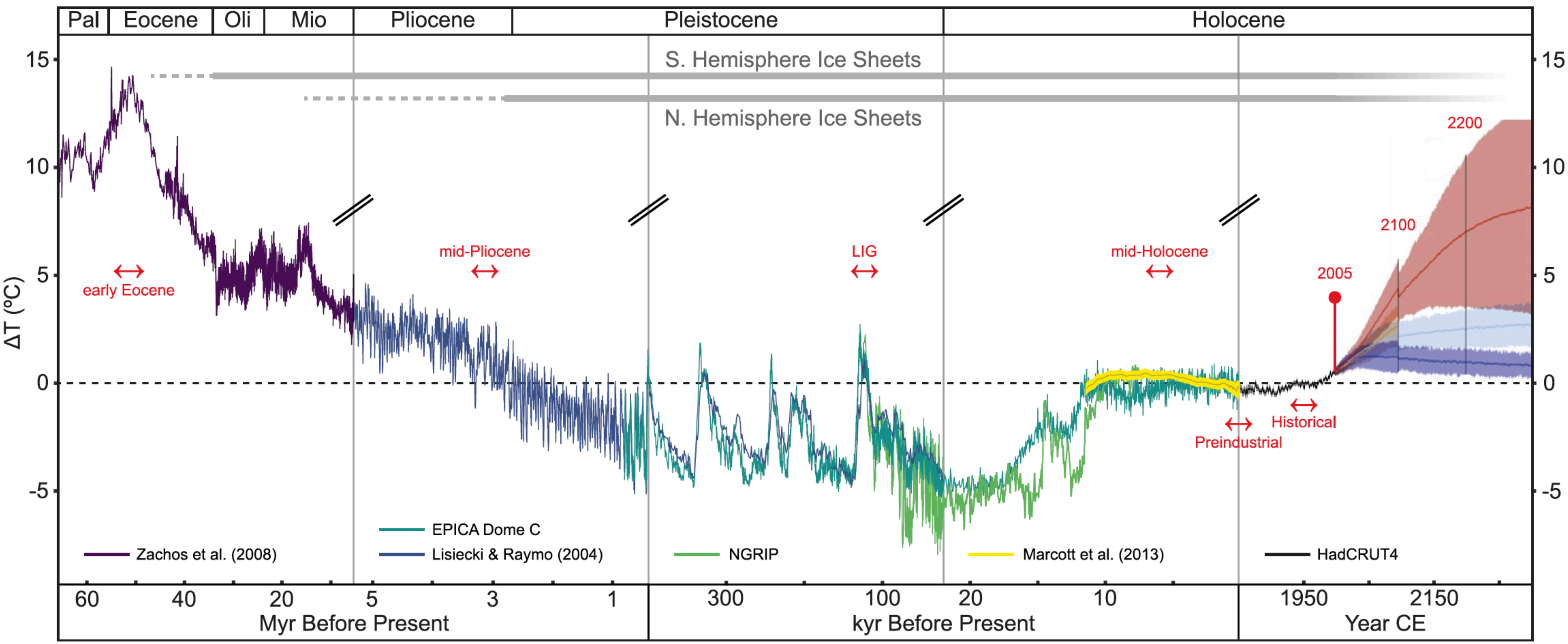
Learning to See and Act in the Era of Climate Breakdown

Fabian Dablander, PhD Candidate
Department of Psychological Methods
University of Amsterdam
29th October, 2021

Part I:
Situating Ourselves



Burke et al. (2018)

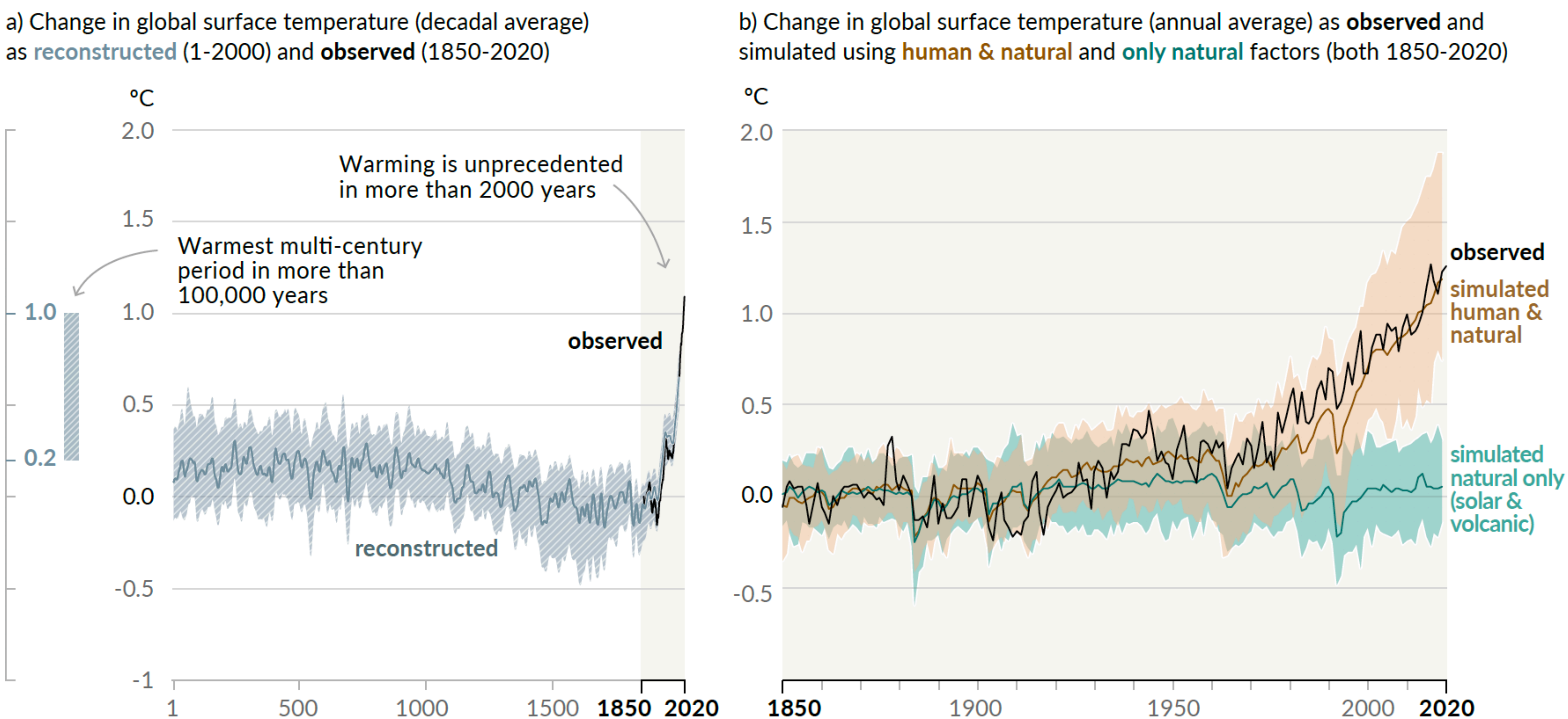
Brannen (2021)

United Nations (2021)

Lenton & Watson (2011)

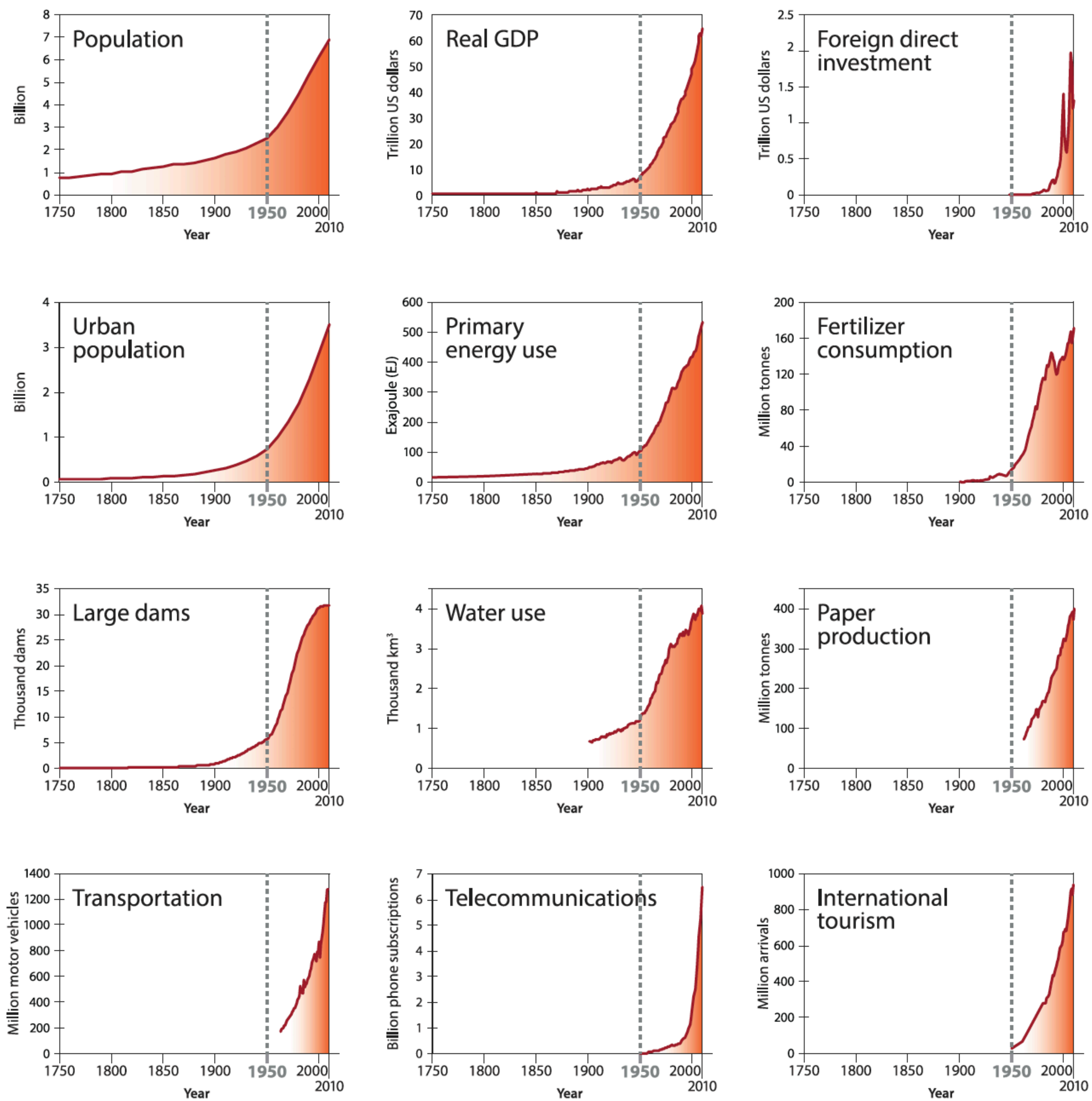
Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years

Changes in global surface temperature relative to 1850-1900



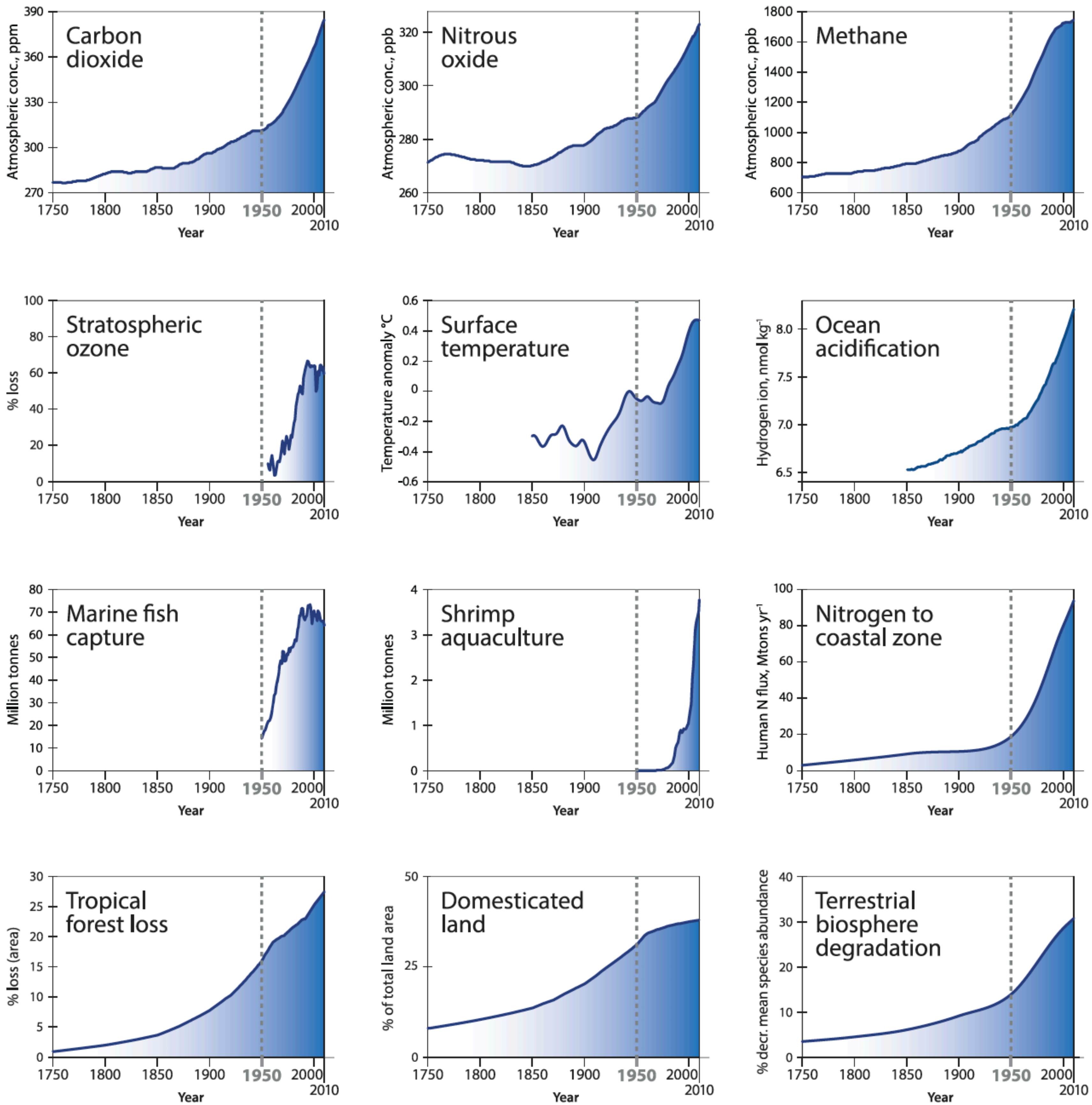
IPCC AR6 WGI SPM

Socio-economic trends



Steffen et al. (2015)

Earth system trends



Steffen et al. (2015)

Rockström et al. (2009a,b); Steffen et al. (2015)

Documentary

Part II:

Climate Impacts Today & Tomorrow

Seville, Spain
August 2021: A billboard shows 47C (117F)

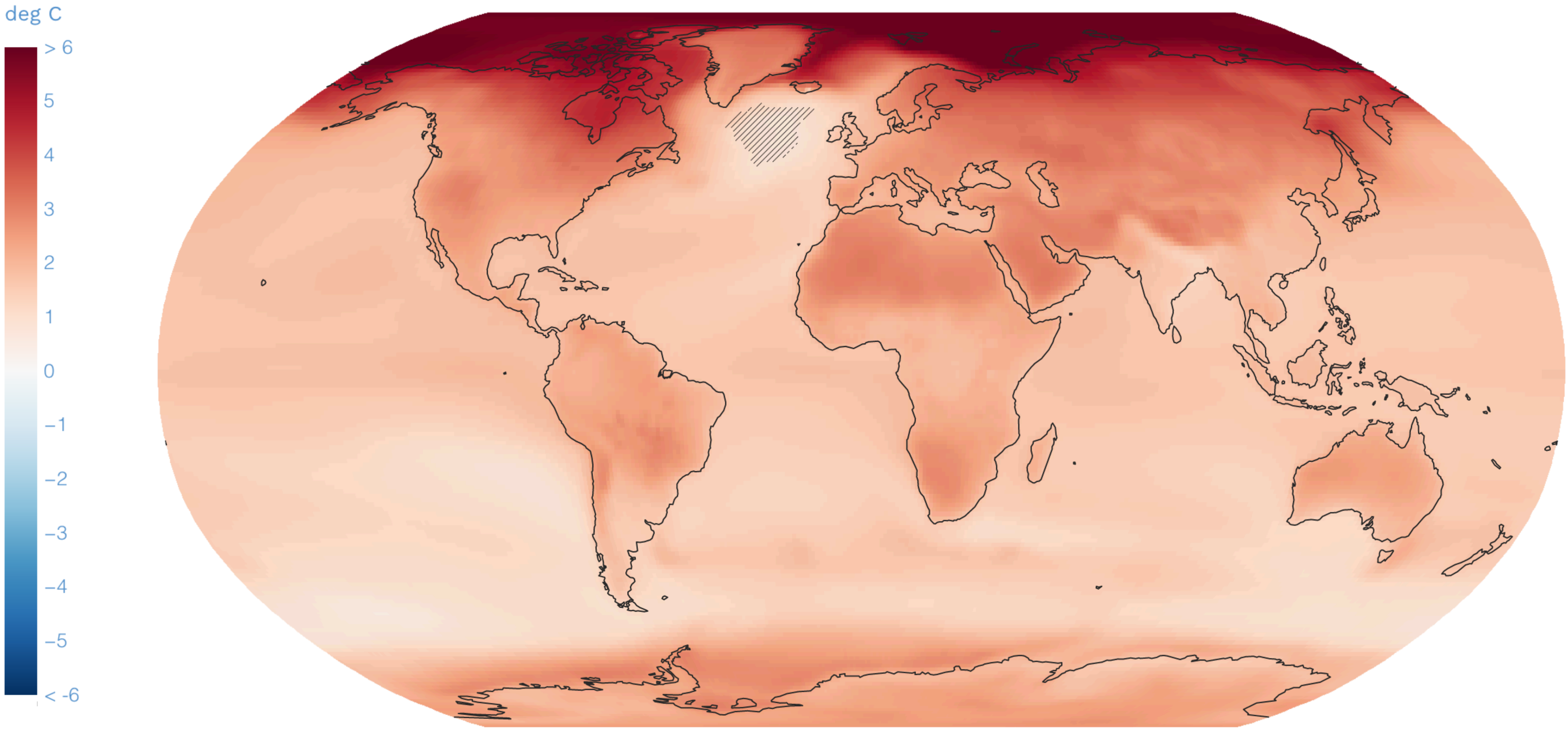
Extreme Heat


Badghis, Afghanistan
September 2021: A farmer holds a handful of failed wheat from his crop

Crop Failures

Source

Heat



CMIP6 - Mean temperature (T) Change deg C - Warming 2°C SSP2-4.5 (rel. to 1850-1900) - Annual (34 models)

IPCC AR6 WGI Interactive Atlas

Article | Open Access | Published: 03 July 2020

Increasing trends in regional heatwaves

S. E. Perkins-Kirkpatrick & S. C. Lewis

Nature Communications 11, Article number: 3357 (2020) | Cite this article

Abstract

Heatwaves have increased in intensity, frequency and duration, with these trends projected to worsen under enhanced global warming. Understandi
critical implications for the biophysical and human syste
comprehensive assessment of regional observed change
metrics employed, underpinning datasets, and time peri
Berkeley Earth temperature dataset and key heatwave me
regional and global observed heatwave trends. In almost
demonstrates the most rapid and significant change. A m
significant increases almost everywhere since the 1950s, r
Trends in heatwave frequency, duration and cumulative h
1950s, and due to the high influence of variability we reco
assessed over multiple decades. Our results provide com
heatwave trends, on spatial and temporal scales necessar

Article | Published: 31 May 2021

The burden of heat-related mortality attributable to recent human-induced climate change

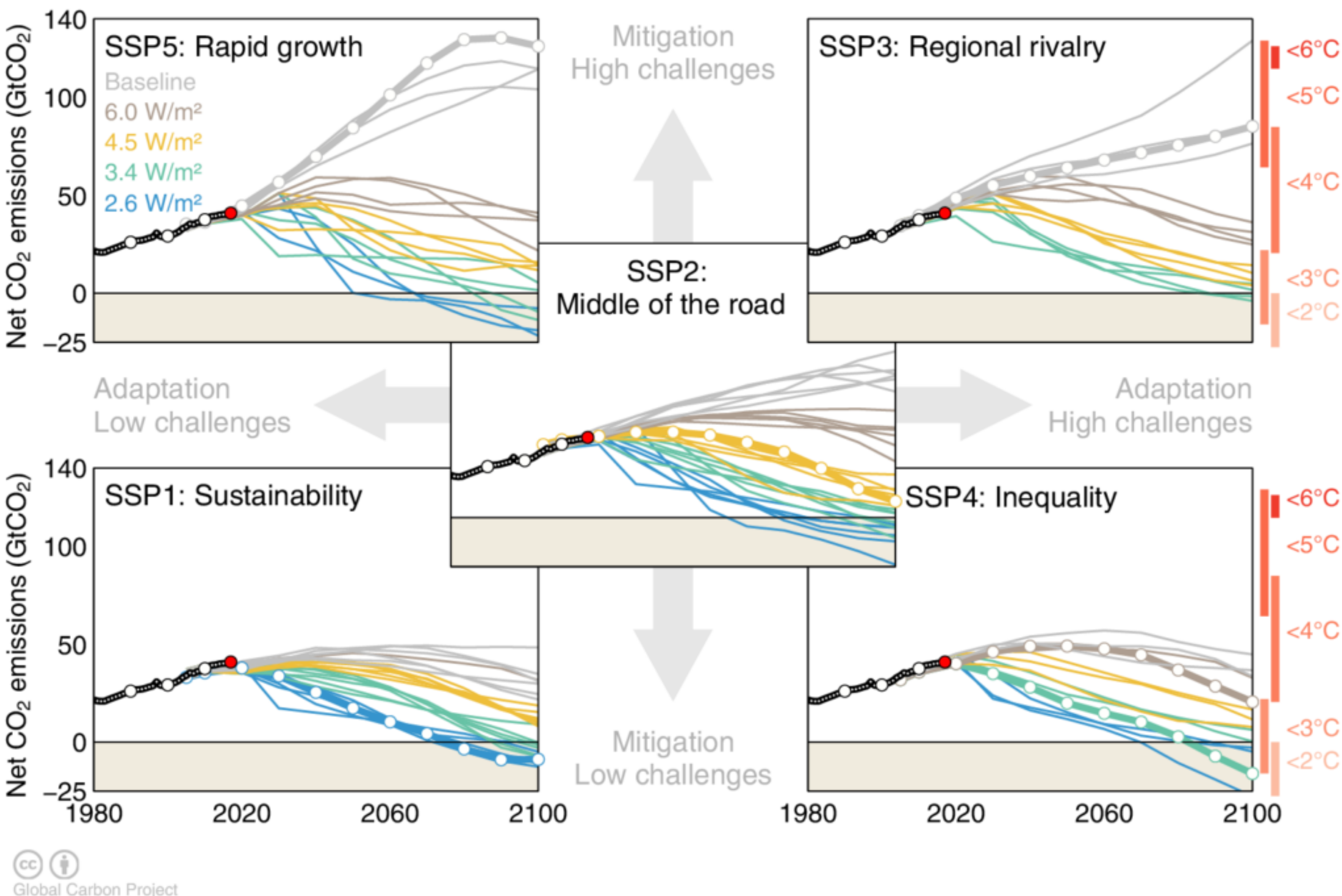
A. M. Vicedo-Cabrera, N. Scovronick, [...] A. Gasparrini

Nature Climate Change 11, 492–500 (2021) | Cite this article

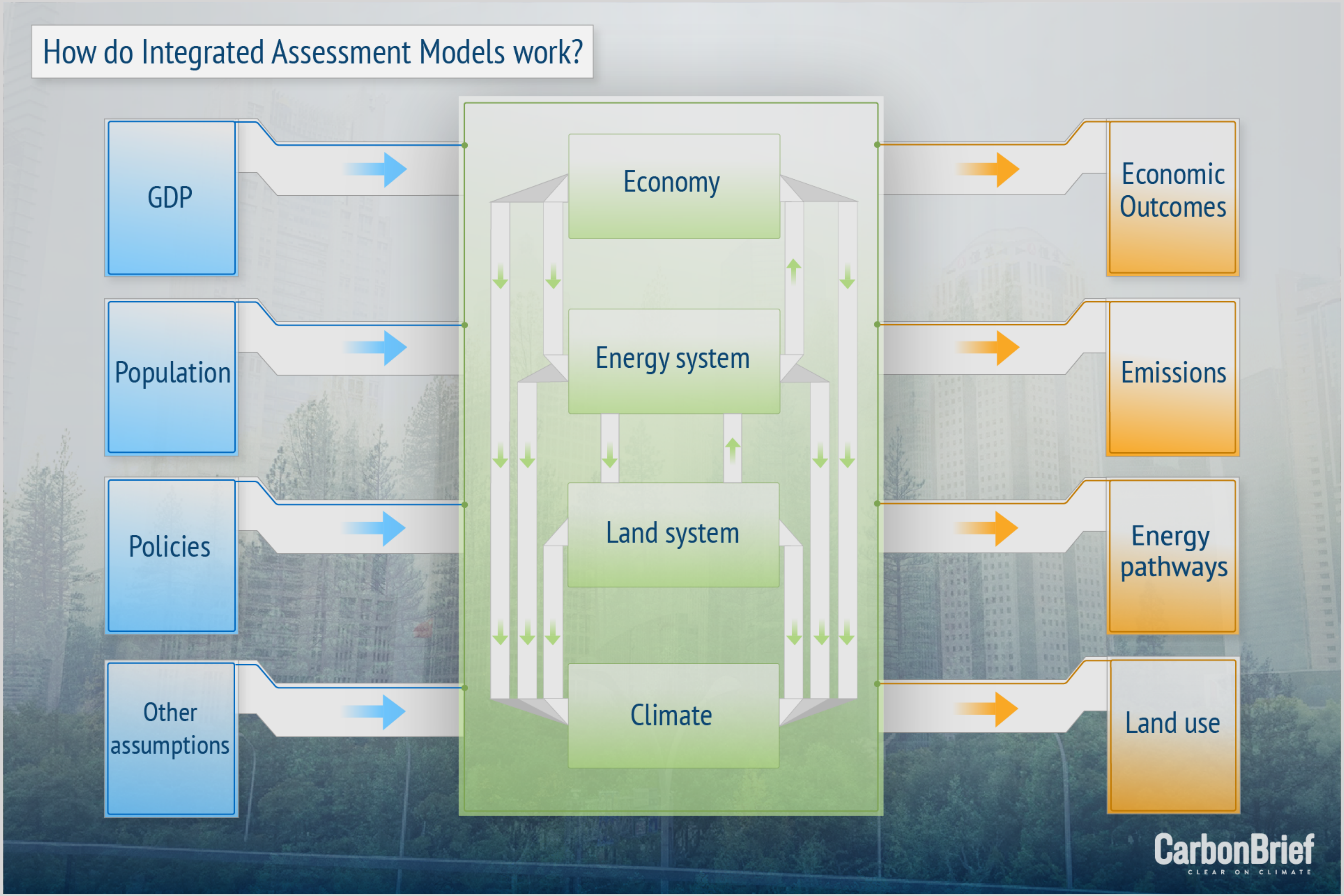
Abstract

Climate change affects human health; however, there have been no large-scale, systematic efforts to quantify the heat-related human health impacts that have already occurred due to climate change. Here, we use empirical data from 732 locations in 43 countries to estimate the mortality burdens associated with the additional heat exposure that has resulted from recent human-induced warming, during the period 1991–2018. Across all study countries, we find that 37.0% (range 20.5–76.3%) of warm-season heat-related deaths can be attributed to anthropogenic climate change and that increased mortality is evident on every continent. Burdens varied geographically but were of the order of dozens to hundreds of deaths per year in many locations. Our findings support the urgent need for more ambitious mitigation and adaptation strategies to minimize the public health impacts of climate change.

Reporting here and here

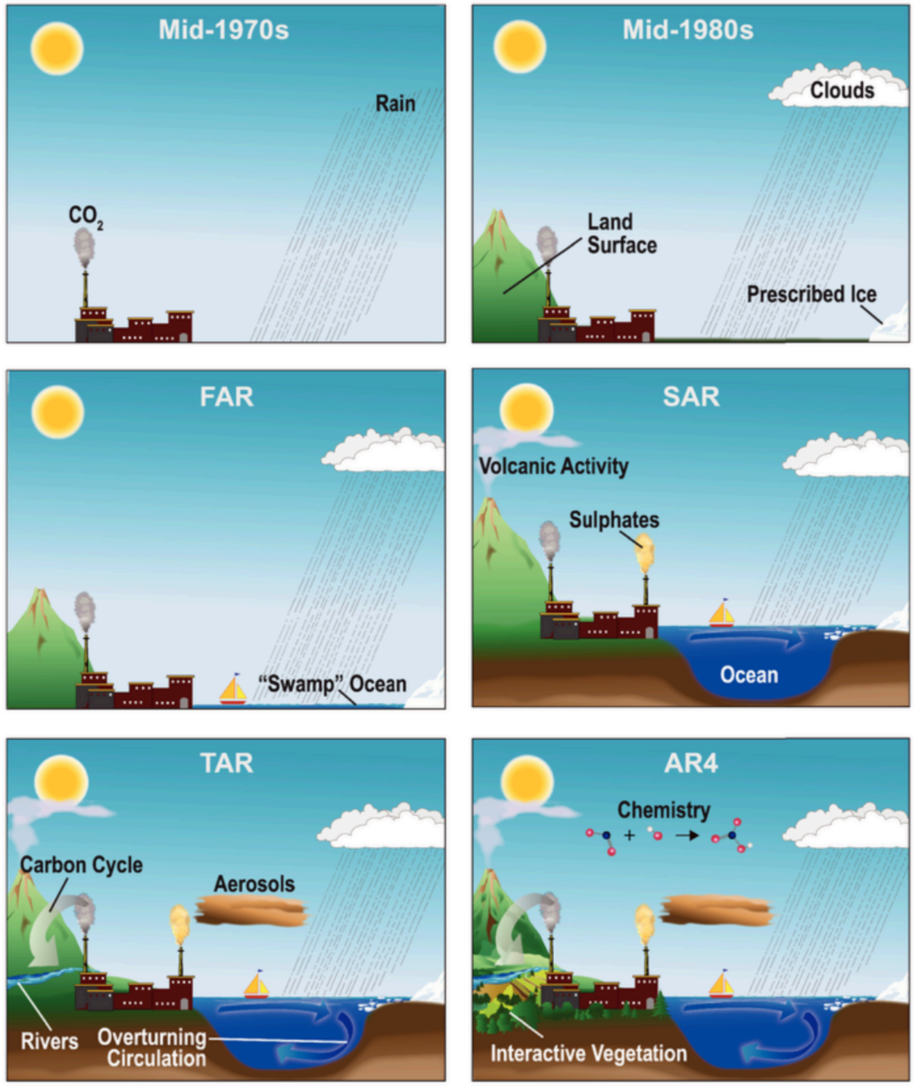


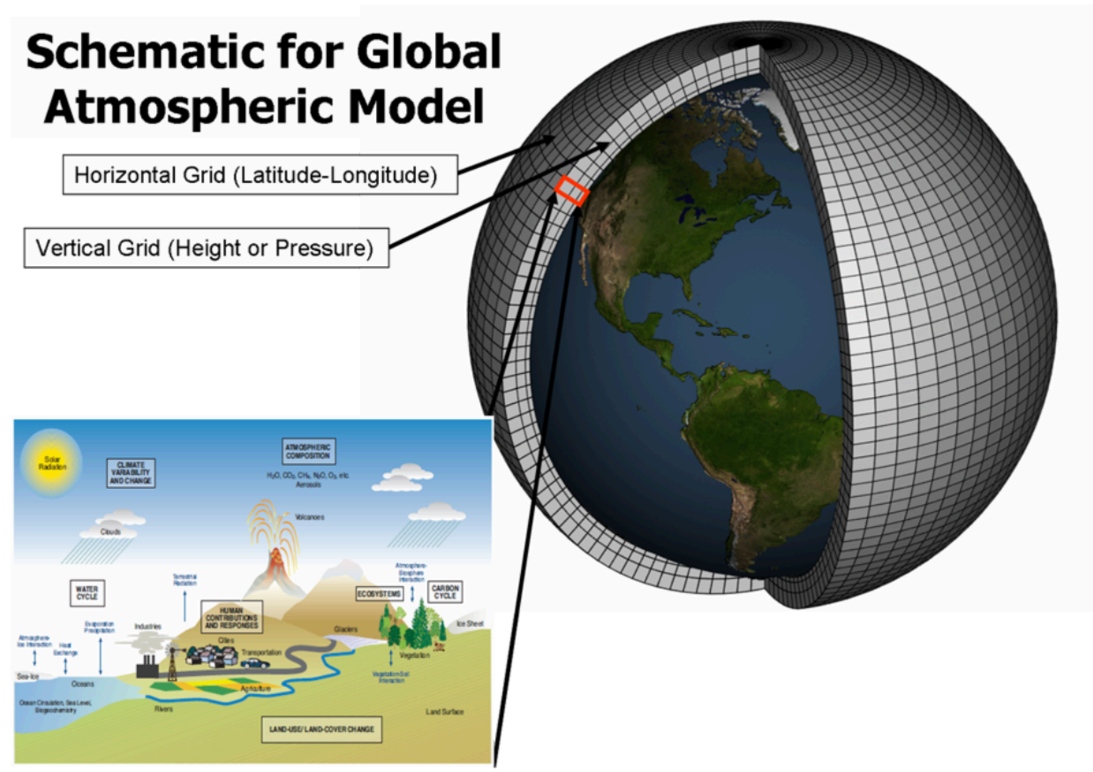
Hausfather (2018); Evans & Hausfather (2018)



Hausfather (2018); Evans & Hausfather (2018); Farmer et al. (2015); Creutzig et al. (2017); Read et al. (2021); Hickel et al. (2021)

The World in Global Climate Models





PERSPECTIVE

The scientific challenge of understanding and estimating climate change

Tim Palmer and Bjorn Stevens
+ See all authors and affiliations

PNAS December 3, 2019 116 (49) 24390-24395; first published December 2, 2019; https://doi.org/10.1073/pnas.1906691116

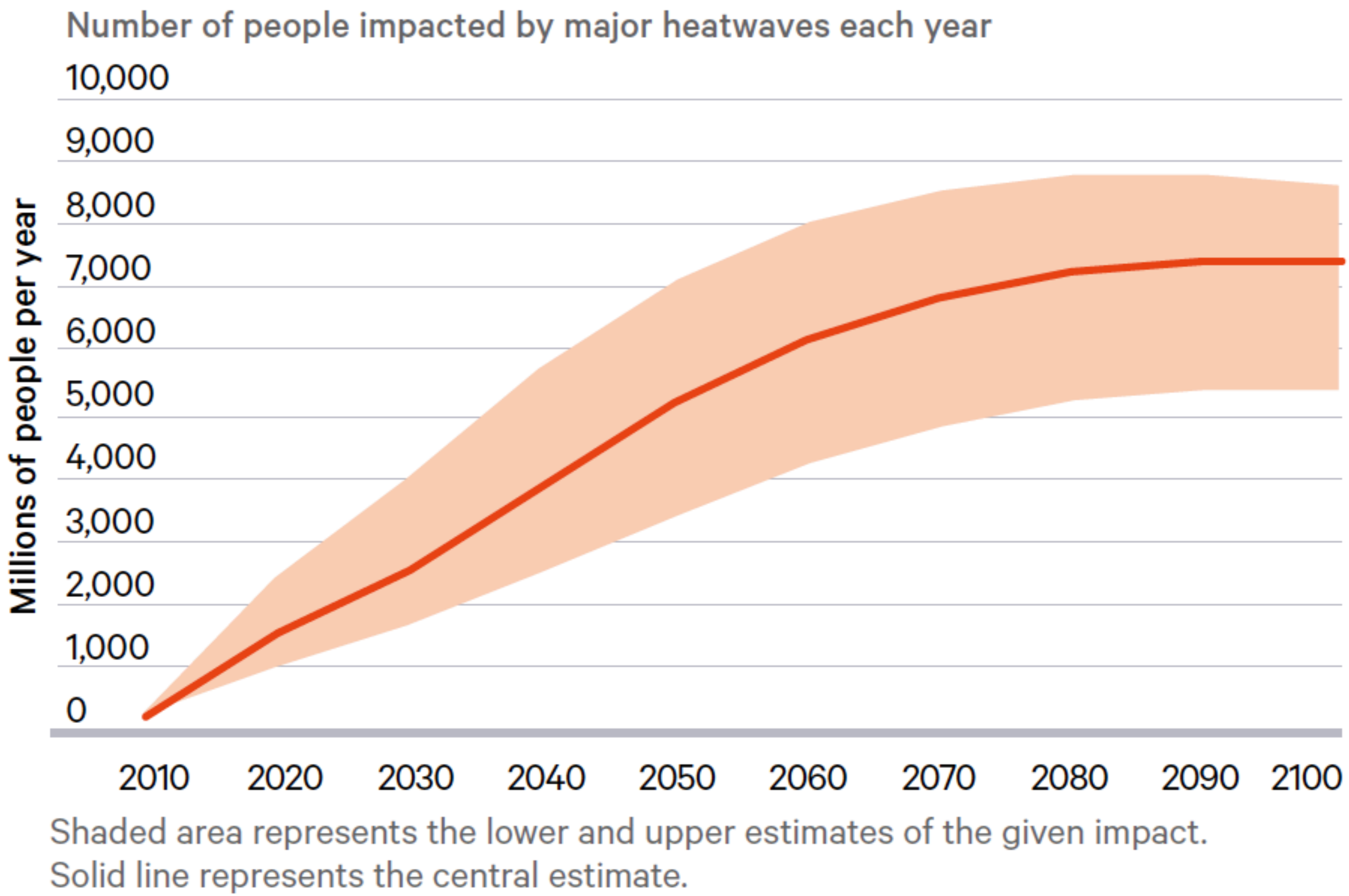
GLOBAL WARMING

Climate panel confronts implausibly hot models

Major IPCC report likely to curb near-term projections with measured warming trend

Voosen (2021)
Palmer & Stevens (2019)
Philip Stier Talk
McSweeney & Hausfather (2018)

Extreme Heat - Current Trajectory



Quiggin et al. (2021)

Arnell et al. (2019)

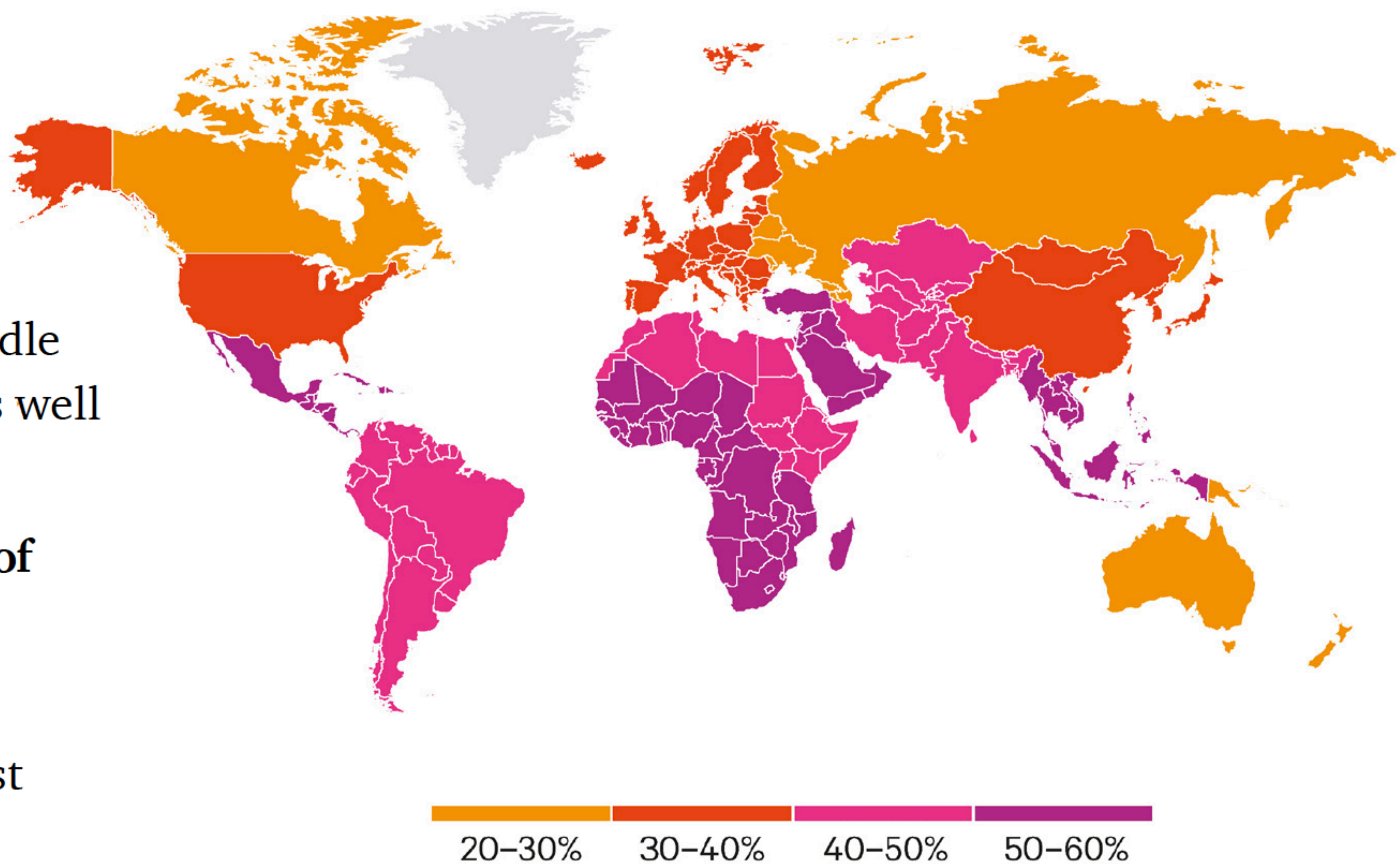
Extreme Heat - Current Trajectory

Regional impacts, 2040: proportion of population experiencing major heatwaves each year
(Major heatwaves are comparable to the most extreme historic heatwaves)

No region will be spared.
By 2040, major heatwaves will be experienced each year by **50 per cent or more** of the populations in West, Central, East and Southern Africa, the Middle East, South and Southeast Asia, as well as Central America and Brazil.

By 2050, **more than 70 per cent of people in every region** will experience heatwaves each year.

Urban areas will suffer the greatest challenges of workability and survivability.



Quiggin et al. (2021)

Arnell et al. (2019)

SCIENCE ADVANCES | RESEARCH ARTICLE

CLIMATOLOGY

The emergence of heat and humidity too severe for human tolerance

Colin Raymond[1,2]*, Tom Matthews[3], Radley M. Horton[2,4]

Humans' ability to efficiently shed heat has enabled us to range over every continent, but a wet-bulb temperature (TW) of 35°C marks our upper physiological limit, and much lower values have serious health and productivity impacts. Climate models project the first 35°C TW occurrences by the mid-21st century. However, a comprehensive evaluation of weather station data shows that some coastal subtropical locations have already reported a TW of 35°C and that extreme humid heat overall has more than doubled in frequency since 1979. Recent exceedances of 35°C in global maximum sea surface temperature provide further support for the validity of these dangerously high TW values. We find the most extreme humid heat is highly localized in both space and time and is correspondingly substantially underestimated in reanalysis products. Our findings thus underscore the serious challenge posed by humid heat that is more intense than previously reported and increasingly severe.

nature geoscience

ARTICLES

https://doi.org/10.1038/s41561-021-00695-3

Check for updates

Projections of tropical heat stress constrained by atmospheric dynamics

Yi Zhang[1]✉, Isaac Held[1] and Stephan Fueglistaler[1,2]

Extreme heat under global warming is a concerning issue for the growing tropical population. However, model projections of extreme temperatures, a widely used metric for extreme heat, are uncertain on regional scales. In addition, humidity needs to be taken into account to estimate the health impact of extreme heat. Here we show that an integrated temperature–humidity metric for the health impact of heat, namely, the extreme wet-bulb temperature (TW), is controlled by established atmospheric dynamics and thus can be robustly projected on regional scales. For each 1 °C of tropical mean warming, global climate models project extreme TW (the annual maximum of daily mean or 3-hourly values) to increase roughly uniformly between 20° S and 20° N latitude by about 1 °C. This projection is consistent with theoretical expectation based on tropical atmospheric dynamics, and observations over the past 40 years, which gives confidence to the model projection. For a 1.5 °C warmer world, the probable (66% confidence interval) increase of regional extreme TW is projected to be 1.33–1.49 °C, whereas the uncertainty of projected extreme temperatures is 3.7 times as large. These results suggest that limiting global warming to 1.5 °C will prevent most of the tropics from reaching a TW of 35 °C, the limit of human adaptation.

Reporting here and here

Canadian inferno: northern heat exceeds worst-case climate models

The Guardian

Source

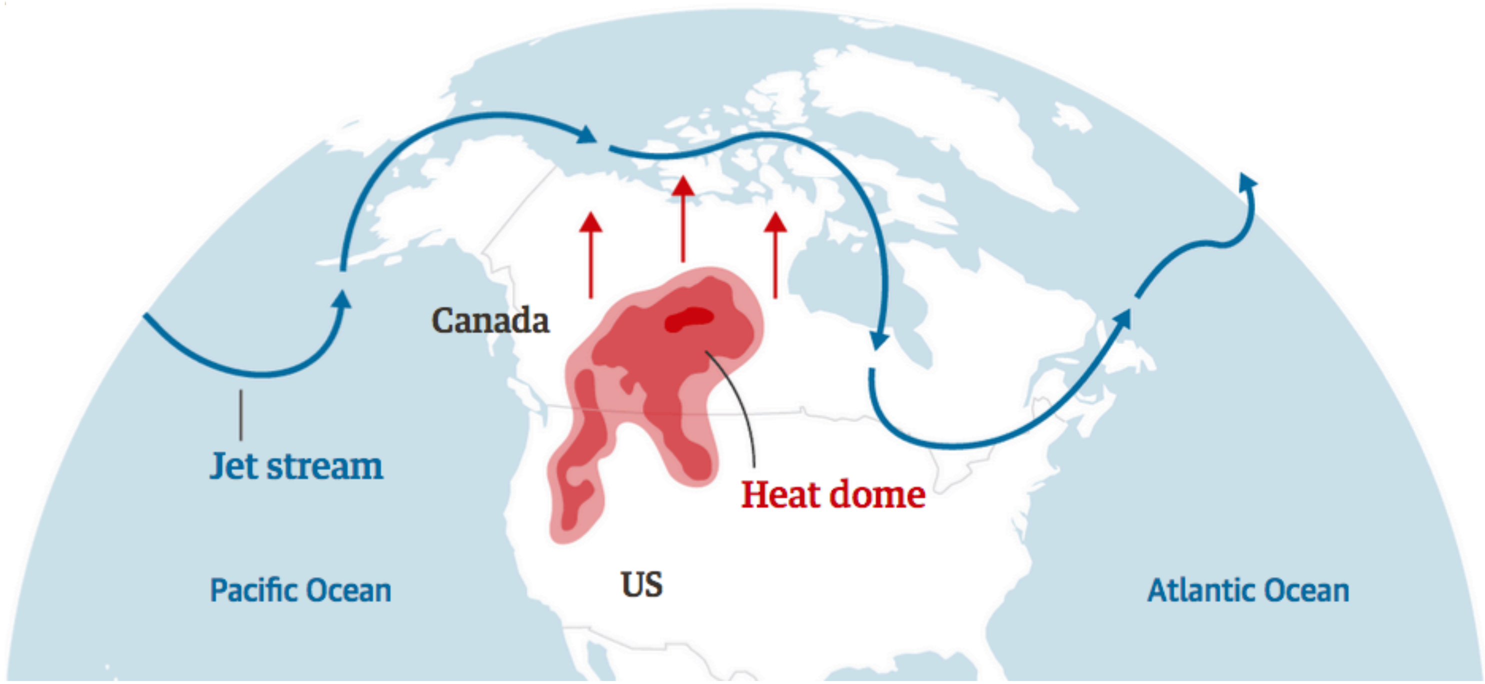
Mann Podcast

Scientists fear heat domes in North America and Siberia indicate a new dimension to the global crisis

Jonathan Watts

@jonathanwatts

Fri 2 Jul 2021 16.28 BST



"[T]here is something else going on with this heatwave, and indeed, with many of the very persistent weather extremes we've seen in recent years in the US, Europe, Asia and elsewhere, where the models aren't quite capturing the impact of climate change."

\- Michael Mann

"The recent extreme weather anomalies were not represented in global computer models that are used to project how the world might change with more emissions."

\- Johan Rockström

Contents lists available at SciVerse ScienceDirect

Global Environmental Change

journal homepage: www.elsevier.com/locate/gloenvcha

Climate change prediction: Erring on the side of least drama?

Keynyn Brysse[a,*], Naomi Oreskes[b], Jessica O'Reilly[c], Michael Oppenheimer[d]

[a] Program in Science, Technology and Society, Office of Interdisciplinary Studies, University of Alberta, Canada
[b] History and Science Studies, University of California, San Diego, United States
[c] Department of Sociology, College of St. Benedict/St. John's University, United States
[d] Department of Geosciences and Woodrow Wilson School of Public and International Affairs, Princeton University, United States

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Scientific norms
Scientific assessment
Erring on the side of least drama

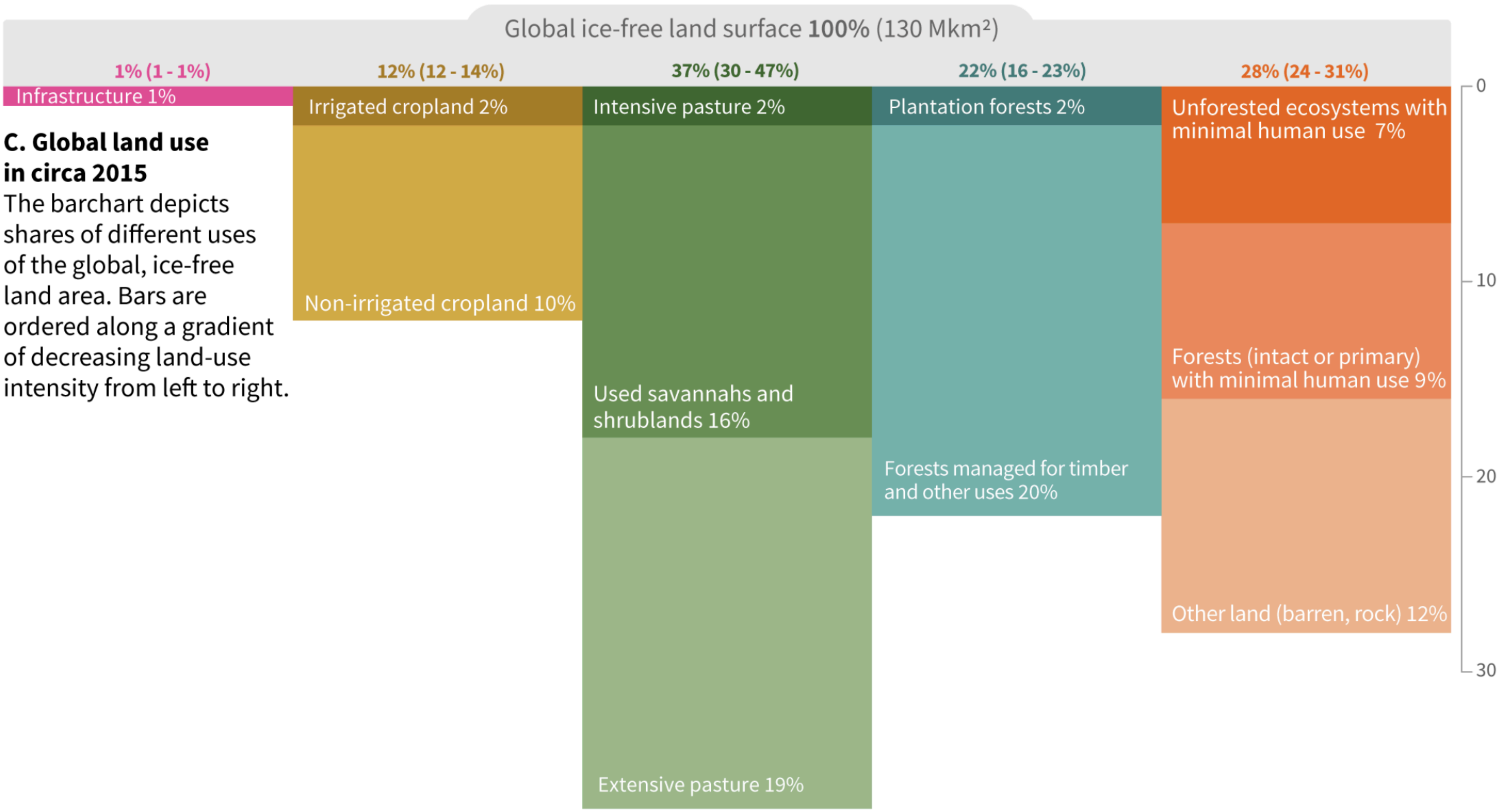
ABSTRACT

Over the past two decades, skeptics of the reality and significance of anthropogenic climate change have frequently accused climate scientists of "alarmism": of over-interpreting or overreacting to evidence of human impacts on the climate system. However, the available evidence suggests that scientists have in fact been conservative in their projections of the impacts of climate change. In particular, we discuss recent studies showing that at least some of the key attributes of global warming from increased atmospheric greenhouse gases have been under-predicted, particularly in IPCC assessments of the physical science, by Working Group I. We also note the less frequent manifestation of over-prediction of key characteristics of climate in such assessments. We suggest, therefore, that scientists are biased not toward alarmism but rather the reverse: toward cautious estimates, where we define caution as erring on the side of less rather than more alarming predictions. We call this tendency "erring on the side of least drama (ESLD)." We explore some cases of ESLD at work, including predictions of Arctic ozone depletion and the possible disintegration of the West Antarctic ice sheet, and suggest some possible causes of this directional bias, including adherence to the scientific norms of restraint, objectivity, skepticism, rationality, dispassion, and moderation. We conclude with suggestions for further work to identify and explore ESLD.

Brysse et al. (2012); Oppenheimer (2021)

Oreskes Podcast

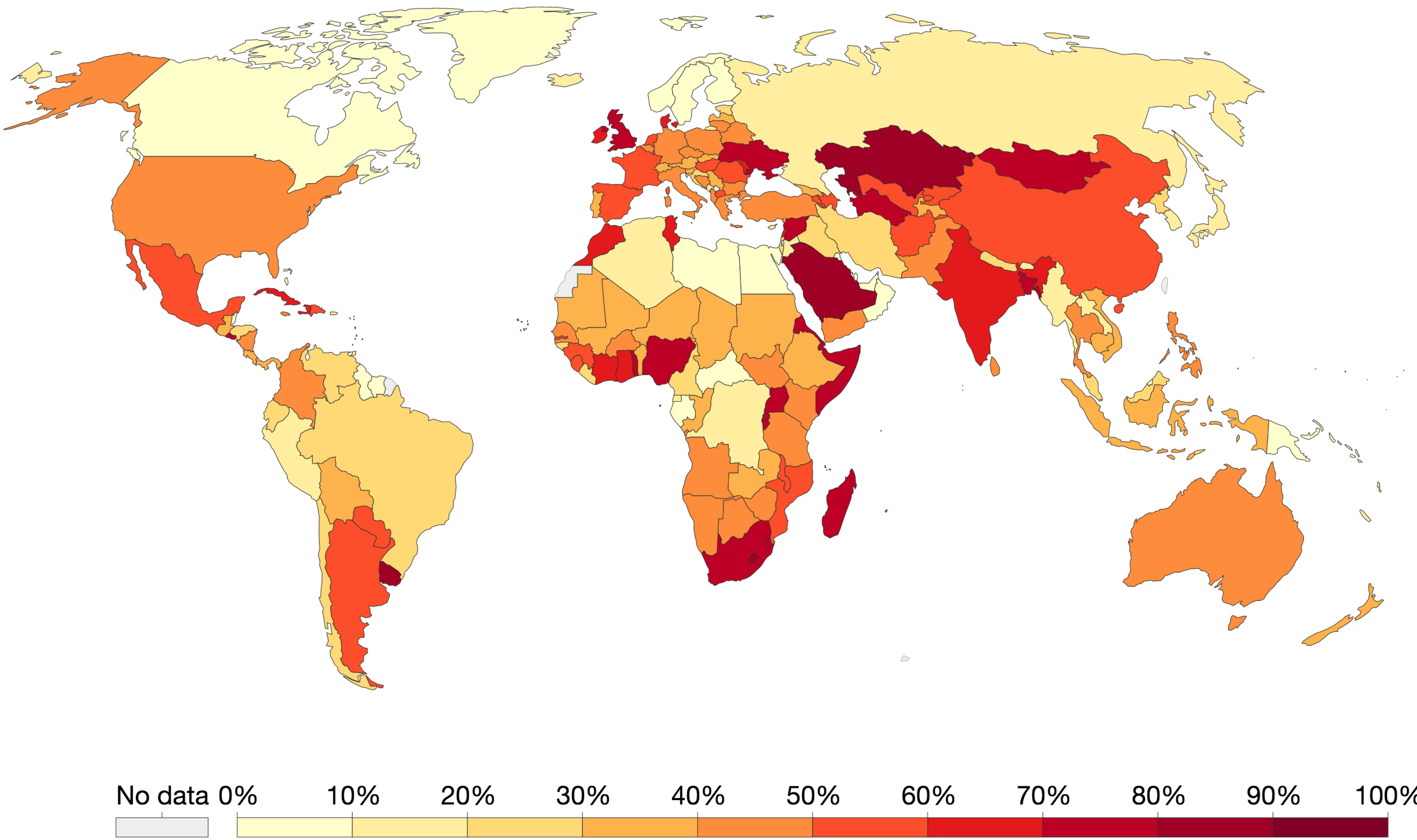
Land Use



IPCC SRCCL SPM

Share of land area used for agriculture, 2018

The share of land area used for agriculture, measured as a percentage of total land area. Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures.



Source: Food and Agriculture Organization of the United Nations (via World Bank)
OurWorldInData.org/yields-and-land-use-in-agriculture/ • CC BY

Source

Severe drought devastates Washington state's wheat crop

abcNEWS

A drought in eastern Washington state that is the worst since 1977 has devastated what is normally the fourth largest U.S. wheat crop

By **NICHOLAS K. GERANIOS Associated Press**
11 August 2021, 20:46 • 4 min read

'Worst year I've ever witnessed': Drought withers Western Canada's spring wheat

'Some are harvesting about 25 per cent of what they would typically expect. The conditions are terrible'

Laura Brehaut
Aug 19, 2021 • August 19, 2021 • 8 minute read • 72 Comments

NATIONAL POST

News | Climate Change

Mexico water supply buckles on worsening drought, crops at risk

Weather forecasts warn of high temperatures portending crop damage and water supply shortages.

2 Jul 2021

ALJAZEERA

World / Americas

Record-breaking drought in Chile offers bountiful proof of climate change

- Science Minister Andres Couve said the steady decline in the country's water reserves because of climate change was now a 'national priority'
- 'The weather events are happening with a frequency and intensity that makes it very easy for people to see', he said

REUTERS

Reuters in Santiago + FOLLOW

Published: 3:46pm, 11 Aug, 2021

Brazil, Besieged by Covid, Now Faces a Severe Drought

Brazilians are paying more for electricity, dealing with the possibility of water rationing and expecting a destructive fire season in the Amazon in the worst dry spell in at least 90 years.

Published June 19, 2021 Updated June 21, 2021

The New York Times

Thursday, July 8, 2021

Record Droughts Plague Latin America

By Chase Harrison and Katie Hopkins

Abnormally dry conditions in Argentina, Brazil, Mexico, and Paraguay threaten water reserves and economic recovery.

AS/COA
AMERICAS SOCIETY
COUNCIL OF THE AMERICAS

Jordan facing ‘one of the most severe’ droughts in its history

ALJAZEERA

Experts say Jordan is now in the grip of one of the most severe droughts in its history, but many warn the worst is yet to come.

6 May 2021

COMMODITIES OCTOBER 13, 2021 / 1:59 PM / UPDATED 2 DAYS AGO

Iran buying record volume of wheat after worst drought in 50 years – sources

REUTERS

‘The challenge for us now is drought, not war’: livelihoods of millions of Afghans at risk

Tue 21 Sep 2021 10.36 BST

The Guardian

The Guardian

At least 1m people facing starvation as Madagascar's drought worsens

People eating termites and clay as UN says acute malnutrition has almost doubled this year in south

Mon 10 May 2021 06.00 BST

Drought puts 2.1 million Kenyans at risk of starvation

National disaster declared as crops fail after poor rains and locusts, while ethnic conflicts add to crisis

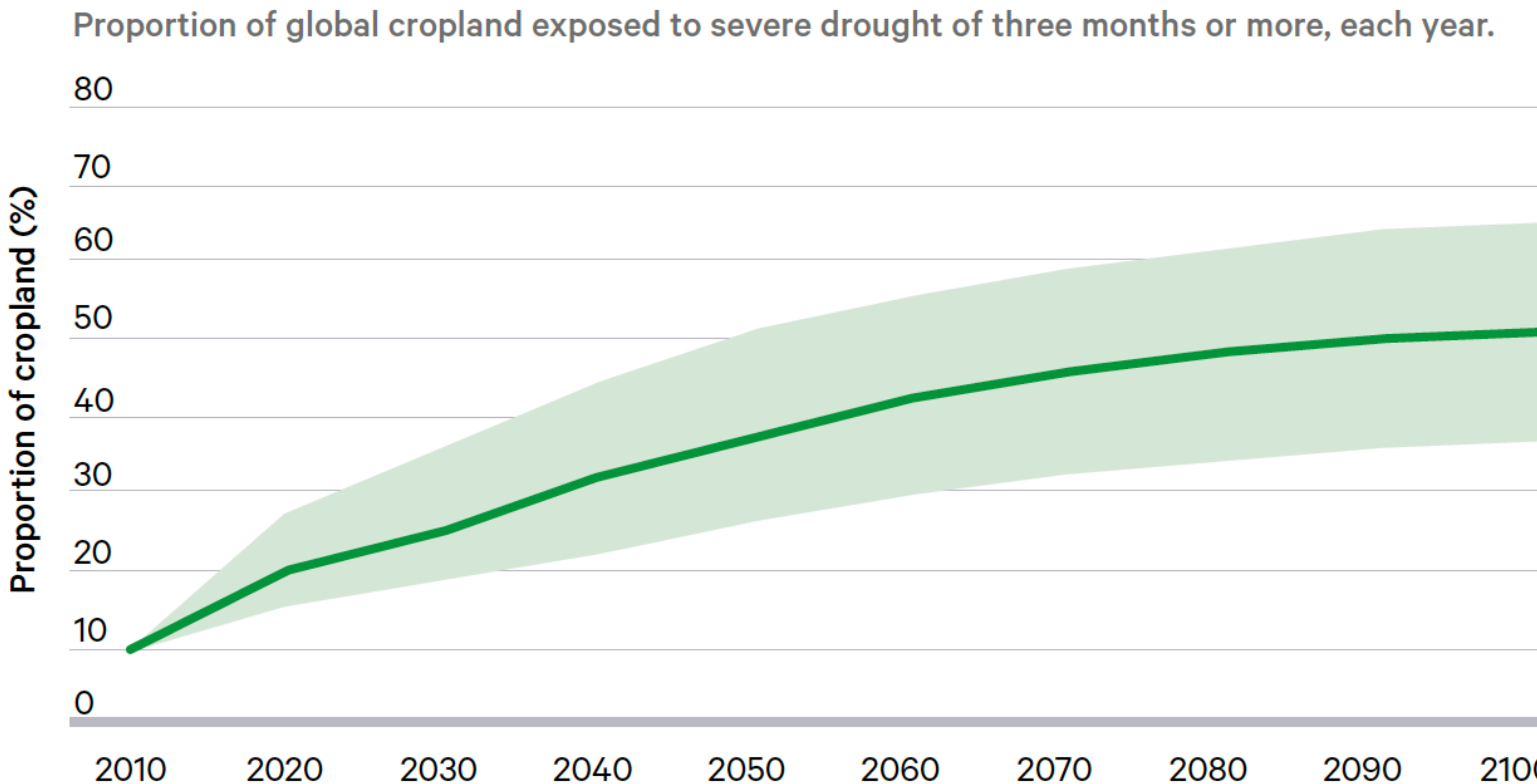
Wed 15 Sep 2021 07.00 BST

Angola: Millions facing hunger, as thousands flee their homes as drought ravages the south of Angola

July 22, 2021 2:00 am

AMNESTY INTERNATIONAL

Agriculture - Current Trajectory



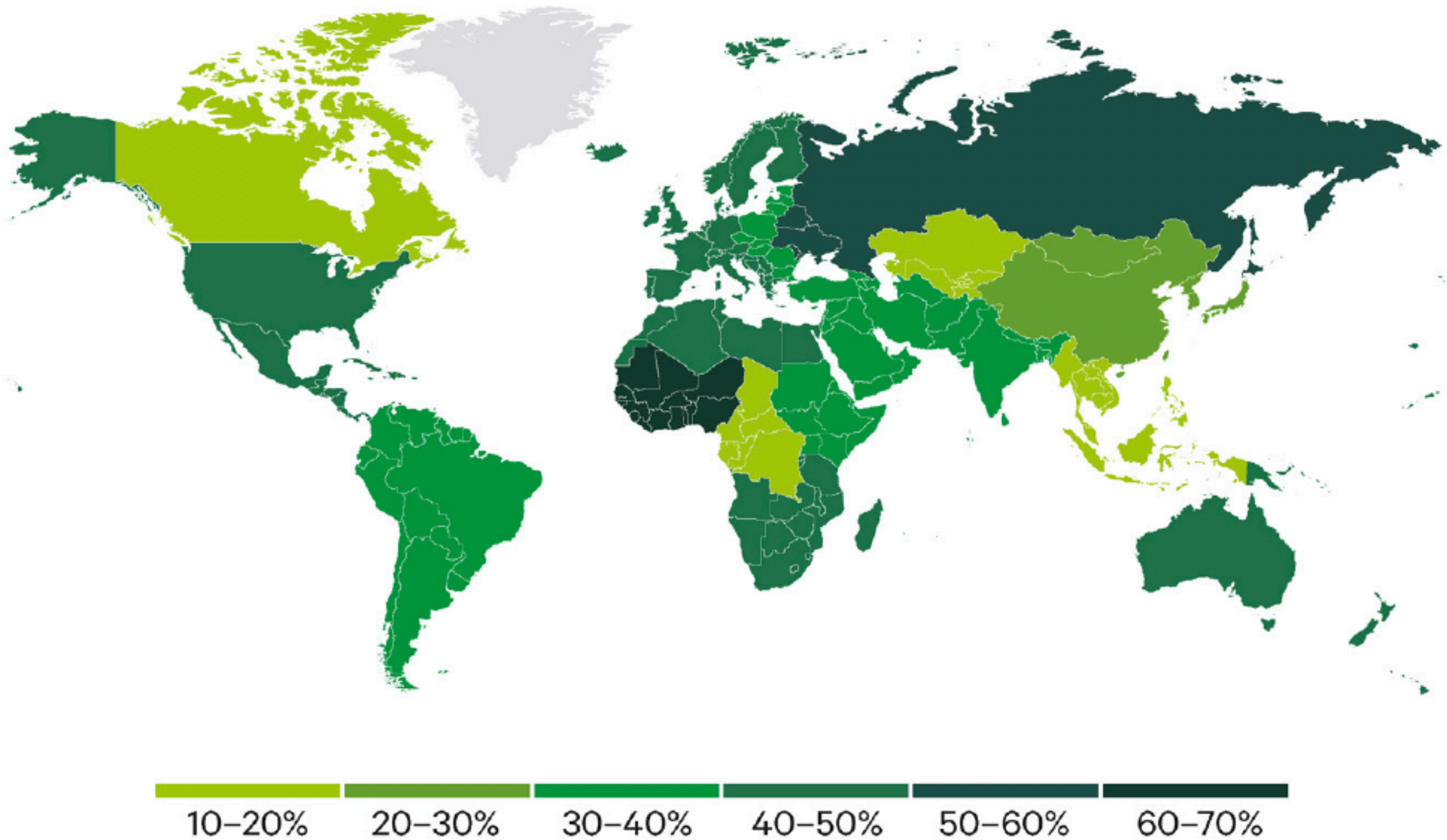
Shaded area represents the lower and upper estimates of the given impact.
Solid line represents the central estimate.

Quiggin et al. (2021)

Arnell et al. (2019)

Agriculture - Current Trajectory

Regional impacts, 2050: proportion of cropland exposed to severe drought each year
(Severe drought is equivalent to that experienced in Central Europe in 2018)



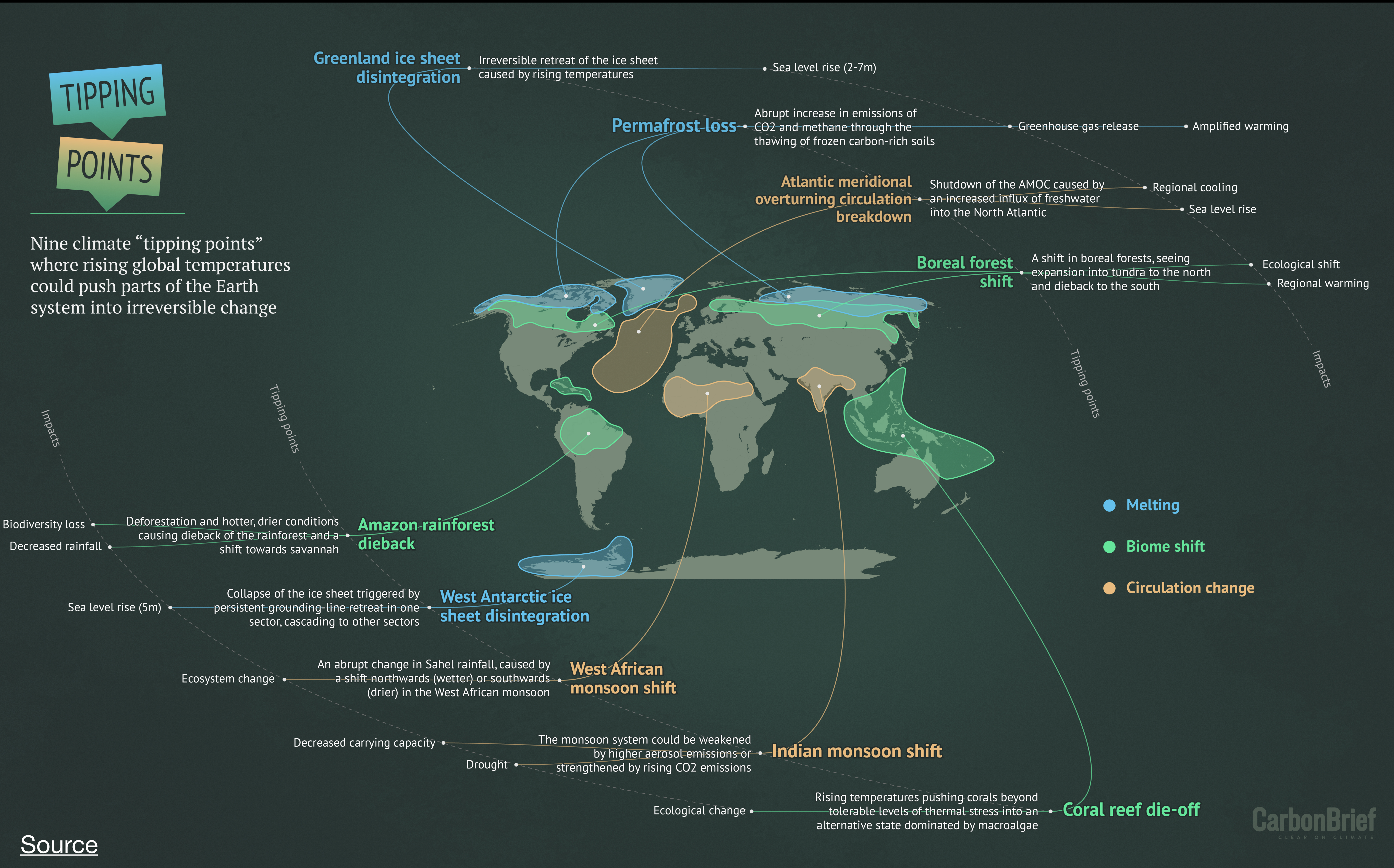
Farmers in the worst-affected areas (including the critical breadbasket regions of **southern Russia** and the **US**) are likely to experience severe agricultural drought impacting 40 per cent or more of their cropland area every year during the 2050s.

During the 2040s there is a 50% chance of synchronous crop failure

Baird (2021)

Arnell et al. (2019)

Quiggin et al. (2021)



TIPPING
POINTS
Nine climate "tipping points" where rising global temperatures could push parts of the Earth system into irreversible change
Greenland ice sheet disintegration
Irreversible retreat of the ice sheet caused by rising temperatures
Sea level rise (2-7m)
Permafrost loss
Abrupt increase in emissions of CO2 and methane through the thawing of frozen carbon-rich soils
Greenhouse gas release
Amplified warming
Atlantic meridional overturning circulation breakdown
Shutdown of the AMOC caused by an increased influx of freshwater into the North Atlantic
Regional cooling
Sea level rise
Boreal forest shift
A shift in boreal forests, seeing expansion into tundra to the north and dieback to the south
Ecological shift
Regional warming
Tipping points
Impacts
Amazon rainforest dieback
Deforestation and hotter, drier conditions causing dieback of the rainforest and a shift towards savannah
Biodiversity loss
Decreased rainfall
West Antarctic ice sheet disintegration
Collapse of the ice sheet triggered by persistent grounding-line retreat in one sector, cascading to other sectors
Sea level rise (5m)
West African monsoon shift
An abrupt change in Sahel rainfall, caused by a shift northwards (wetter) or southwards (drier) in the West African monsoon
Ecosystem change
Indian monsoon shift
The monsoon system could be weakened by higher aerosol emissions or strengthened by rising CO2 emissions
Decreased carrying capacity
Drought
Coral reef die-off
Rising temperatures pushing corals beyond tolerable levels of thermal stress into an alternative state dominated by macroalgae
Ecological change
Melting
Biome shift
Circulation change
Tipping points
Impacts
CarbonBrief
CLEAR ON CLIMATE
Source

REVIEW ARTICLE
https://doi.org/10.1038/s41561-021-00790-5

nature geoscience

Check for updates

Past abrupt changes, tipping points and cascading impacts in the Earth system

Victor Brovkin[1,2], Edward Brook[3], John W. Williams[4], Sebastian Bathiany[5], Timothy M. Lenton[6], Michael Barton[7], Robert M. DeConto[8], Jonathan F. Donges[9,10], Andrey Ganopolski[9], Jerry McManus[11], Summer Praetorius[12], Anne de Vernal[13], Ayako Abe-Ouchi[14], Hai Cheng[15], Martin Claussen[1,16], Michel Crucifix[17], Gilberto Gallopín[18], Virginia Iglesias[19], Darrell S. Kaufman[20], Thomas Kleinen[1], Fabrice Lambert[21], Sander van der Leeuw[22], Hannah Liddy[23], Marie-France Loutre[24], David McGee[25], Kira Rehfeld[26], Rachael Rhodes[27], Alistair W. R. Seddon[28], Martin H. Trauth[29], Lilian Vanderveken[17] and Zicheng Yu[30,31]

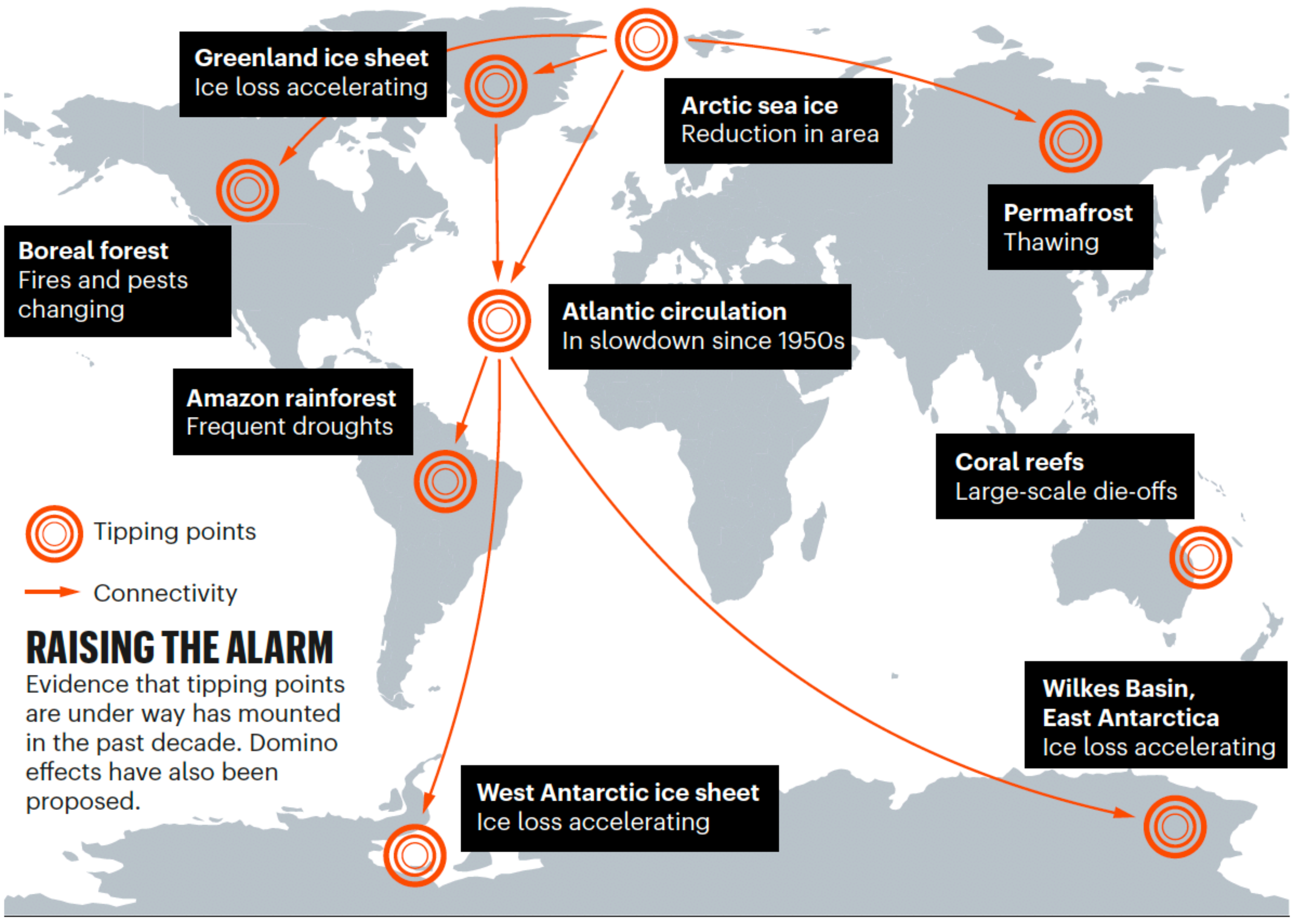
The geological record shows that abrupt changes in the Earth system can occur on timescales short enough to challenge the capacity of human societies to adapt to environmental pressures. In many cases, abrupt changes arise from slow changes in one component of the Earth system that eventually pass a critical threshold, or tipping point, after which impacts cascade through coupled climate–ecological–social systems. The chance of detecting abrupt changes and tipping points increases with the length of observations. The geological record provides the only long-term information we have on the conditions and processes that can drive physical, ecological and social systems into new states or organizational structures that may be irreversible within human time frames. Here, we use well-documented abrupt changes of the past 30 kyr to illustrate how their impacts cascade through the Earth system. We review useful indicators of upcoming abrupt changes, or early warning signals, and provide a perspective on the contributions of palaeoclimate science to the understanding of abrupt changes in the Earth system.

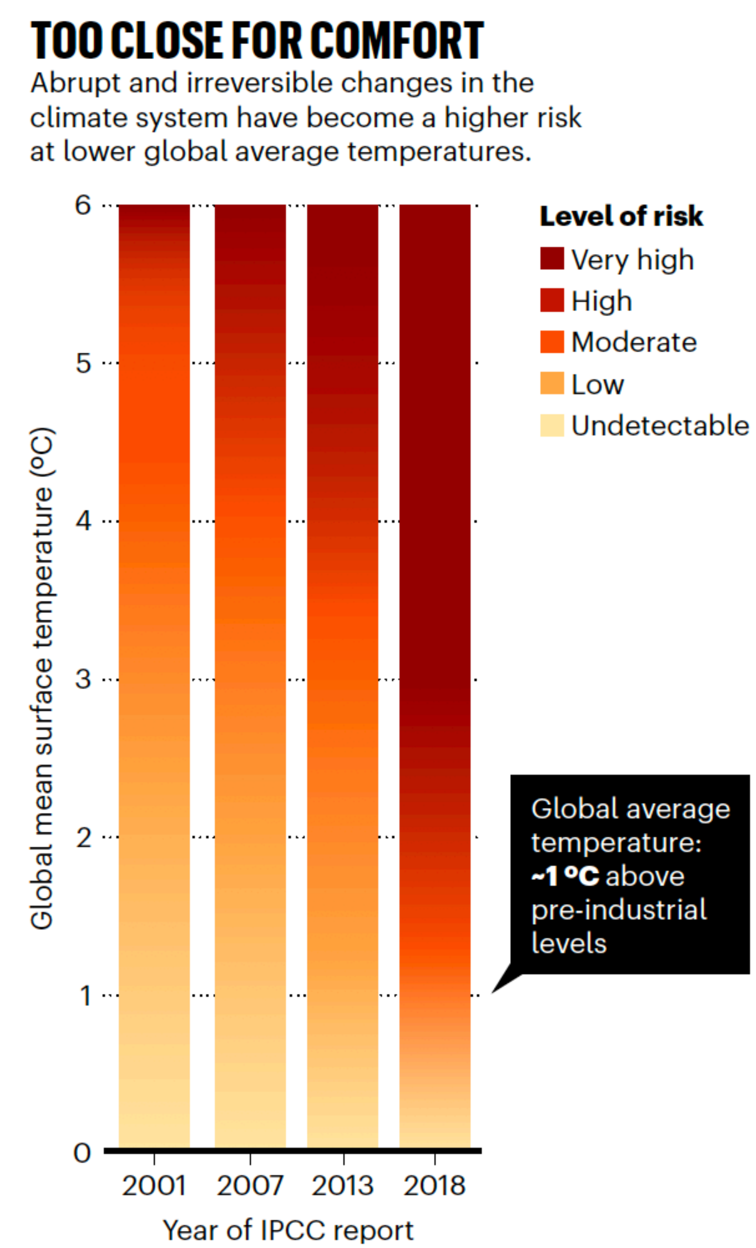
Tipping Point Panel

Brovkin et al. (2021)

Jonathan Donges Talk

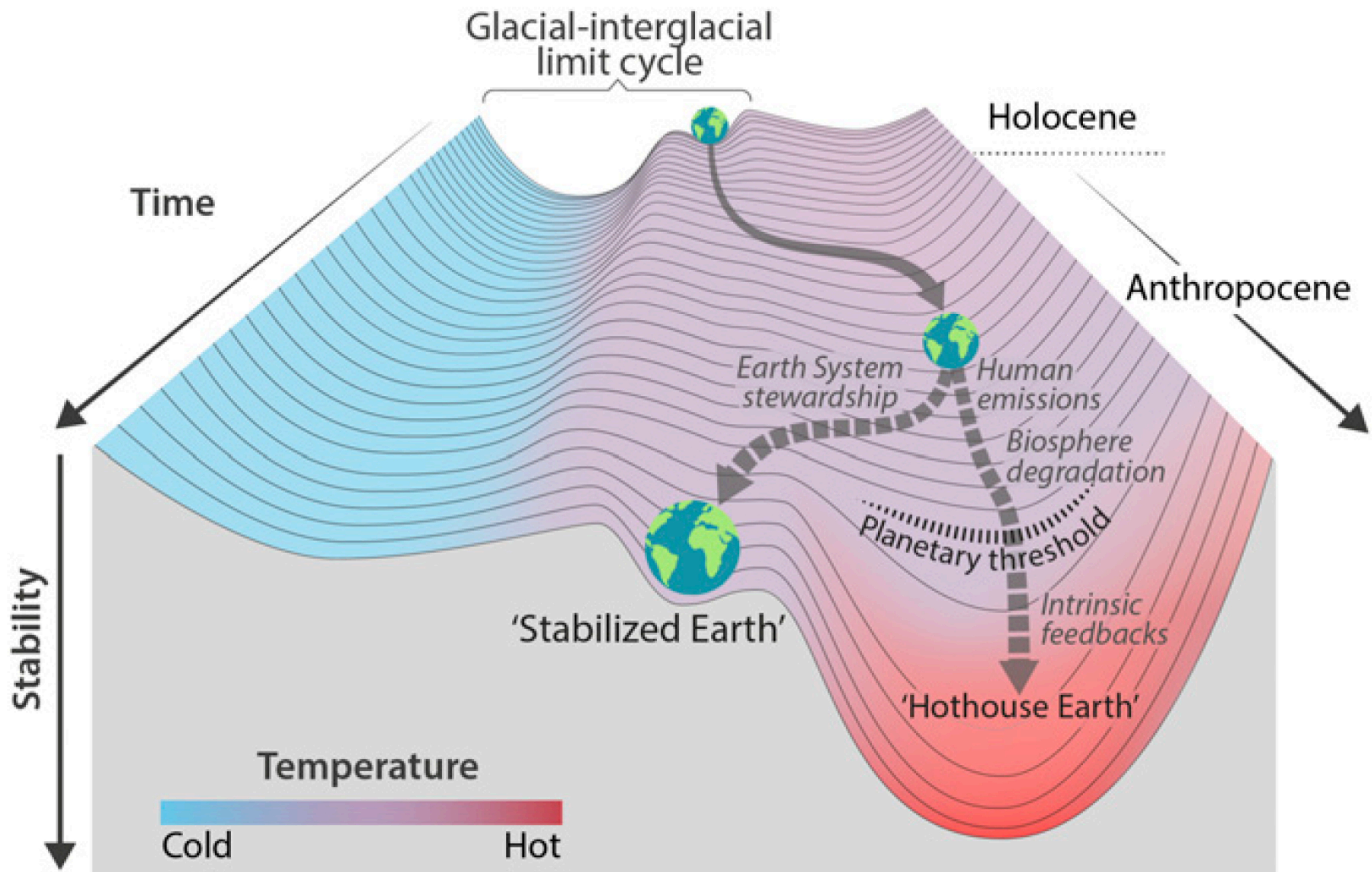
Lenton Podcast





Lenton et al. (2019)

Wunderling et al. (2021)



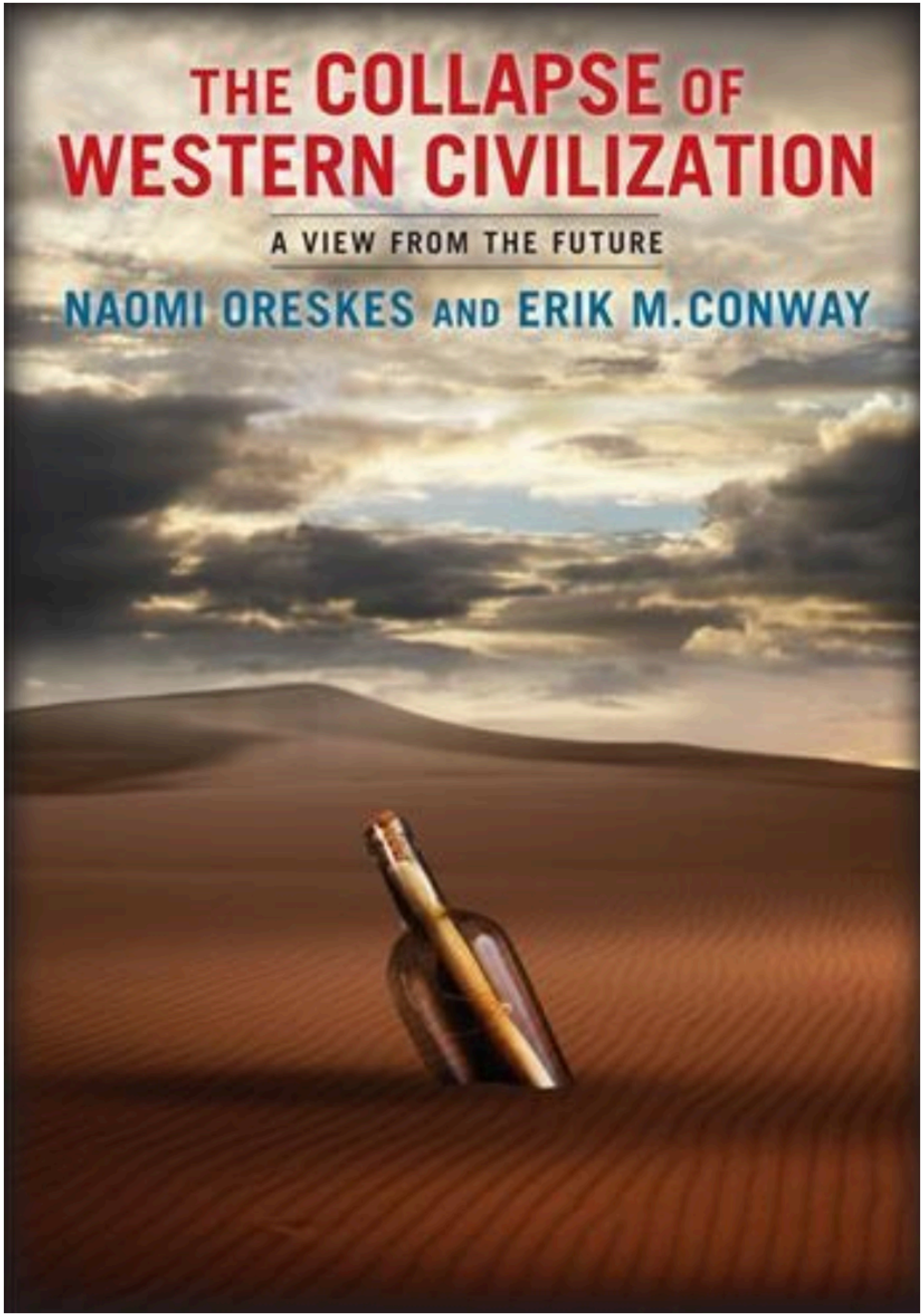
Steffen Podcast

Rockström Podcast

Steffen et al. (2018)

“ I think we have more than a 5% chance of succeeding but it is definitely less than 50%, in my view. But what is the option? If we have a final chance to save our culture and our civilisation, I am just compelled to do it.”

John Schellnhuber
Founding Director
Potsdam Institute for Climate Impact Research



Source

Schellnhuber Talk

“I wish the Ring had never come to me. I wish none of this had happened.”

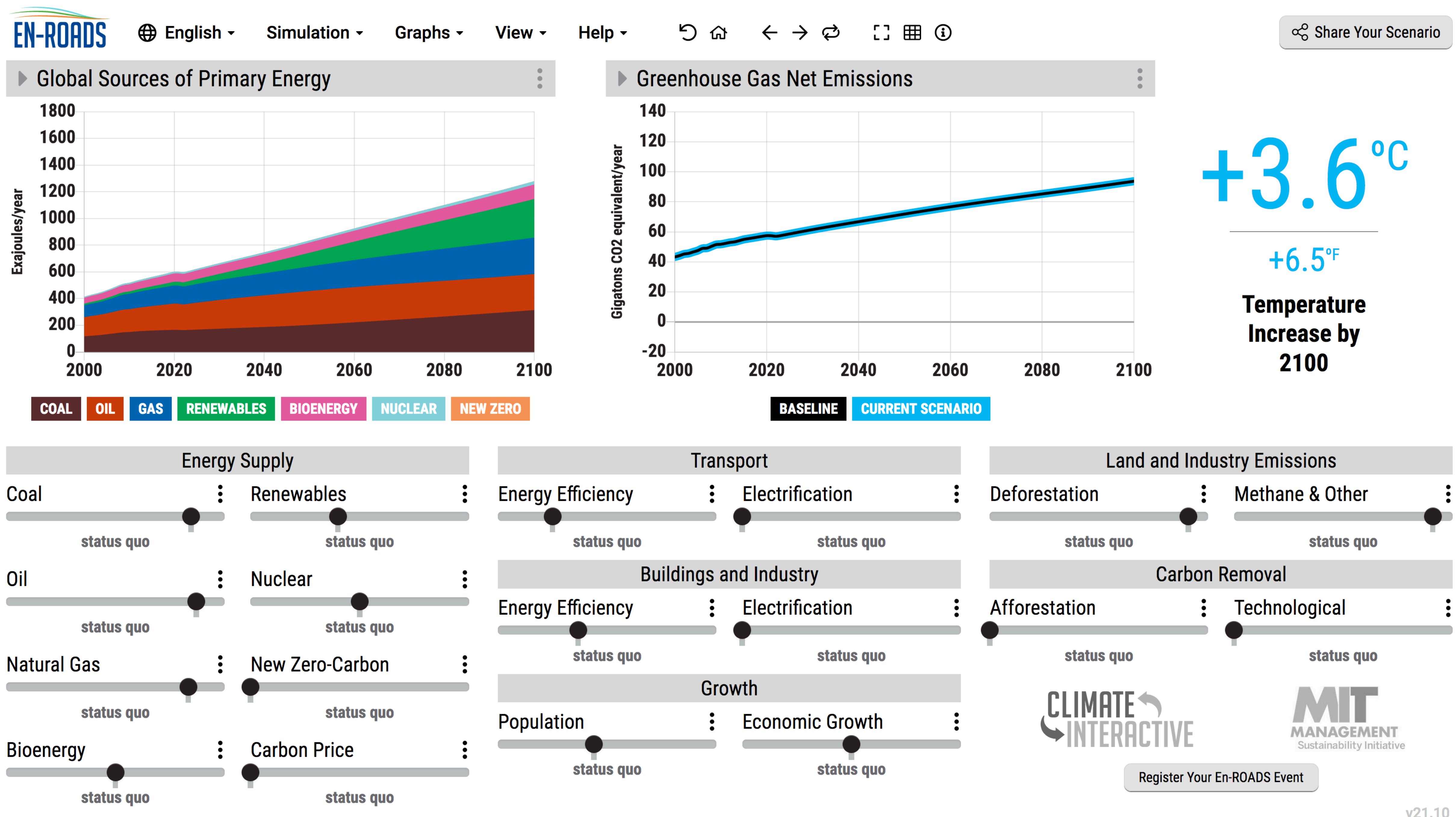
“So do all who live to see such times, but that is not for them to decide.

All we have to decide is what to do with the time that is given to us.”

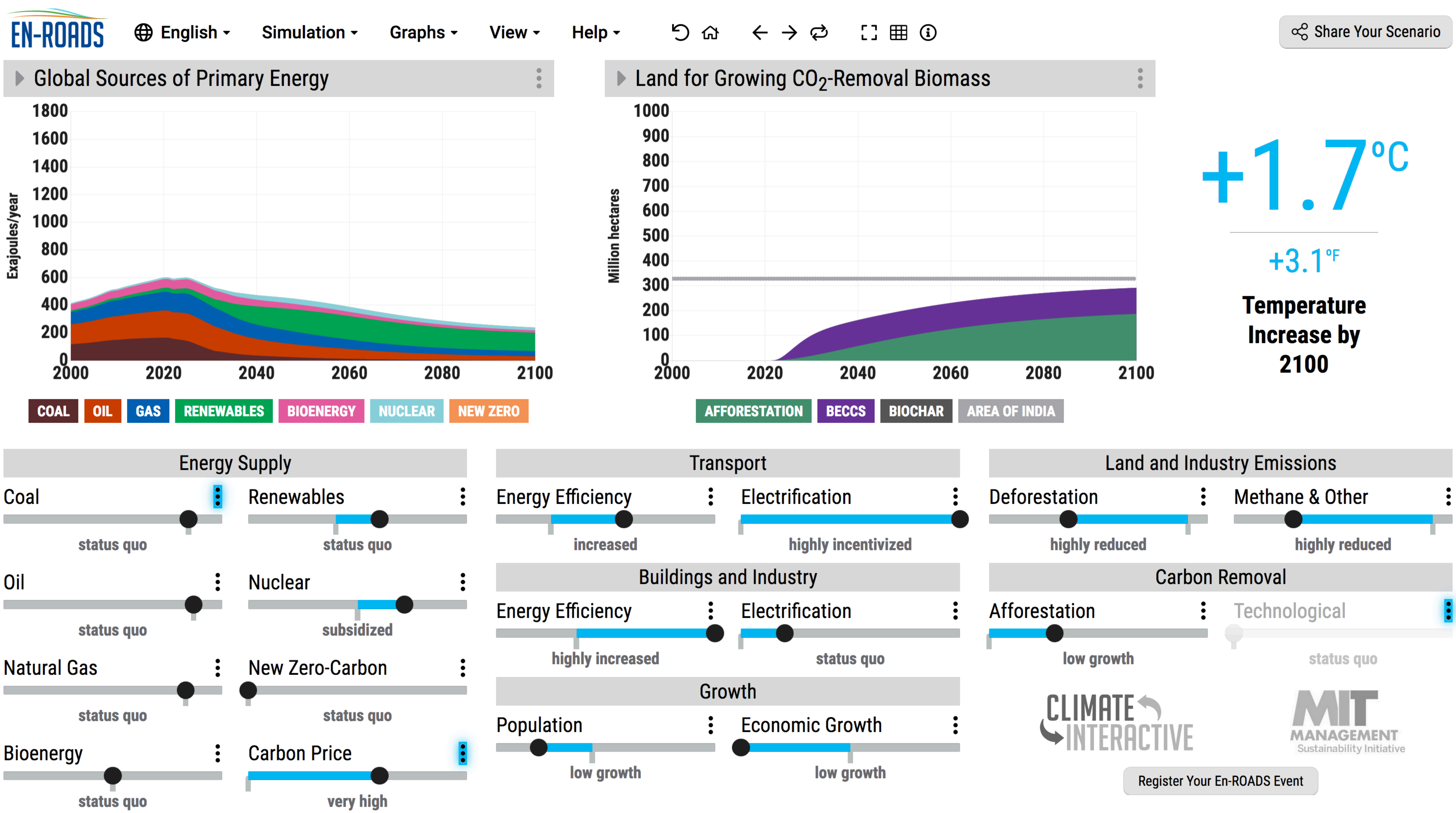
Scene

Part III:
Averting Collapse & Creating a Better World

Interactive Part


EN-ROADS
English
Simulation
Graphs
View
Help
Share Your Scenario
Global Sources of Primary Energy
Exajoules/year
1800
1600
1400
1200
1000
800
600
400
200
0
2000
2020
2040
2060
2080
2100
COAL
OIL
GAS
RENEWABLES
BIOENERGY
NUCLEAR
NEW ZERO
Greenhouse Gas Net Emissions
Gigatons CO2 equivalent/year
140
120
100
80
60
40
20
0
-20
2000
2020
2040
2060
2080
2100
BASELINE
CURRENT SCENARIO
+3.6°C
+6.5°F
Temperature Increase by 2100
Energy Supply
Coal
status quo
Renewables
status quo
Oil
status quo
Nuclear
status quo
Natural Gas
status quo
New Zero-Carbon
status quo
Bioenergy
status quo
Carbon Price
status quo
Transport
Energy Efficiency
status quo
Electrification
status quo
Buildings and Industry
Energy Efficiency
status quo
Electrification
status quo
Growth
Population
status quo
Economic Growth
status quo
Land and Industry Emissions
Deforestation
status quo
Methane & Other
status quo
Carbon Removal
Afforestation
status quo
Technological
status quo
CLIMATE INTERACTIVE
MIT MANAGEMENT
Sustainability Initiative
Register Your En-ROADS Event
v21.10

Link



EN-ROADS
English
Simulation
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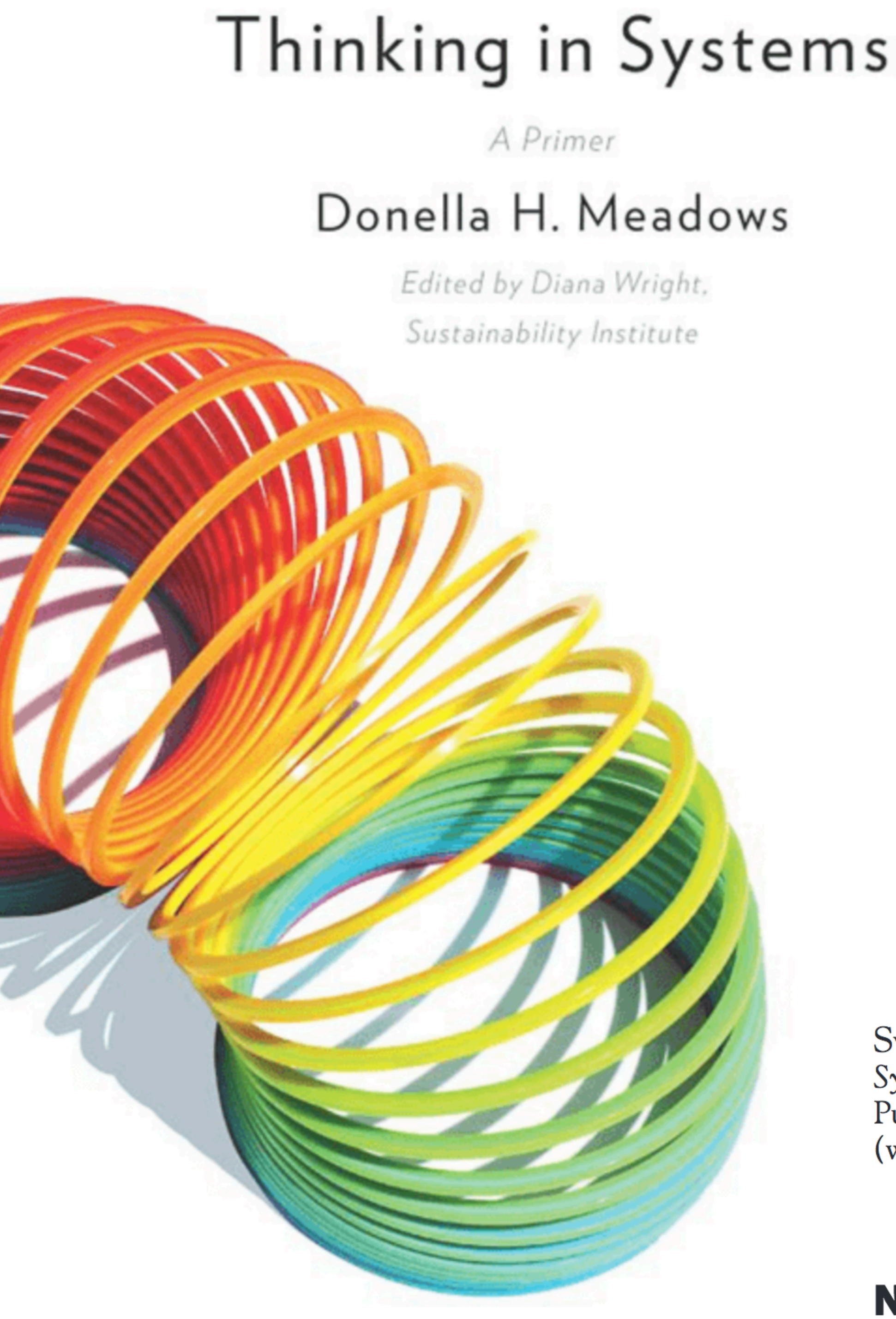
Global Sources of Primary Energy
Exajoules/year
1800
1600
1400
1200
1000
800
600
400
200
0
2000
2020
2040
2060
2080
2100
COAL
OIL
GAS
RENEWABLES
BIOENERGY
NUCLEAR
NEW ZERO
Land for Growing CO_2-Removal Biomass
Million hectares
1000
900
800
700
600
500
400
300
200
100
0
2000
2020
2040
2060
2080
2100
AFFORESTATION
BECCS
BIOCHAR
AREA OF INDIA
+1.7°C
+3.1°F
Temperature Increase by 2100
Energy Supply
Coal
status quo
Renewables
status quo
Oil
status quo
Nuclear
subsidized
Natural Gas
status quo
New Zero-Carbon
status quo
Bioenergy
status quo
Carbon Price
very high
Transport
Energy Efficiency
increased
Electrification
highly incentivized
Buildings and Industry
Energy Efficiency
highly increased
Electrification
status quo
Growth
Population
low growth
Economic Growth
low growth
Land and Industry Emissions
Deforestation
highly reduced
Methane & Other
highly reduced
Carbon Removal
Afforestation
low growth
Technological
status quo
CLIMATE INTERACTIVE
MIT MANAGEMENT
Sustainability Initiative
Register Your En-ROADS Event



The Donella Meadows Project
Academy for Systems Change

CLIMATE INTERACTIVE
tools for a thriving future

MIT MANAGEMENT
SLOAN SCHOOL

System Dynamics Review
System Dynamics Review (2012)
Published online in Wiley Online Library
(wileyonlinelibrary.com) **DOI**: 10.1002/sdr.1474

NOTES AND INSIGHTS

Climate interactive: the C-ROADS climate policy model

John Sterman,[a,b*] Thomas Fiddaman,[b,c] Travis Franck,[b,d] Andrew Jones,[b]
Stephanie McCauley,[b] Philip Rice,[b] Elizabeth Sawin[b] and Lori Siegel[b]

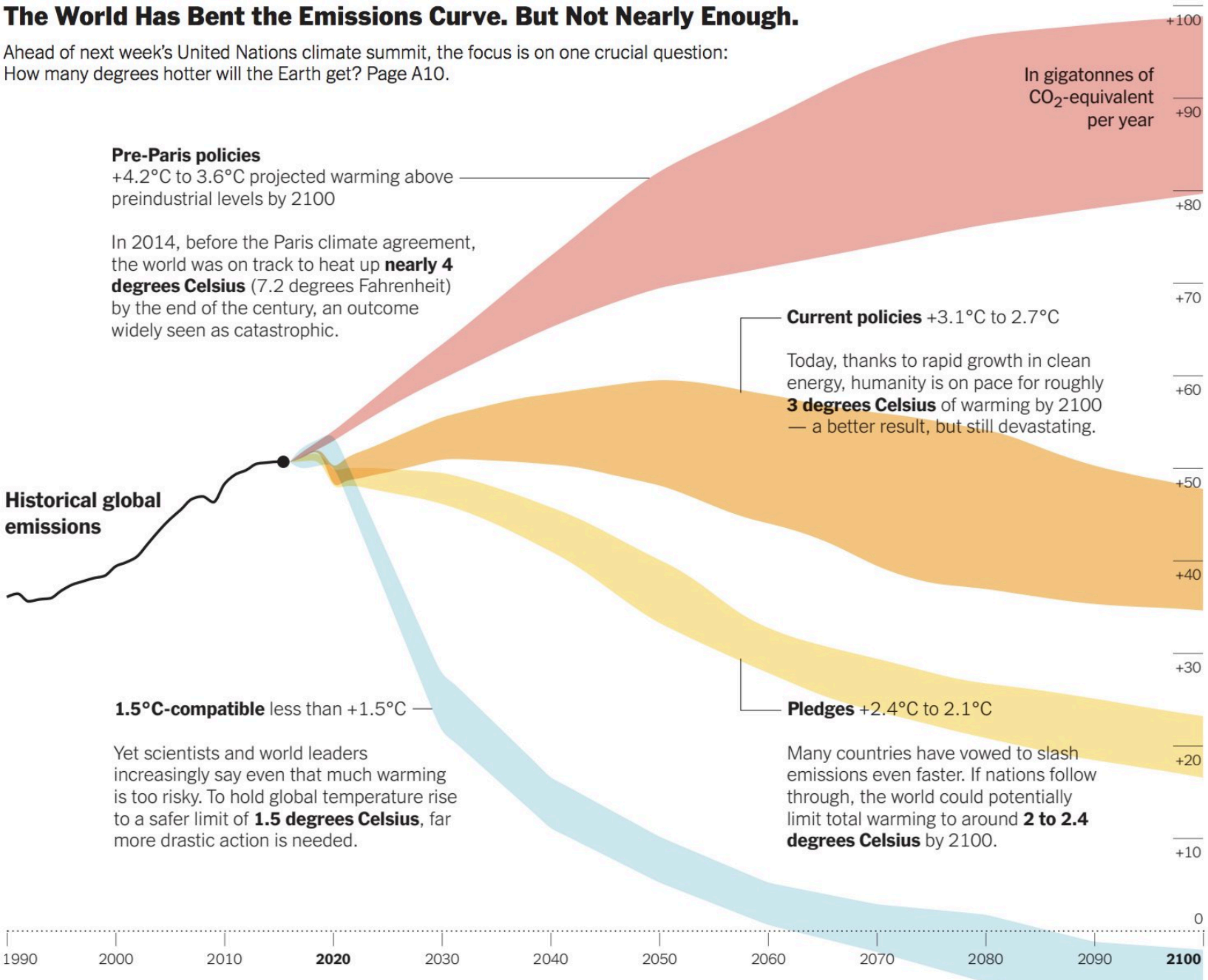
Online Course

Syst. Dyn. Rev. (2012)

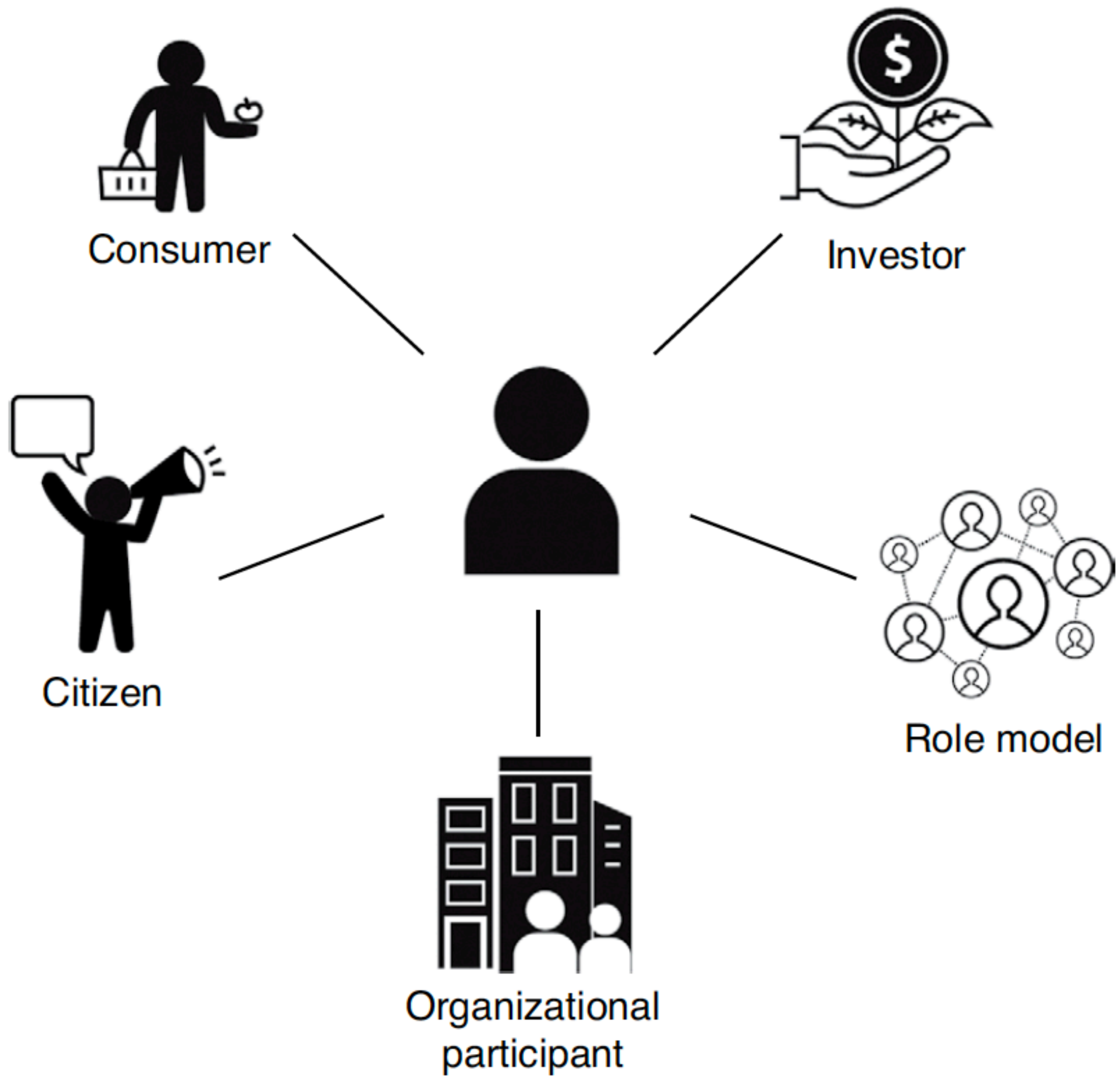
Part VI:
What Can We Do Today?

The World Has Bent the Emissions Curve. But Not Nearly Enough.

Ahead of next week's United Nations climate summit, the focus is on one crucial question: How many degrees hotter will the Earth get? Page A10.

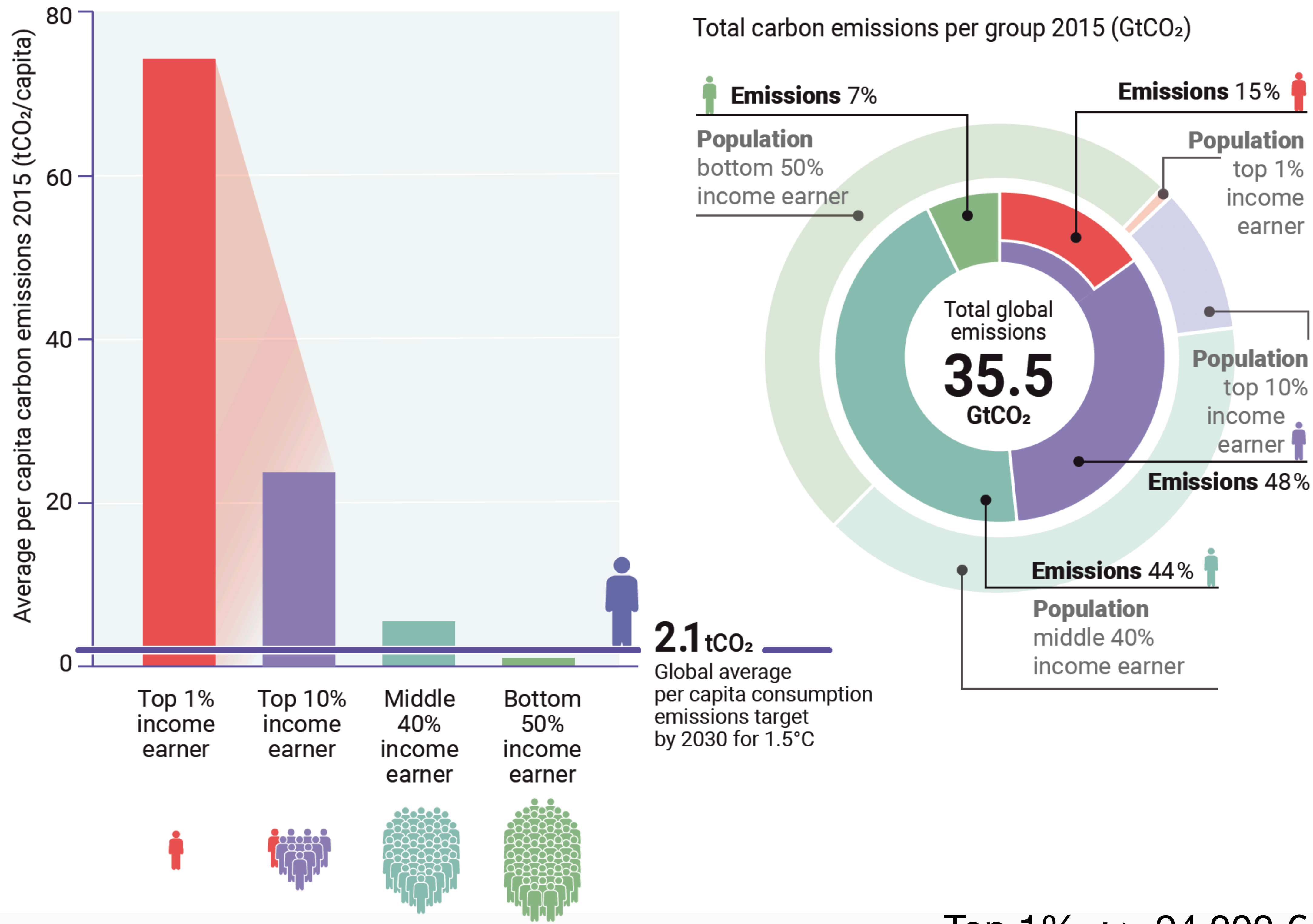


Source: Climate Action Tracker | Note: The graphic does not include Climate Action Tracker's "optimistic net-zero targets" pathway. The group based its 1.5°C-compatible pathway on scenarios from IPCC's Special Report on Global Warming of 1.5°C. NADJA POPOVICH AND BILL MARSH/THE NEW YORK TIMES



Nielsen et al. (2021a,b,c,d)

Consumer



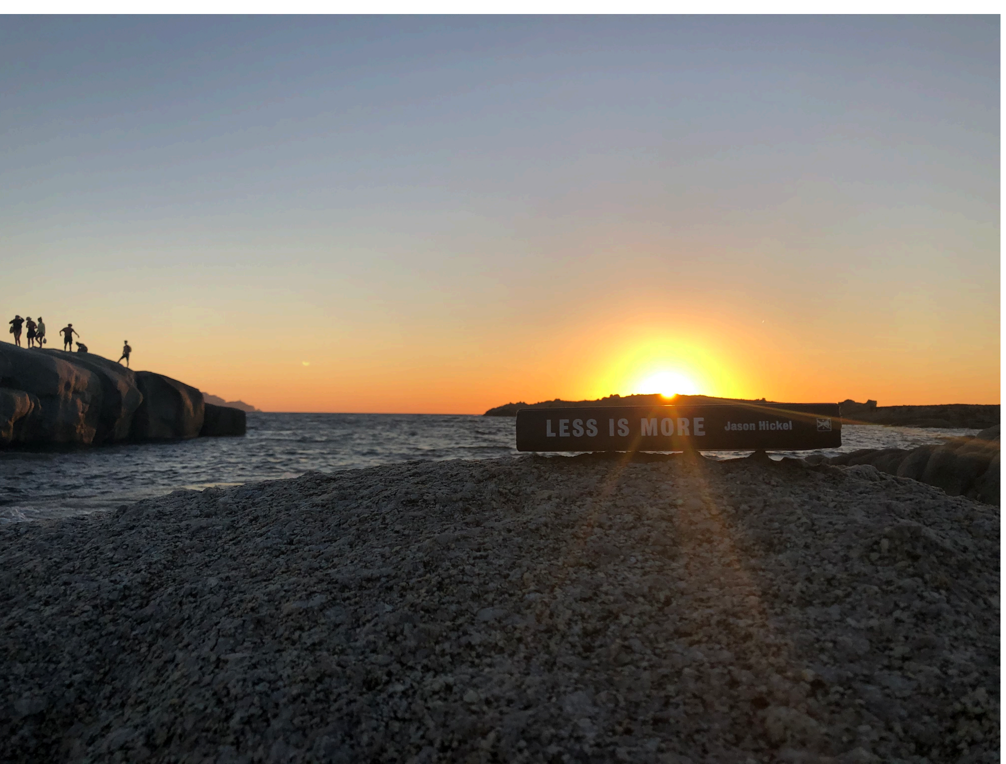
Top 1% : > 94,000 € / year
Top 10%: > 32,800 € / year

Capstick et al. (2020)

Consumer

Carbon Footprint Reduction

- Stop or lower air travel
- Stop driving petrol cars
- Reduce your meat consumption, especially beef
- Private sufficiency, public luxury



An Audacious Toolkit: Actions Against Climate Breakdown (Part 3: I is for Individual)

Julia Steinberger Nov 26, 2018 · 15 min read

Your Personal Action Guide for the Environment

Solving our biggest environmental problems will require huge changes in policy and business practice. But it turns out that our personal actions can help too, if we focus on the right things. Here are some places to start.

Dr. Jonathan Foley Follow
Apr 22, 2020 · 14 min read ★

Steinberger (2018); Foley (2020)

Investor

Organizational participant

- Divestment (Personal & Organizational)
- Donations to environmental organizations
- Influence through position / status

↓

Organize lectures / workshops
High-level interventions
(Reduce meat in cafeteria, at parties, disincentivize flights, etc.)
....

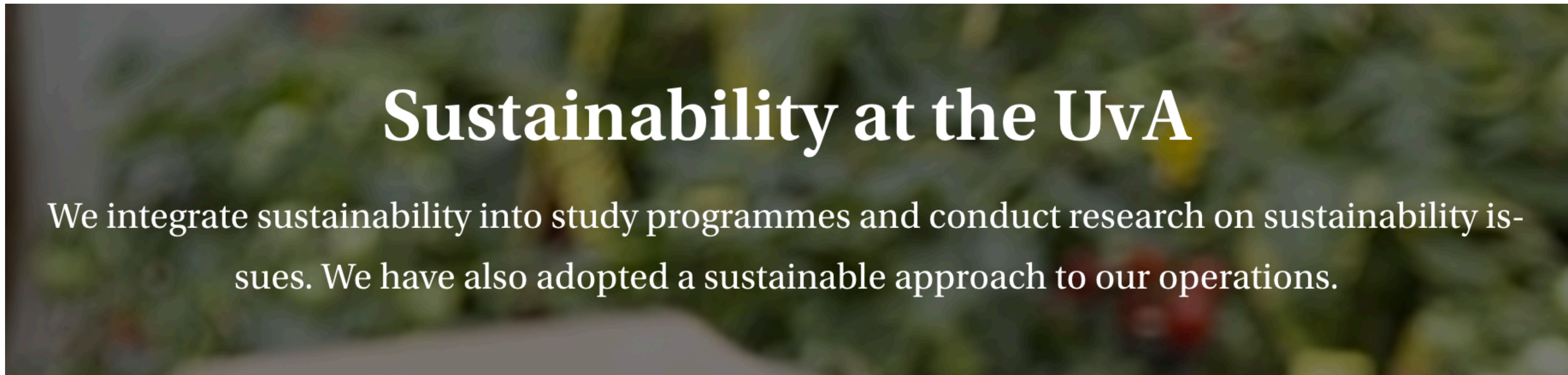
Comment | Published: 15 March 2021

Changing scientific meetings for the better

Sarvenaz Sarabipour, Aziz Khan, Yu Fen Samantha Seah, Aneth D. Mwakilili, Fiona N. Mumoki, Pablo J. Sáez, Benjamin Schwessinger, Humberto J. Debat & Tomislav Mestrovic

Nature Human Behaviour **5**, 296–300 (2021) | Cite this article

7822 Accesses | **4** Citations | **249** Altmetric | Metrics



Sarabipour et al. (2021)


Citizen


Role model

- Vote
- Talk about the climate crisis (urgency **and** agency)
- Contagion of low-carbon lifestyle (social norm shift)

“Mobilize, mobilize, mobilize. Get together with other people and mobilize for a better world.

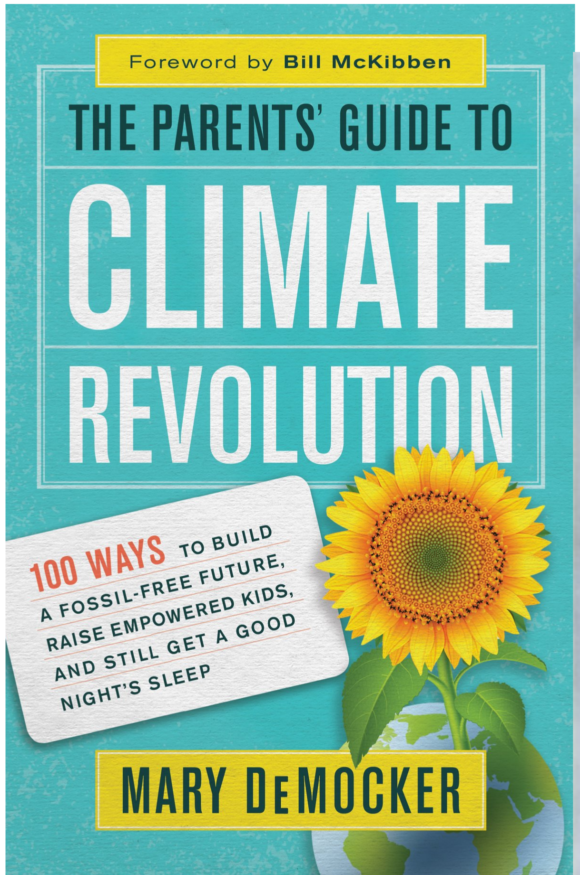
That's the only thing which has ever changed the world, and the only thing that ever will.”

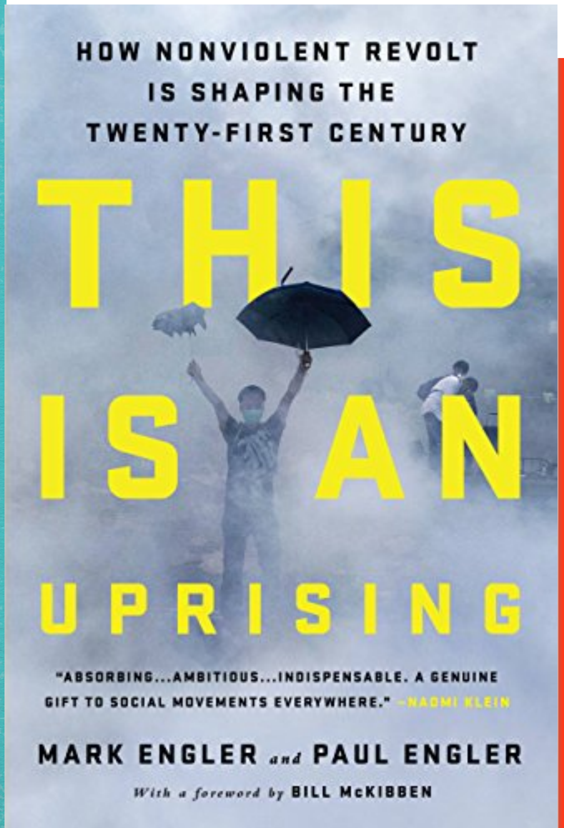
- George Monbiot

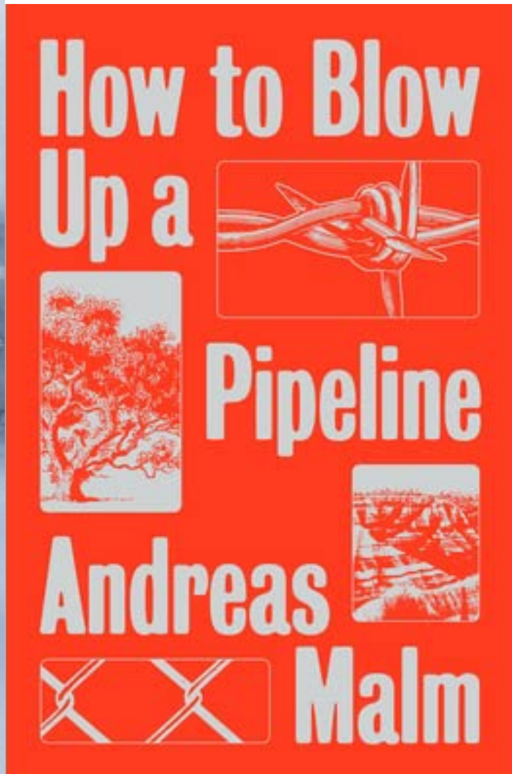
Monbiot Podcast

Monbiot Interview

Stop Line 3 Documentary







“We need a billion climate activists.”

- Peter Kalmus

Humans ‘pushing Earth close to tipping point’, say most in G20

Global survey finds 74% also want climate crises and protecting nature prioritised over jobs and profit

The Guardian

Reporting

Link

Sustainability Resources

Fabian Dablander & Andrea Bacilieri

We recently started to curate a list of resources that we found useful and that we can recommend to others (including those outside the climate bubble). Note that the items are in no particular order, and that they need not necessarily express our views.

Online courses / Lecture series

- *Mastering En-ROADS by Climate Interactive*
- *Climate Solutions 101 by Project Drawdown*
- *Oxford School of Climate Change*
- *Oxford Climate Society YouTube Channel*
  - Especially the talks by Noam Chomsky as well as by Nnimmo Bassey and Anuradha Mittal.

Books

- *Thinking in Systems*
- *The Future We Choose*
- *The New Climate War*
- *Merchants of Doubt*
- *Doughnut Economics*
- *This Changes Everything*
- *Designing Regenerative Cultures*
- *Think Like a Commoner*
- *Less is More*
- *The Divide*
- *To Cook a Continent*
- *Revolutions That Made the Earth*
- *Earth System Science: A Very Short Introduction*
- *Climate Change: A Very Short Introduction*
- *This Is an Uprising*
- *How to Blow Up a Pipeline*
- *The Ministry for the Future*
- *The Great Derangement*
- *The Collapse of Western Civilization*

Podcasts

- *Drilled*
- *The Climate Pod*
- *Sustain Ability - The Potsdam Dialogues*
- *The Sustainability Agenda*
  - Especially the episodes with Daniel Wahl, Rupert Read, Will Steffen, John Foley, Tim Lenton, Jason Hickel, Naomi Klein, Mark Campanale.

News / Newsletters

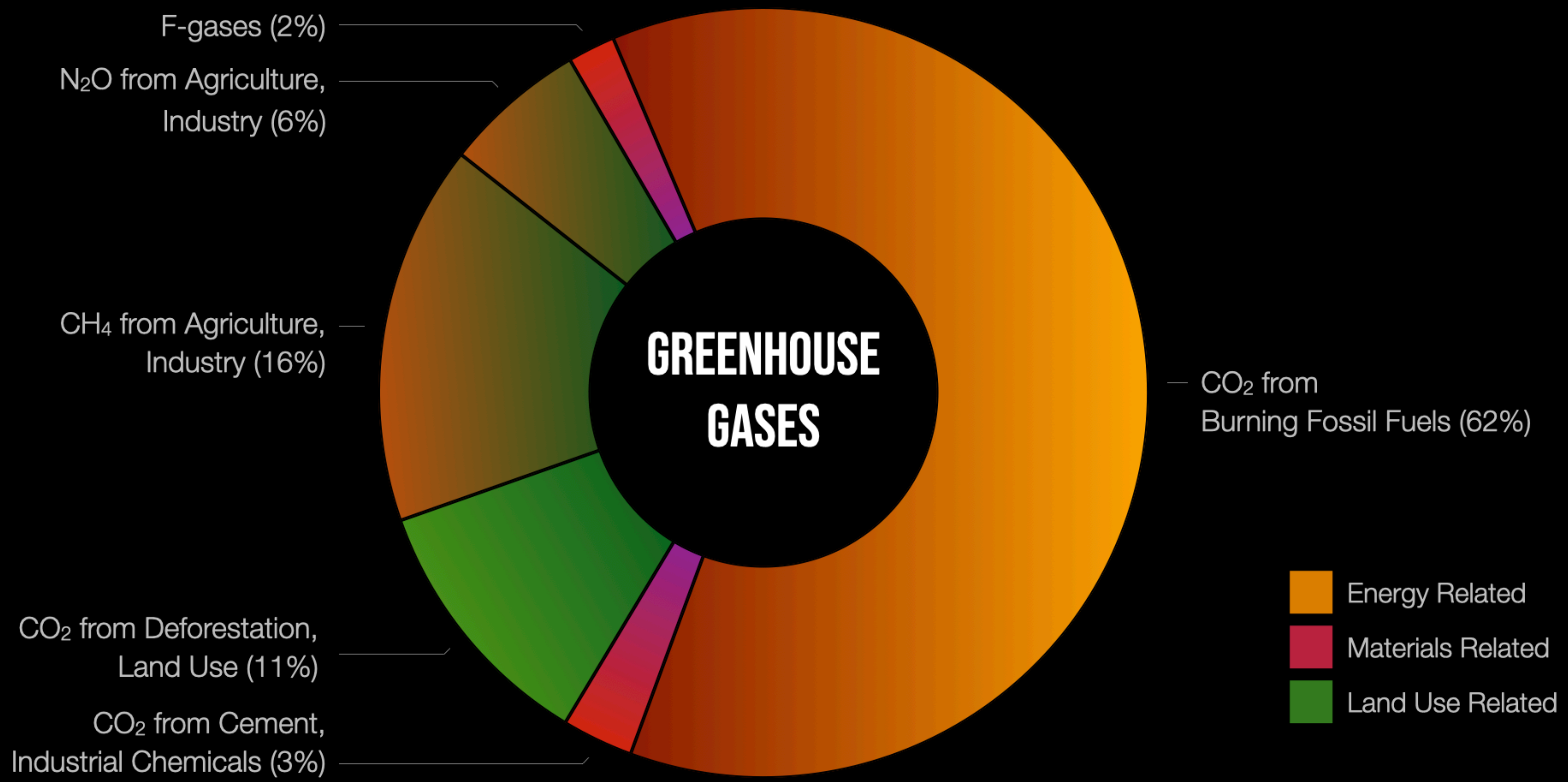
- *Carbon Brief*
- *Mongabay*
- *Inside Climate News*
- *Bill McKibben's Newsletter* [Superseded by his *Substack*]
- *George Monbiot's weekly columns at The Guardian*

Documentaries

- *Breaking Boundaries*
- *David Attenborough: A Life on Our Planet*
- *Chasing Ice*
- *Chasing Coral*
- *Tomorrow*
- *How To Change the World*
- *The End of the Line*
- *Seaspiracy*
- *Cowspiracy*
- *Kiss the Ground*
- *The True Cost*
- *The End of Poverty?*
- *The Four Horsemen*
- *The Corporation*
- *Gasland*
- *The Prize: The Epic Quest for Oil, Money, and Power*
- *Ancient Futures: Learning from Ladakh*
- *LN3: Teachings of the Anishinaabe Resistance*

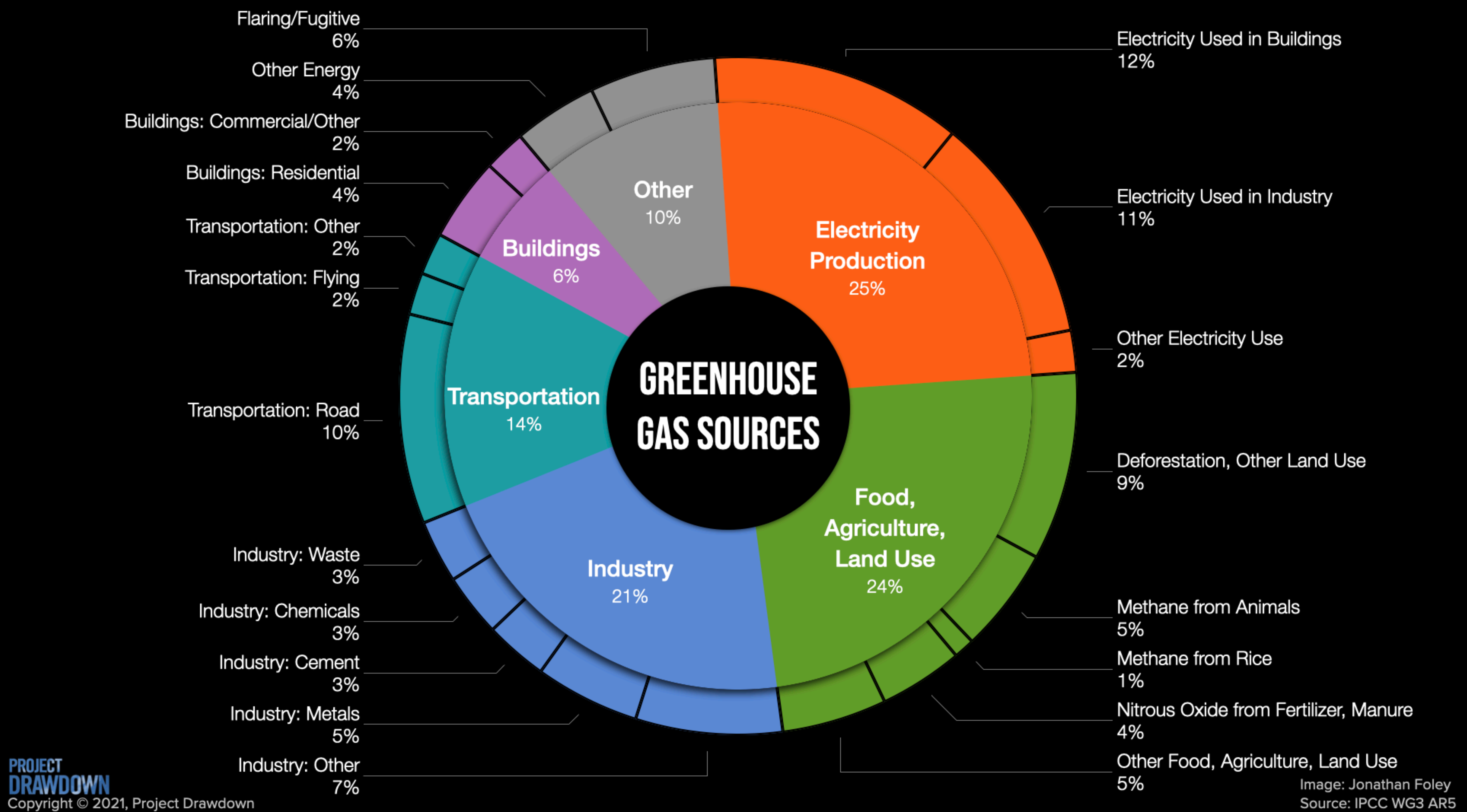
Appendix

Emissions

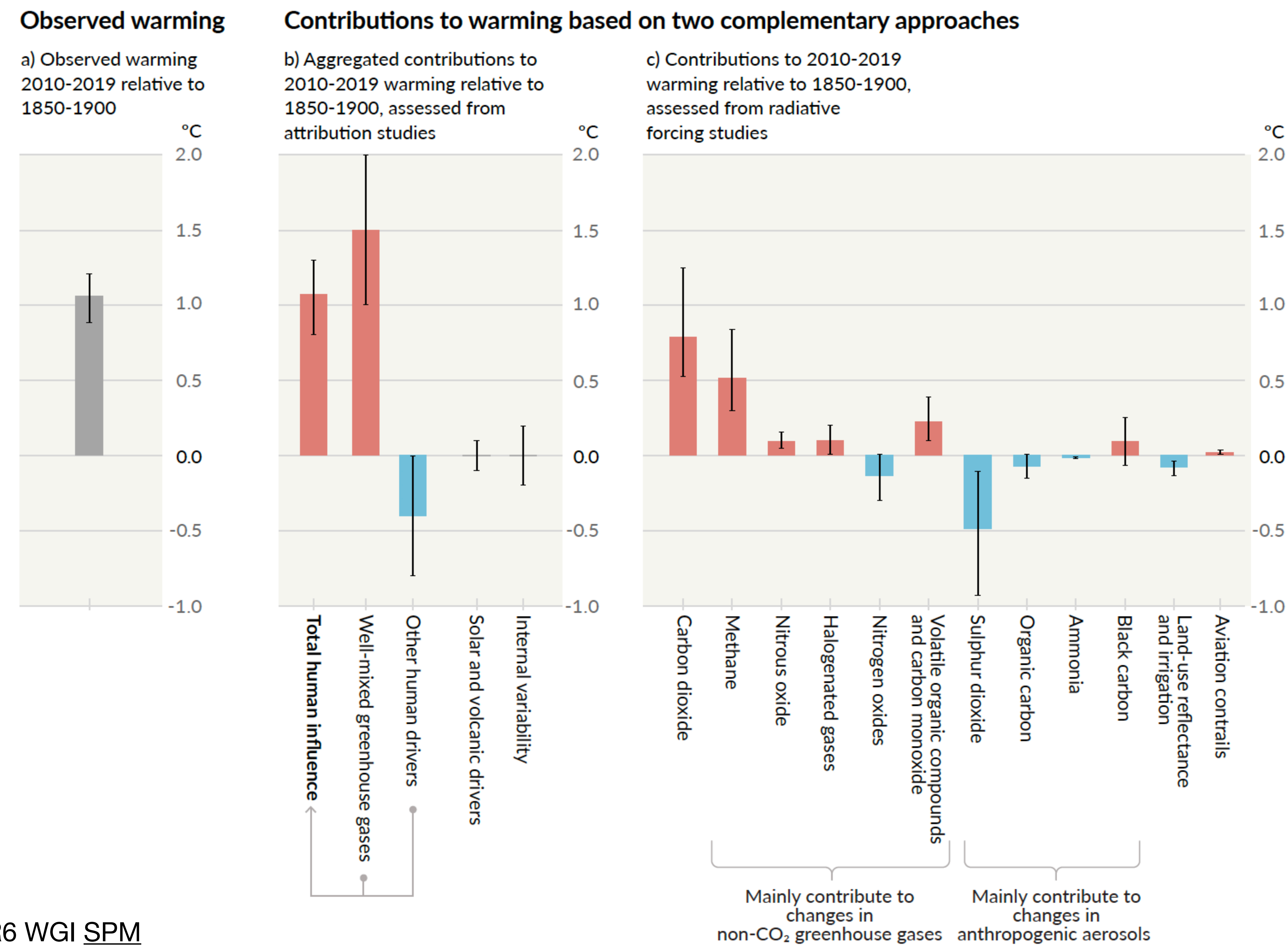


PROJECT DRAWDOWN

Image: Jonathan Foley
Source: IPCC WG3


GREENHOUSE GAS SOURCES
Flaring/Fugitive 6%
Other Energy 4%
Buildings: Commercial/Other 2%
Buildings: Residential 4%
Transportation: Other 2%
Transportation: Flying 2%
Transportation: Road 10%
Industry: Waste 3%
Industry: Chemicals 3%
Industry: Cement 3%
Industry: Metals 5%
Industry: Other 7%
Electricity Used in Buildings 12%
Electricity Used in Industry 11%
Other Electricity Use 2%
Deforestation, Other Land Use 9%
Methane from Animals 5%
Methane from Rice 1%
Nitrous Oxide from Fertilizer, Manure 4%
Other Food, Agriculture, Land Use 5%
Other 10%
Electricity Production 25%
Buildings 6%
Transportation 14%
Industry 21%
Food, Agriculture, Land Use 24%
PROJECT DRAWDOWN
Image: Jonathan Foley
Source: IPCC WG3 AR5

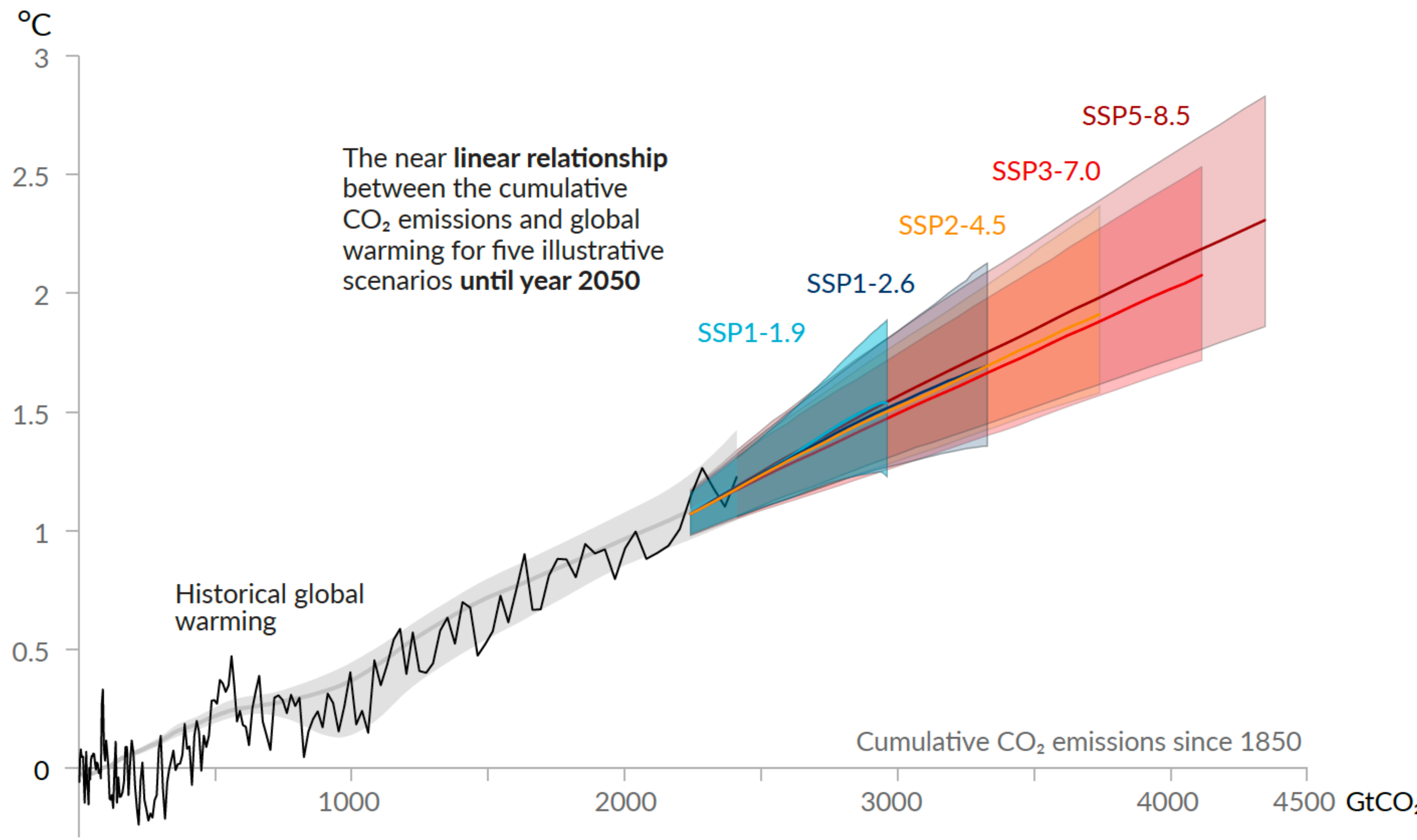
Observed warming is driven by emissions from human activities, with greenhouse gas warming partly masked by aerosol cooling



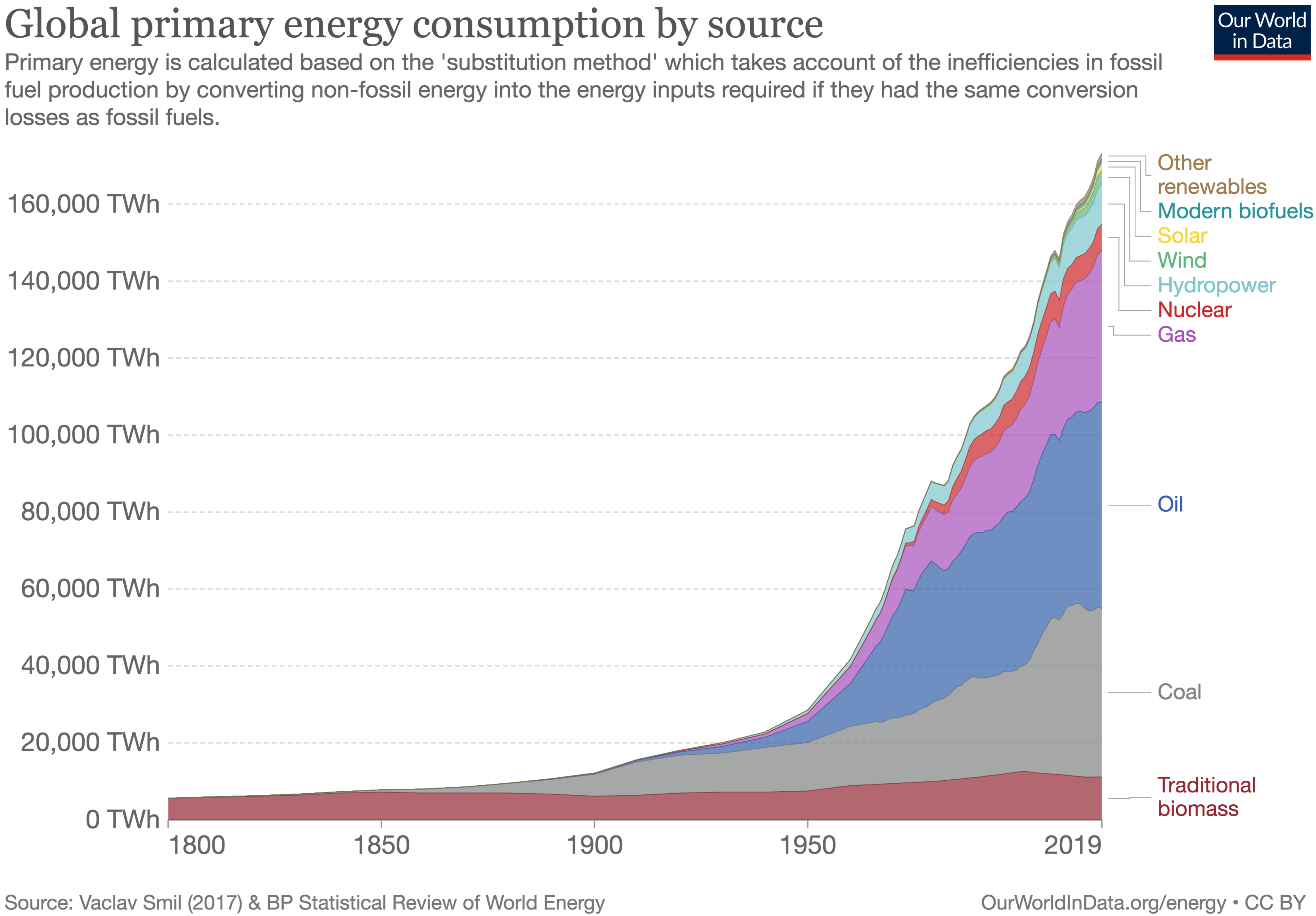
IPCC AR6 WGI SPM

Every tonne of CO_2 emissions adds to global warming

Global surface temperature increase since 1850-1900 (°C) as a function of cumulative CO_2 emissions ($GtCO_2$)

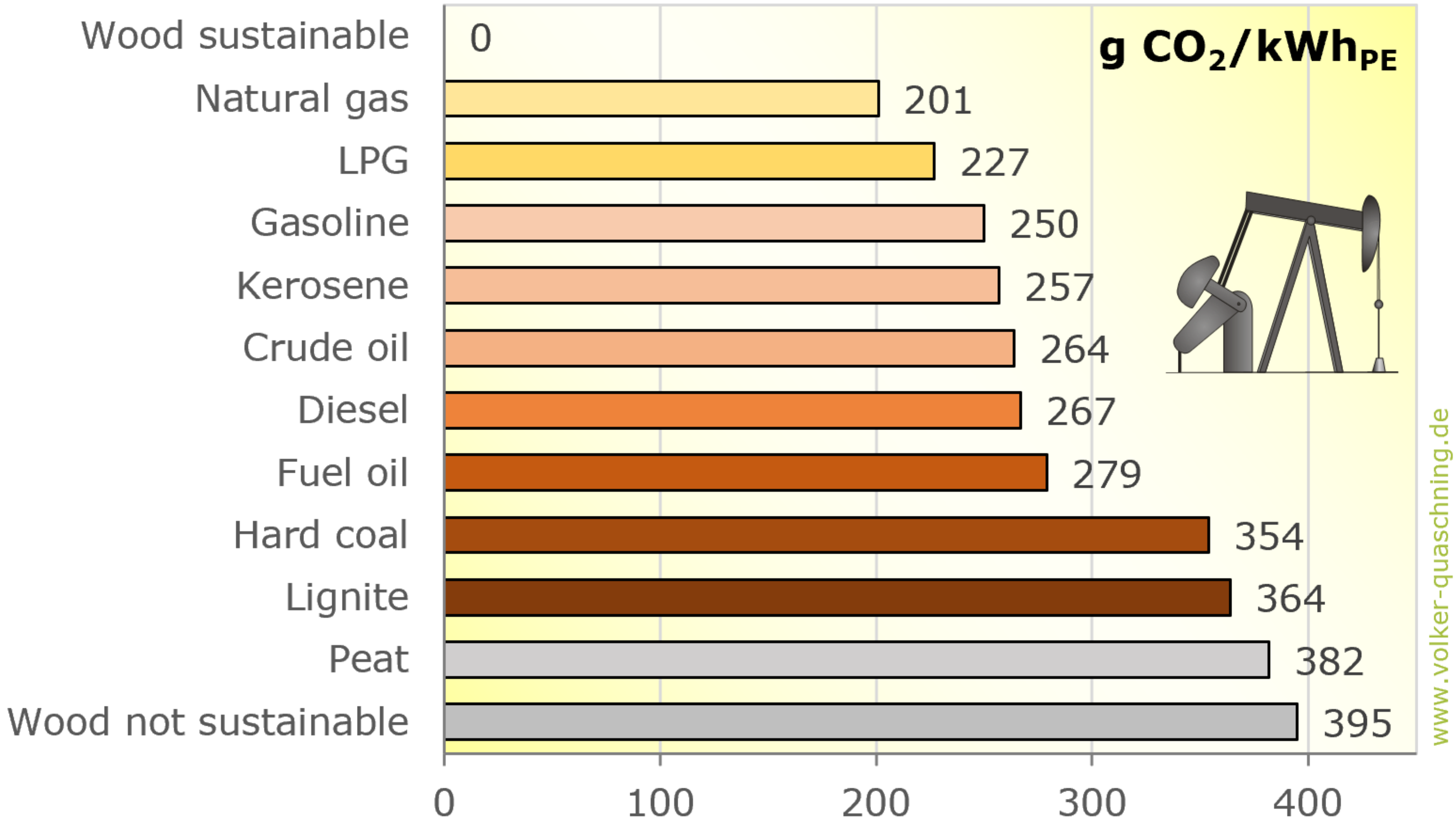


Peters (2019)
IPCC AR6 WGI SPM



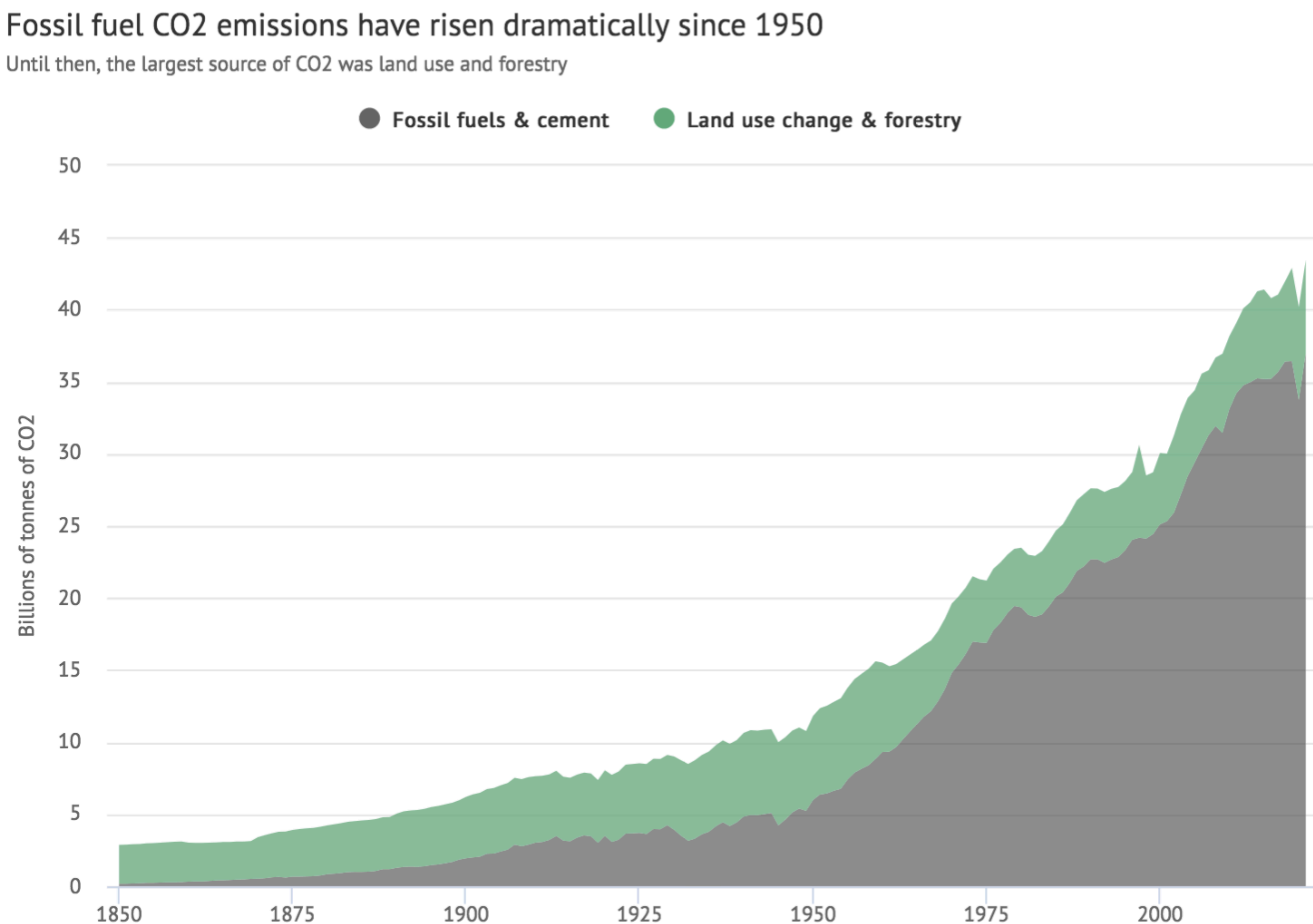
Source

York & Bell (2019)

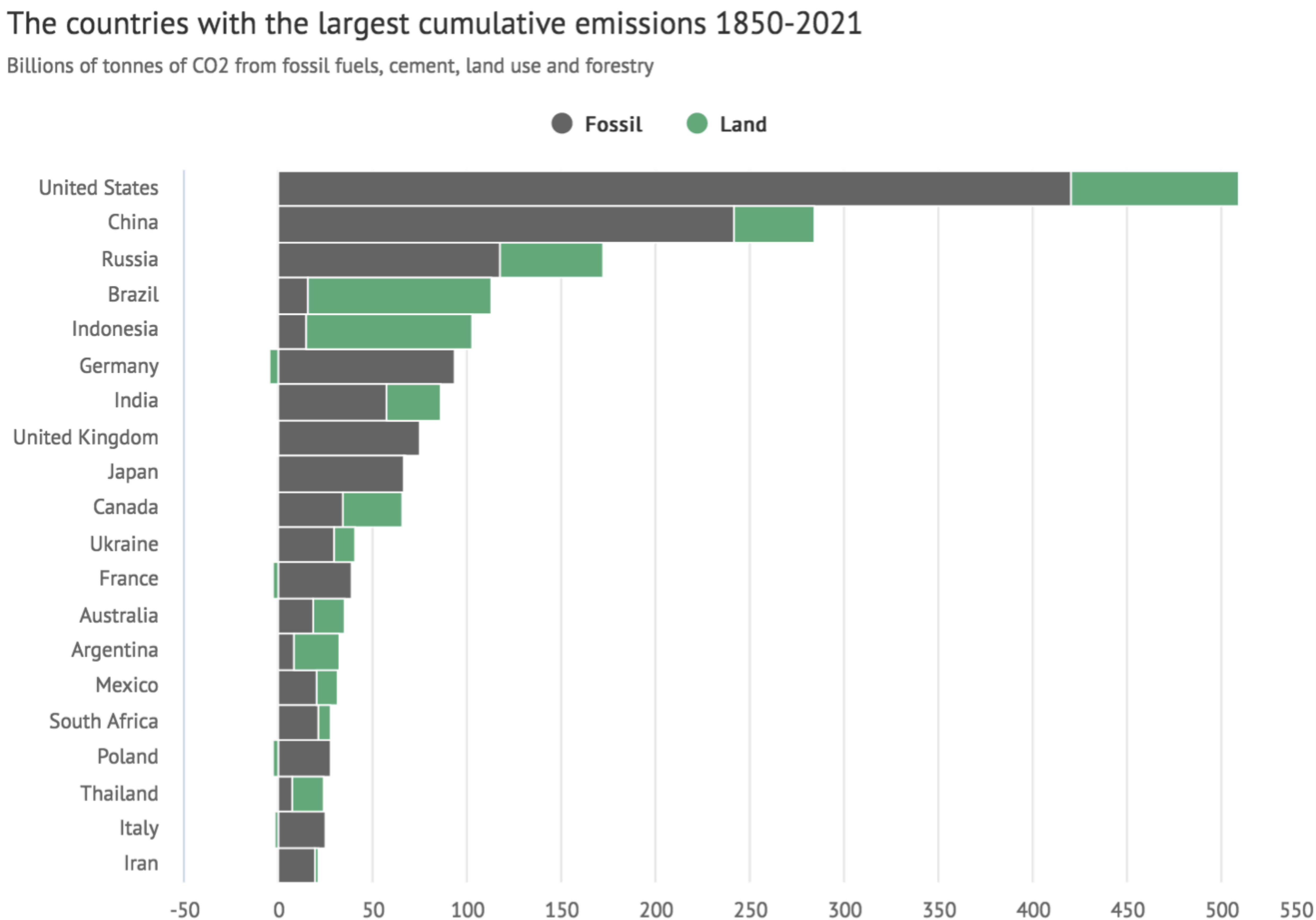


Source

On Biofuels

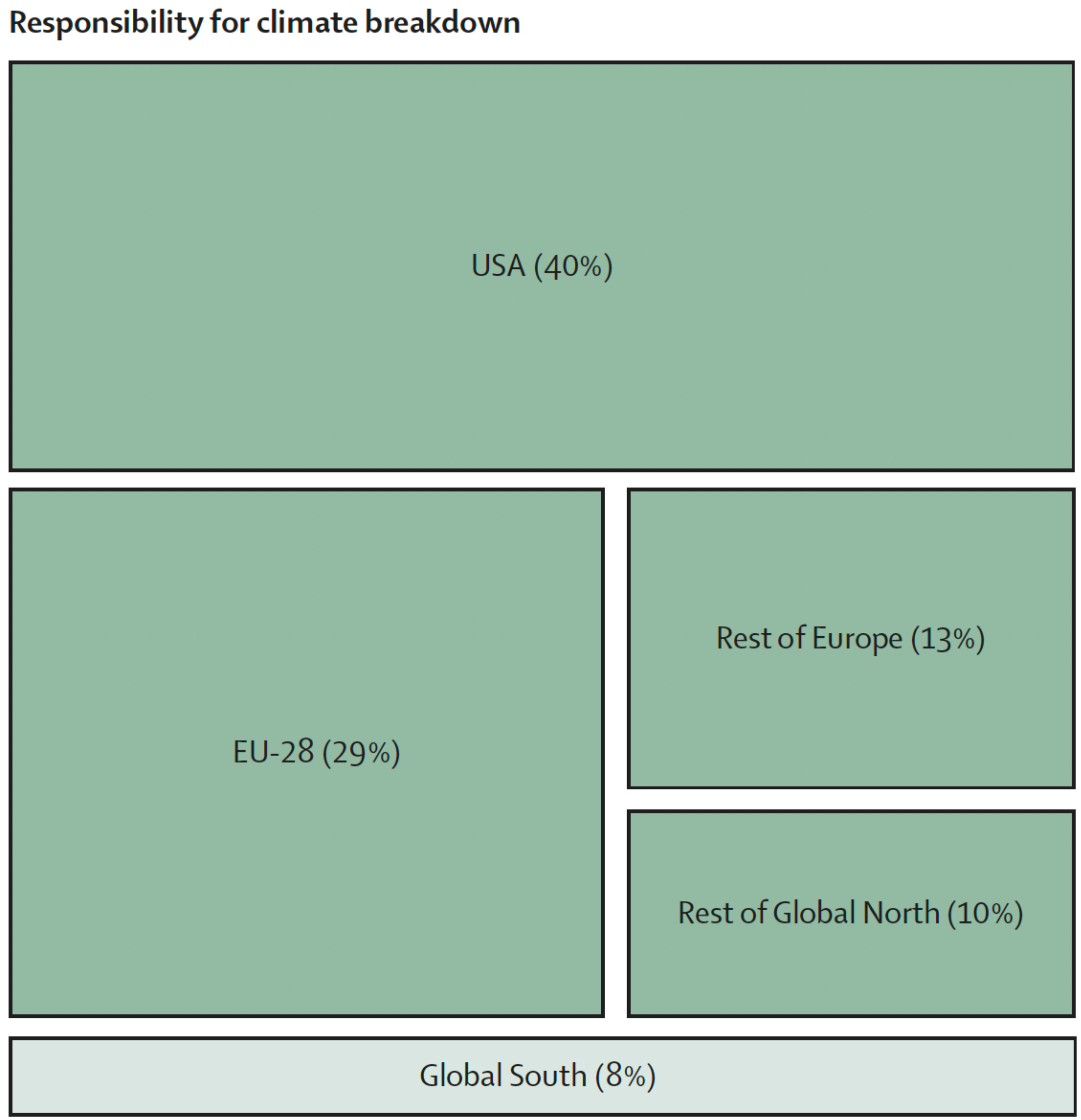

Fossil fuel CO2 emissions have risen dramatically since 1950
Until then, the largest source of CO2 was land use and forestry
Fossil fuels & cement
Land use change & forestry
Billions of tonnes of CO2
50
45
40
35
30
25
20
15
10
5
0
1850
1875
1900
1925
1950
1975
2000

Evans (2021)

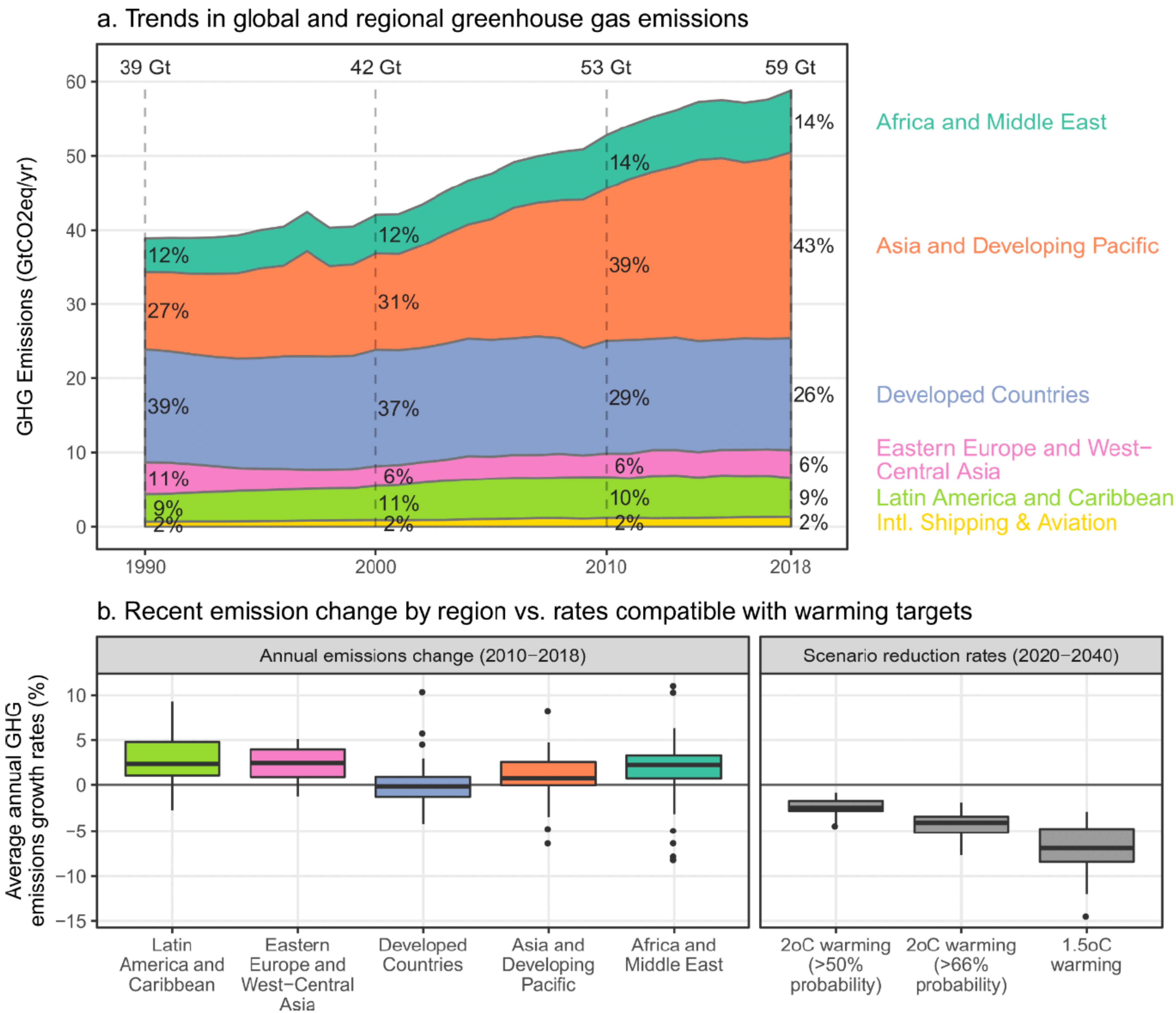


The countries with the largest cumulative emissions 1850-2021
Billions of tonnes of CO2 from fossil fuels, cement, land use and forestry
Fossil
Land
United States
China
Russia
Brazil
Indonesia
Germany
India
United Kingdom
Japan
Canada
Ukraine
France
Australia
Argentina
Mexico
South Africa
Poland
Thailand
Italy
Iran
-50
0
50
100
150
200
250
300
350
400
450
500
550

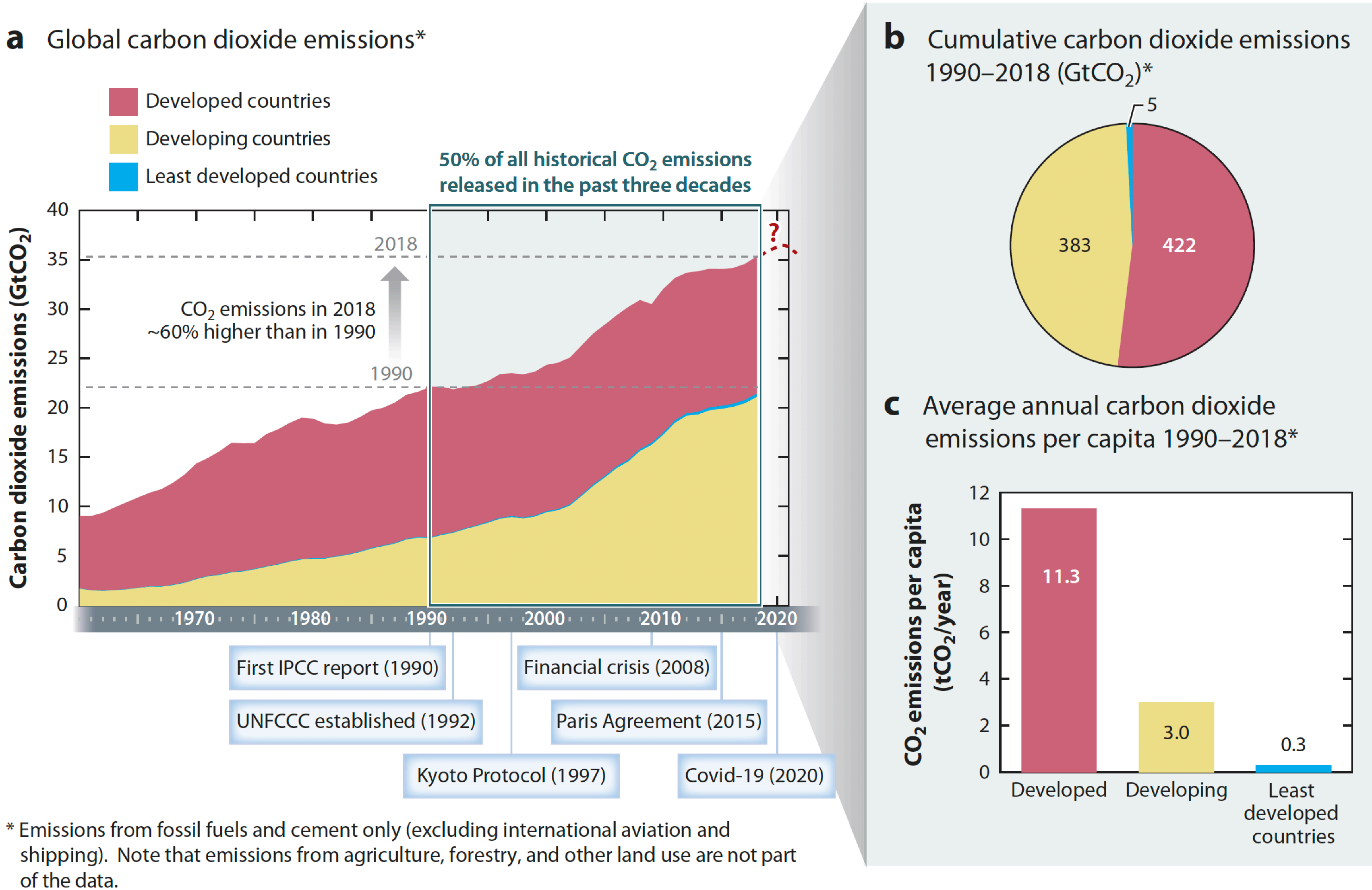
Evans (2021)


Responsibility for climate breakdown
USA (40%)
EU-28 (29%)
Rest of Europe (13%)
Rest of Global North (10%)
Global South (8%)

Hickel (2020)



Leaked IPCC AR6 WGIII SPM



Stoddard et al. (2021)

Three Decades of Climate Mitigation: Why Haven't We Bent the Global Emissions Curve?

Annual Review of Environment and Resources
Vol. 46:653-689 (Volume publication date October 2021)
First published as a Review in Advance on June 29, 2021
https://doi.org/10.1146/annurev-environ-012220-011104

Isak Stoddard,[1] Kevin Anderson,[1,2] Stuart Capstick,[3] Wim Carton,[4] Joanna Depledge,[5] Keri Facer,[1,6] Clair Gough,[2] Frederic Hache,[7] Claire Hoolohan,[2,3] Martin Hultman,[8] Niclas Hällström,[9] Sivan Kartha,[10] Sonja Klinsky,[11] Magdalena Kuchler,[1] Eva Lövbrand,[12] Naghmeh Nasiritousi,[13,14] Peter Newell,[15] Glen P. Peters,[16] Youba Sokona,[17] Andy Stirling,[18] Matthew Stilwell,[19] Clive L. Spash,[20] and Mariama Williams[17]

Davos Cluster

- International Climate Governance
- Vested Interests of the Fossil Fuel Industry
- Geopolitics & Militarism

Enabler Cluster

- Economics & Financialization
- Mitigation Modelling
- Energy Supply System

Ostrich & Phoenix

- Inequity
- High-Carbon Lifestyles
- Social Imaginaries

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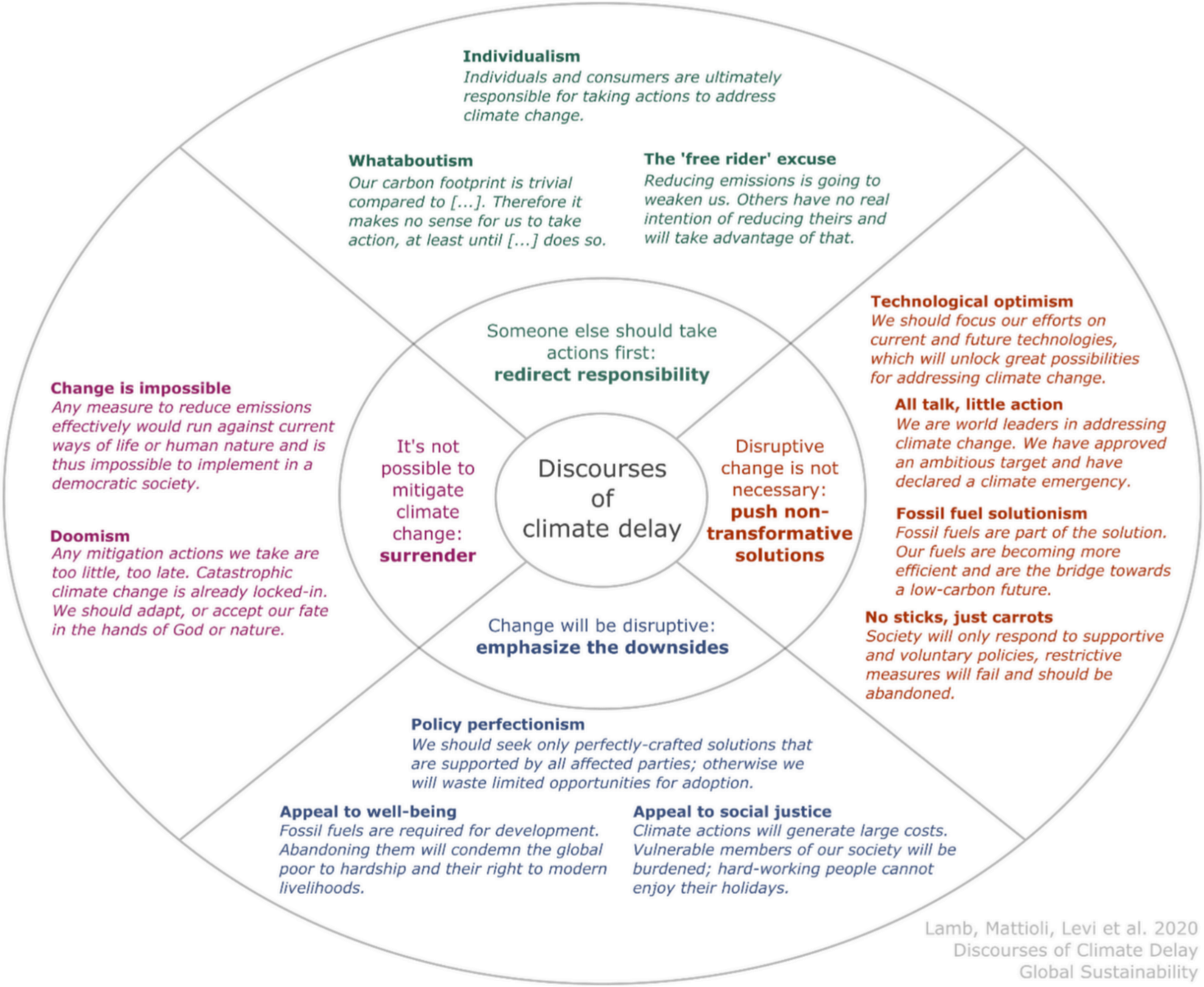
"I've been there all along, and it had taken me too long to figure out what was happening. I wrote the first book about [climate change] and I kept writing more books, articles, and having symposiums on the theory that if we kept piling up enough data and reason eventually the powers that be would get to work — why wouldn't they?

I thought that we were in an argument. And it took me too long to figure out that we won the argument, but that that didn't mean anything. We won the argument — the science was entirely robust and clear. We were just losing the fight.

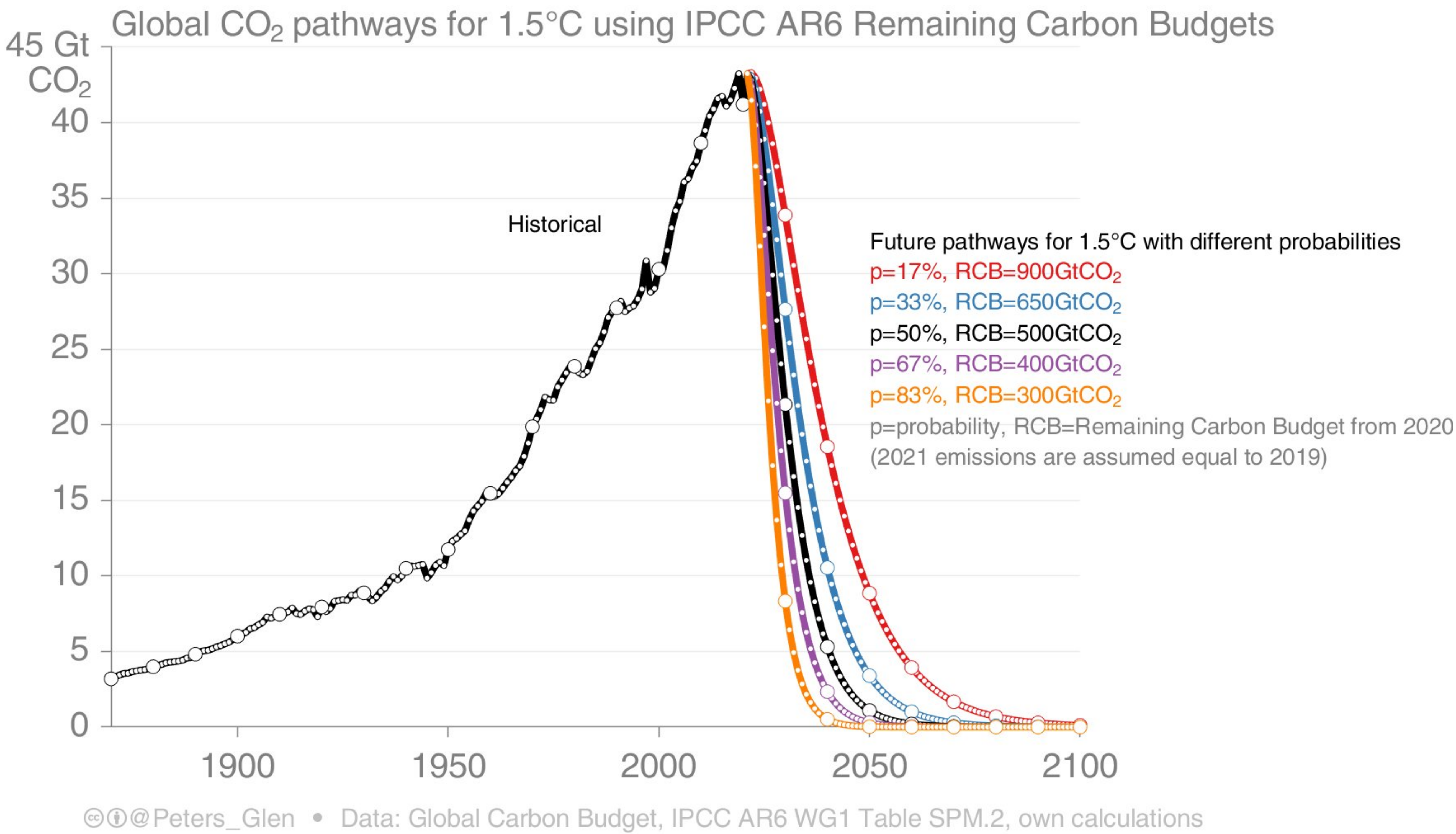
Because the fight wasn't about data and reason, the fight was about money and power, which is what fights are always about."

\- Bill McKibben

Power

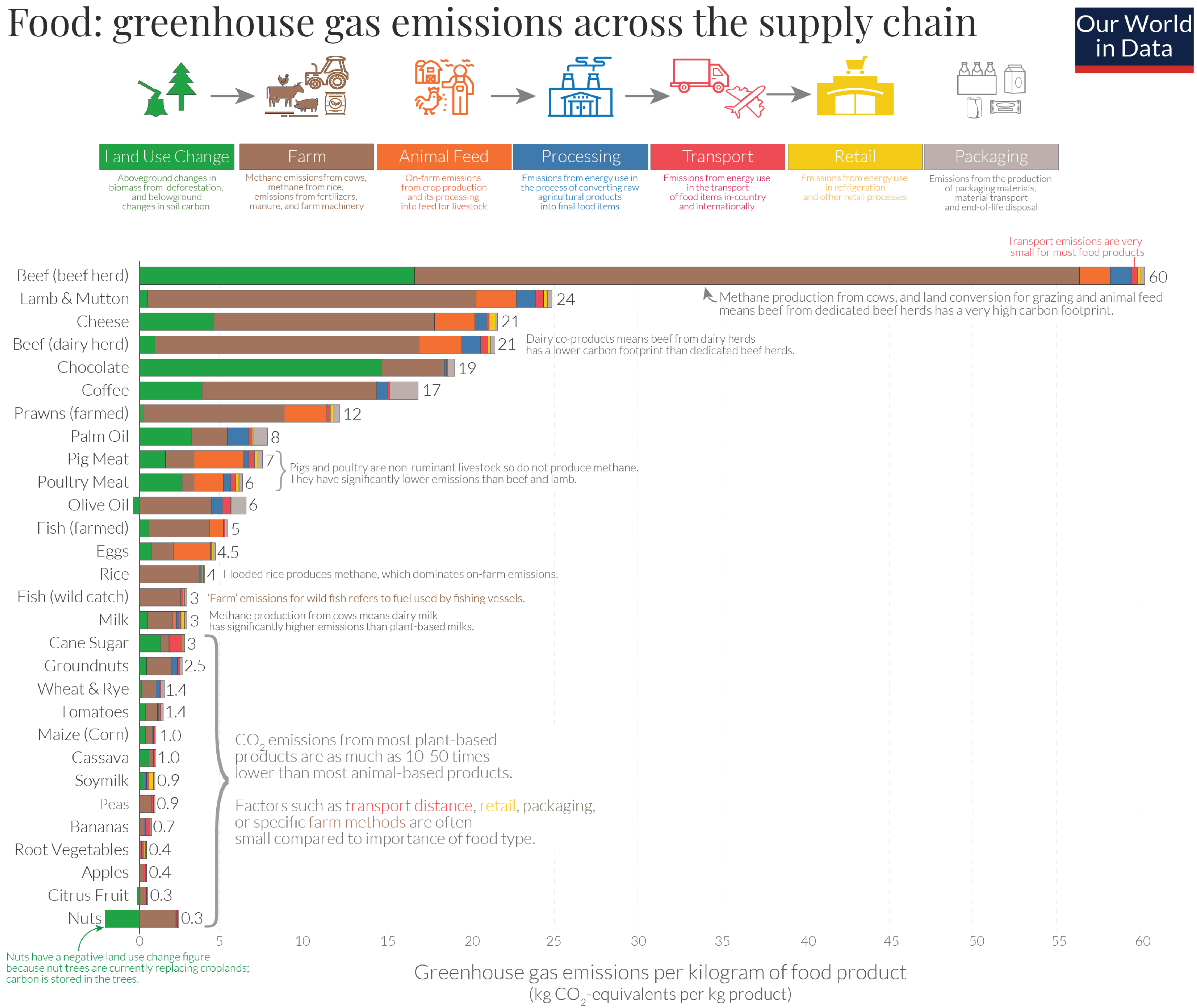

Individualism
Individuals and consumers are ultimately responsible for taking actions to address climate change.
Whataboutism
Our carbon footprint is trivial compared to [...]. Therefore it makes no sense for us to take action, at least until [...] does so.
The 'free rider' excuse
Reducing emissions is going to weaken us. Others have no real intention of reducing theirs and will take advantage of that.
Someone else should take actions first:
redirect responsibility
Technological optimism
We should focus our efforts on current and future technologies, which will unlock great possibilities for addressing climate change.
All talk, little action
We are world leaders in addressing climate change. We have approved an ambitious target and have declared a climate emergency.
Fossil fuel solutionism
Fossil fuels are part of the solution. Our fuels are becoming more efficient and are the bridge towards a low-carbon future.
No sticks, just carrots
Society will only respond to supportive and voluntary policies, restrictive measures will fail and should be abandoned.
Disruptive change is not necessary:
push non-transformative solutions
Discourses of climate delay
Change is impossible
Any measure to reduce emissions effectively would run against current ways of life or human nature and is thus impossible to implement in a democratic society.
Doomism
Any mitigation actions we take are too little, too late. Catastrophic climate change is already locked-in. We should adapt, or accept our fate in the hands of God or nature.
It's not possible to mitigate climate change:
surrender
Change will be disruptive:
emphasize the downsides
Policy perfectionism
We should seek only perfectly-crafted solutions that are supported by all affected parties; otherwise we will waste limited opportunities for adoption.
Appeal to well-being
Fossil fuels are required for development. Abandoning them will condemn the global poor to hardship and their right to modern livelihoods.
Appeal to social justice
Climate actions will generate large costs. Vulnerable members of our society will be burdened; hard-working people cannot enjoy their holidays.
Lamb, Mattioli, Levi et al. 2020
Discourses of Climate Delay
Global Sustainability

Lamb (2020)


Global CO_2 pathways for 1.5°C using IPCC AR6 Remaining Carbon Budgets
45 Gt CO_2
40
35
30
25
20
15
10
5
0
1900
1950
2000
2050
2100
Historical
Future pathways for 1.5°C with different probabilities
p=17%, RCB=900GtCO_2
p=33%, RCB=650GtCO_2
p=50%, RCB=500GtCO_2
p=67%, RCB=400GtCO_2
p=83%, RCB=300GtCO_2
p=probability, RCB=Remaining Carbon Budget from 2020
(2021 emissions are assumed equal to 2019)
@Peters_Glen • Data: Global Carbon Budget, IPCC AR6 WG1 Table SPM.2, own calculations

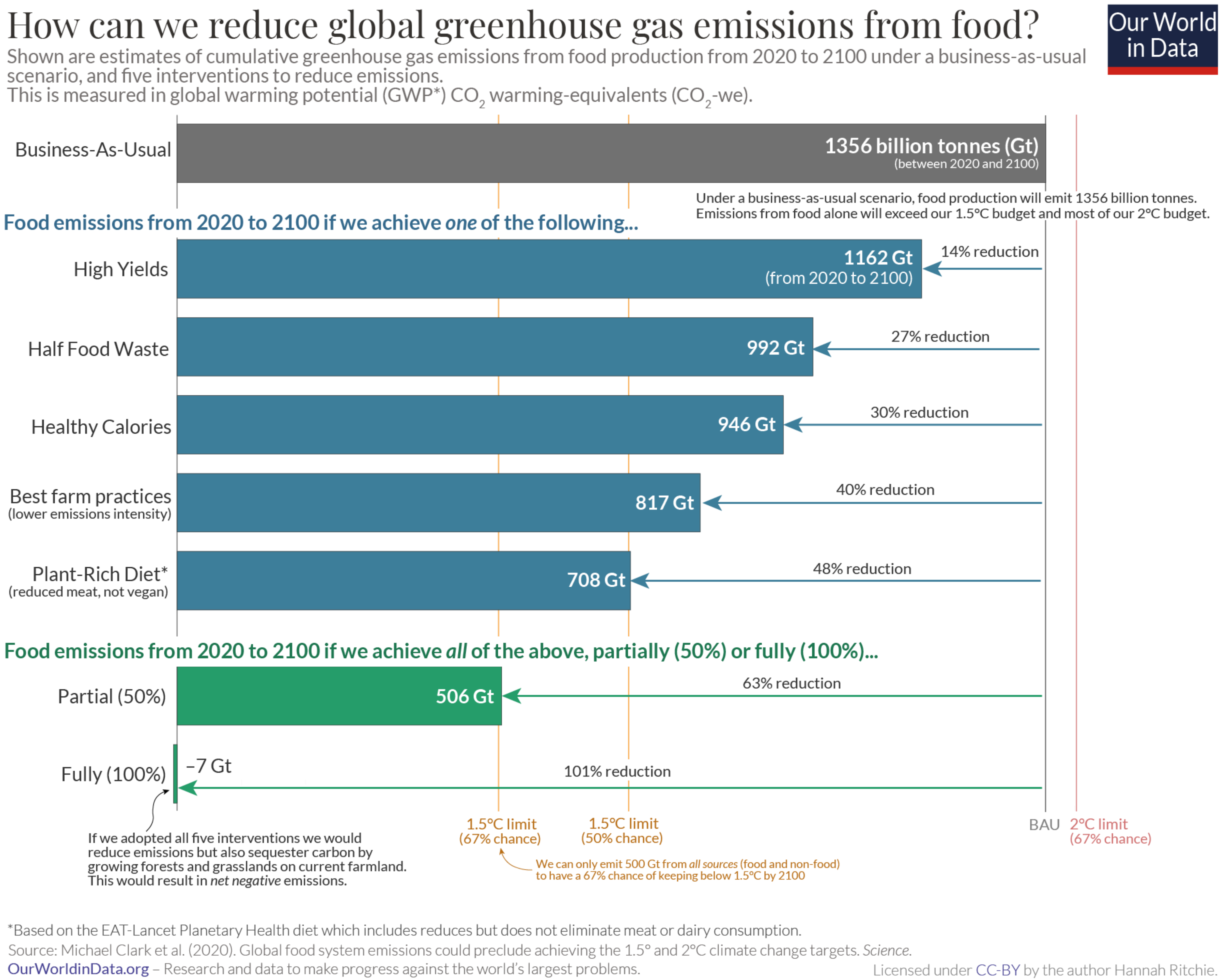
Peters (2021)

Food



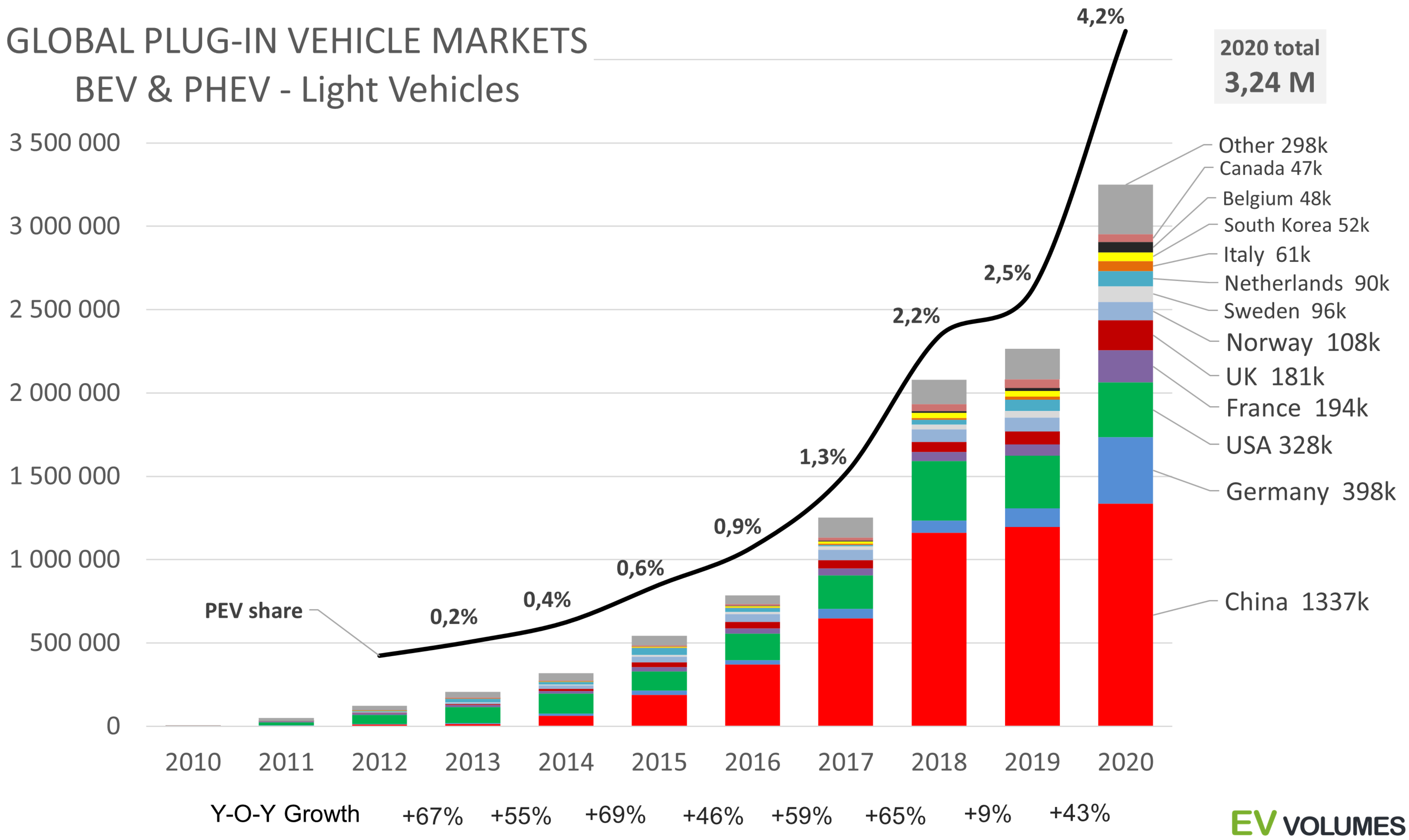
Note: Greenhouse gas emissions are given as global average values based on data across 38,700 commercially viable farms in 119 countries.
Data source: Poore and Nemecek (2018). Reducing food's environmental impacts through producers and consumers. *Science*. Images sourced from the Noun Project.
OurWorldinData.org – Research and data to make progress against the world's largest problems.

Source


How can we reduce global greenhouse gas emissions from food?
Shown are estimates of cumulative greenhouse gas emissions from food production from 2020 to 2100 under a business-as-usual scenario, and five interventions to reduce emissions.
This is measured in global warming potential (GWP*) CO_2 warming-equivalents (CO_2-we).
Our World in Data
Business-As-Usual
1356 billion tonnes (Gt)
(between 2020 and 2100)
Under a business-as-usual scenario, food production will emit 1356 billion tonnes. Emissions from food alone will exceed our 1.5°C budget and most of our 2°C budget.
Food emissions from 2020 to 2100 if we achieve *one* of the following...
High Yields
1162 Gt
(from 2020 to 2100)
14% reduction
Half Food Waste
992 Gt
27% reduction
Healthy Calories
946 Gt
30% reduction
Best farm practices
(lower emissions intensity)
817 Gt
40% reduction
Plant-Rich Diet*
(reduced meat, not vegan)
708 Gt
48% reduction
Food emissions from 2020 to 2100 if we achieve *all* of the above, partially (50%) or fully (100%)...
Partial (50%)
506 Gt
63% reduction
Fully (100%)
−7 Gt
101% reduction
If we adopted all five interventions we would reduce emissions but also sequester carbon by growing forests and grasslands on current farmland. This would result in *net negative* emissions.
1.5°C limit
(67% chance)
1.5°C limit
(50% chance)
We can only emit 500 Gt from *all sources* (food and non-food) to have a 67% chance of keeping below 1.5°C by 2100
BAU
2°C limit
(67% chance)
*Based on the EAT-Lancet Planetary Health diet which includes reduces but does not eliminate meat or dairy consumption.
Source: Michael Clark et al. (2020). Global food system emissions could preclude achieving the 1.5° and 2°C climate change targets. *Science*.
OurWorldinData.org – Research and data to make progress against the world's largest problems.
Licensed under CC-BY by the author Hannah Ritchie.

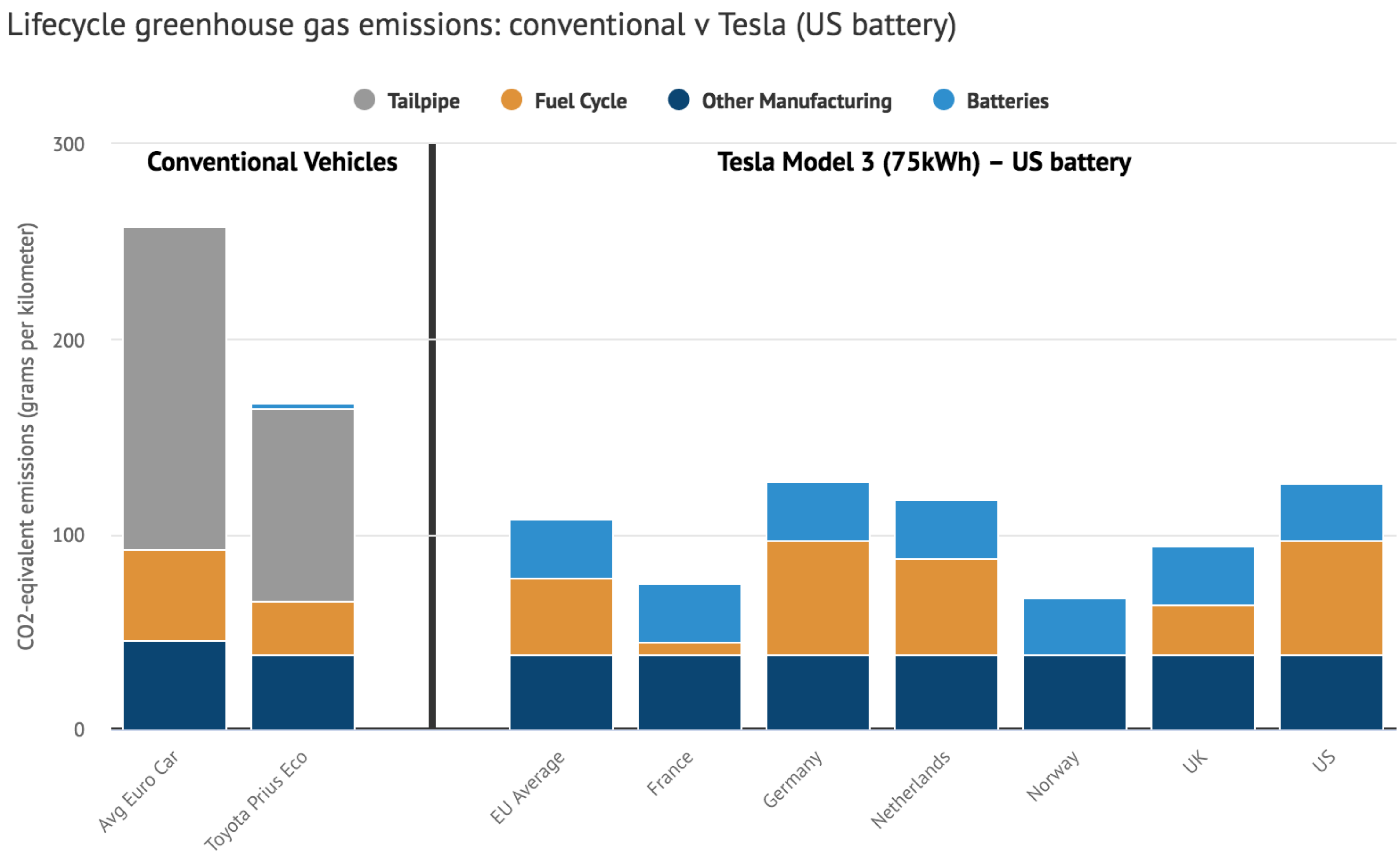
Source

Transport



GLOBAL PLUG-IN VEHICLE MARKETS
BEV & PHEV - Light Vehicles
2020 total
3,24 M
3 500 000
3 000 000
2 500 000
2 000 000
1 500 000
1 000 000
500 000
0
PEV share
0,2%
0,4%
0,6%
0,9%
1,3%
2,2%
2,5%
4,2%
Other 298k
Canada 47k
Belgium 48k
South Korea 52k
Italy 61k
Netherlands 90k
Sweden 96k
Norway 108k
UK 181k
France 194k
USA 328k
Germany 398k
China 1337k
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Y-O-Y Growth
+67%
+55%
+69%
+46%
+59%
+65%
+9%
+43%
EV VOLUMES

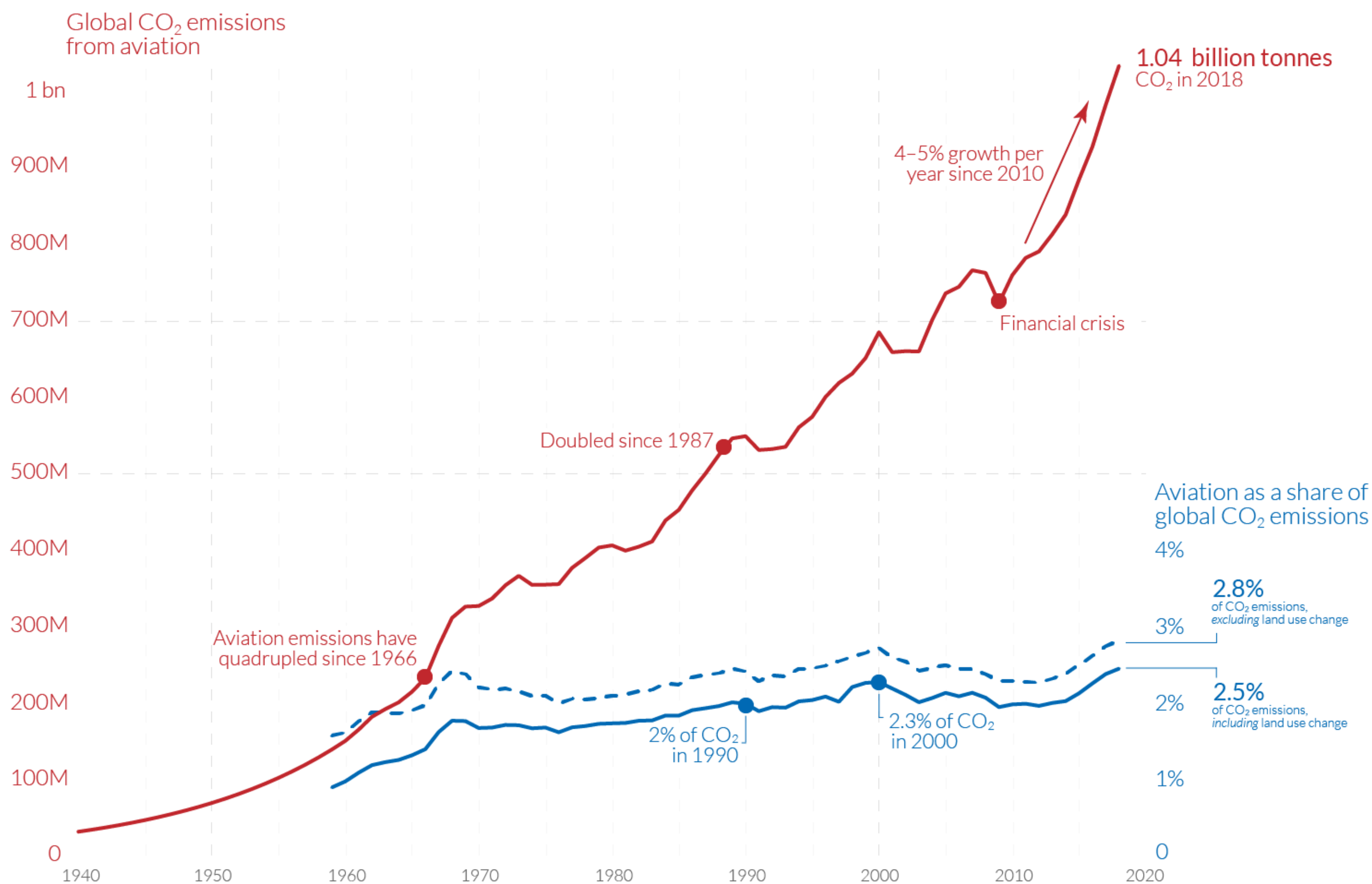
Source



Hausfather (2019)

Global carbon dioxide emissions from aviation

Aviation emissions includes passenger air travel, freight and military operations. It does not include non-CO_2 climate forcings, or a multiplier for warming effects at altitude.

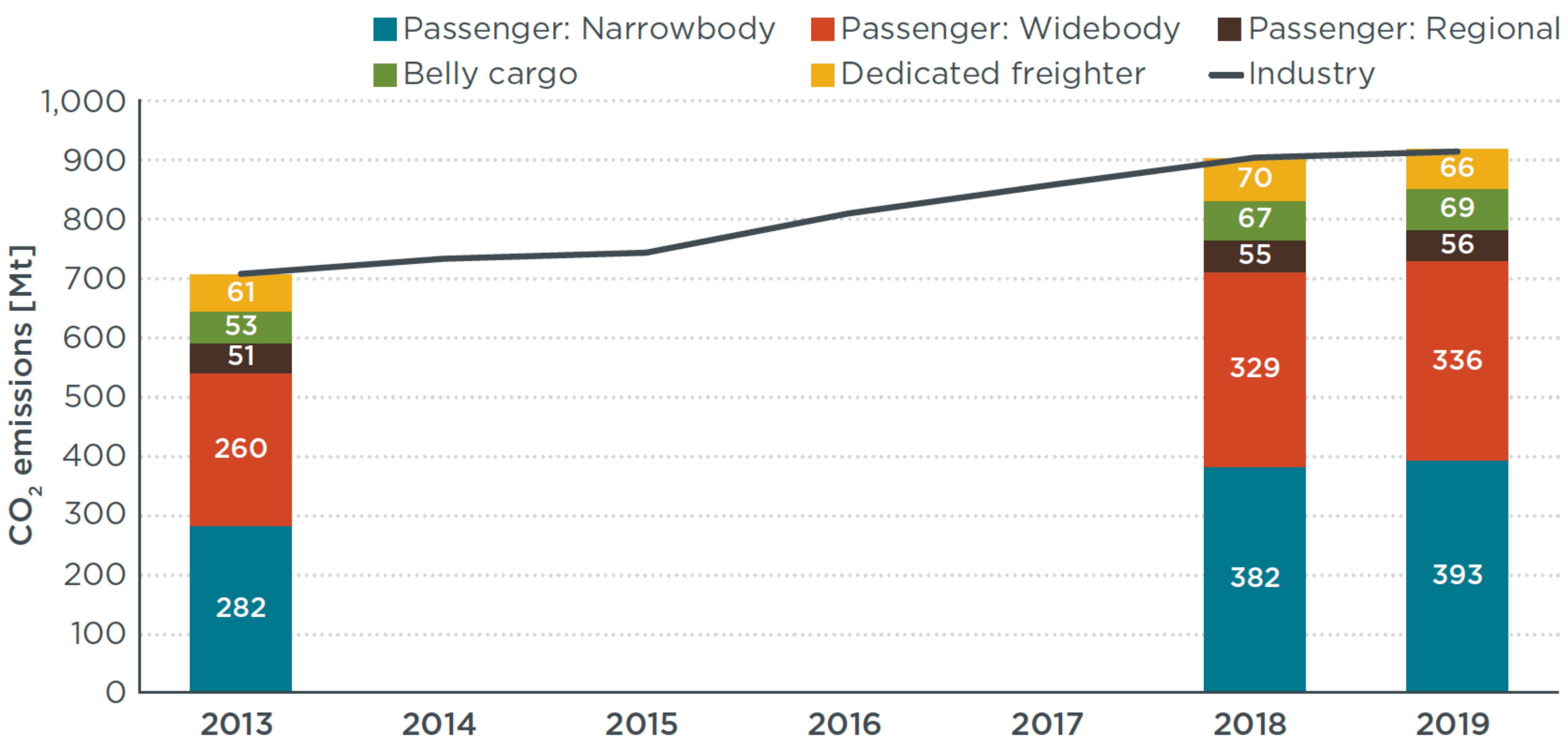


OurWorldinData.org – Research and data to make progress against the world's largest problems.

Source: Lee et al. (2020). The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018; based on Sausen and Schumann (2000) & IEA.

Share of global emissions calculated based on total CO_2 data from the Global Carbon Project.

Ritchie (2020)

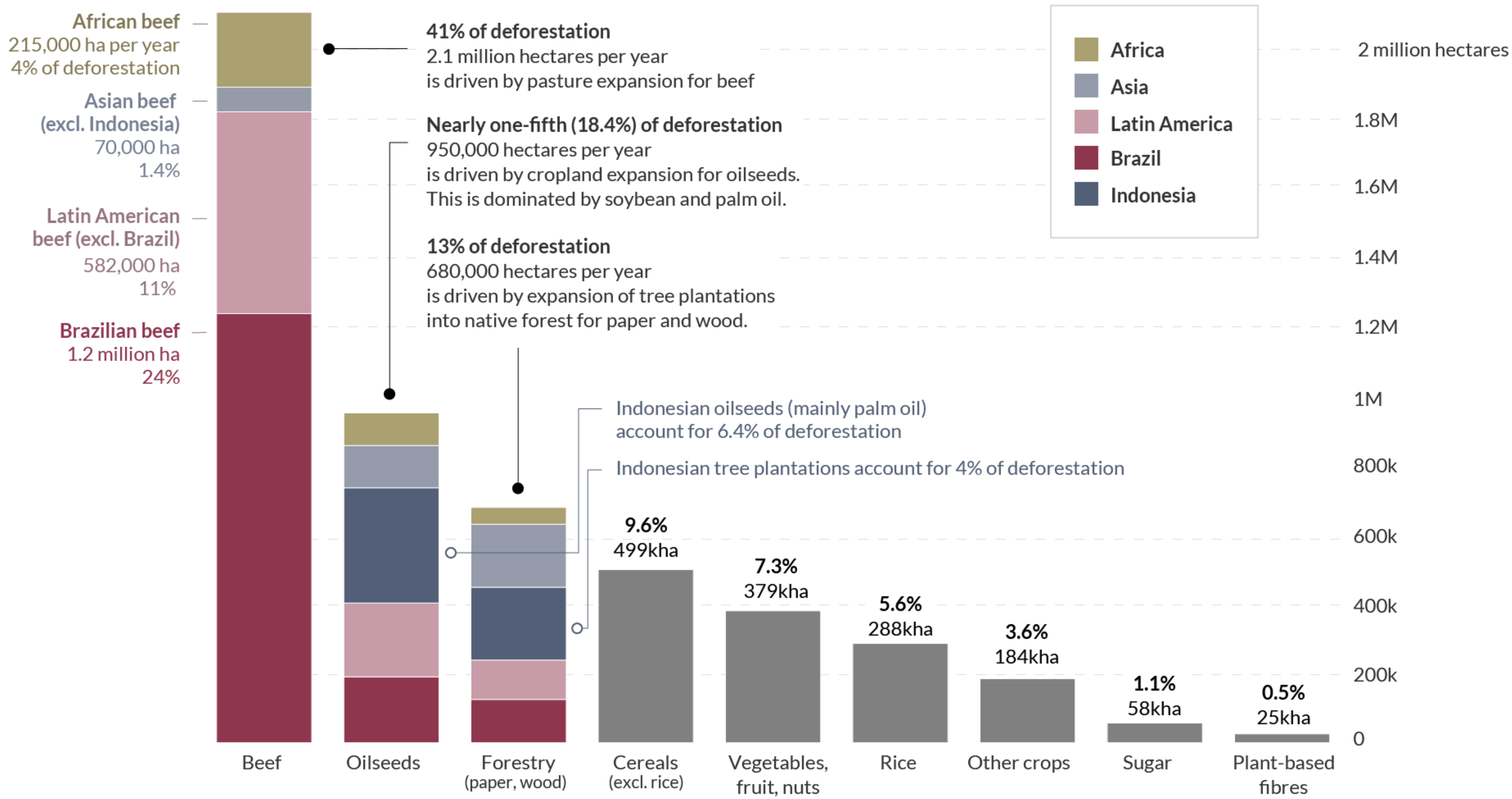


Graver, Rutherford, & Zheng (2020)

Deforestation

What are the drivers of tropical deforestation?

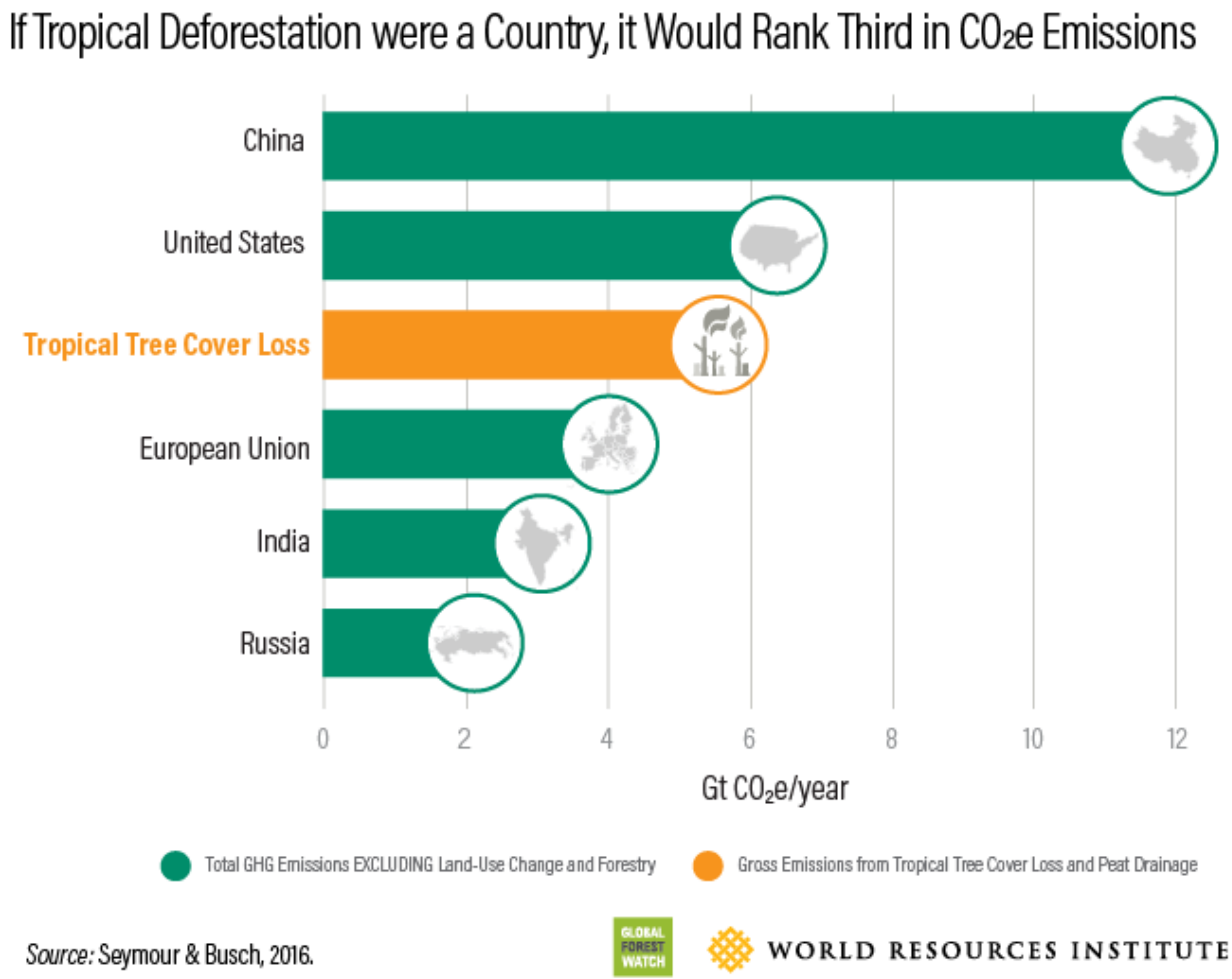
Nearly all of global deforestation occurs in tropical and subtropical countries. 70% to 80% is driven by conversion of primary forest to agriculture or tree plantations. Shown is the breakdown of these drivers averaged over the years 2005 to 2013. Further observations since 2013 suggest that drivers have not changed substantially over this period.



Data source: Florence Pendrill et al. (2019). Deforestation displaced: trade in forest-risk commodities and the prospects for a global forest transition.

OurWorldinData.org – Research and data to make progress against the world's largest problems.

Source


If Tropical Deforestation were a Country, it Would Rank Third in CO2e Emissions
China
United States
Tropical Tree Cover Loss
European Union
India
Russia
0
2
4
6
8
10
12
Gt CO2e/year
Total GHG Emissions EXCLUDING Land-Use Change and Forestry
Gross Emissions from Tropical Tree Cover Loss and Peat Drainage
Source: Seymour & Busch, 2016.
GLOBAL FOREST WATCH
WORLD RESOURCES INSTITUTE

Source

Pitfalls of Tree Planting Show Why We Need People-Centered Natural Climate Solutions FREE

Forrest Fleischman ✉, Shishir Basant, Ashwini Chhatre, Eric A Coleman, Harry W Fischer, Divya Gupta, Burak Güneralp, Prakash Kashwan, Dil Khatri, Robert Muscarella ... Show more

BioScience, Volume 70, Issue 11, November 2020, Pages 947–950, https://doi.org/10.1093/biosci/biaa094

Published: 16 September 2020

(1) Ecosystems, not tree planting campaigns, capture and store carbon

(2) Preventing ecosystem destruction is the most cost-effective natural climate solution

(3) Forests can regrow on deforested land without tree planting

(4) Tree plantations sequester less carbon, less securely, than naturally regenerated forests

(5) Tree plantations in grasslands, shrublands, and peatlands destroy biodiversity

(6) Trees can reduce water availability

(7) Trees can warm the atmosphere

(8) Perverse financial incentives lead to rushed planting and high tree mortality

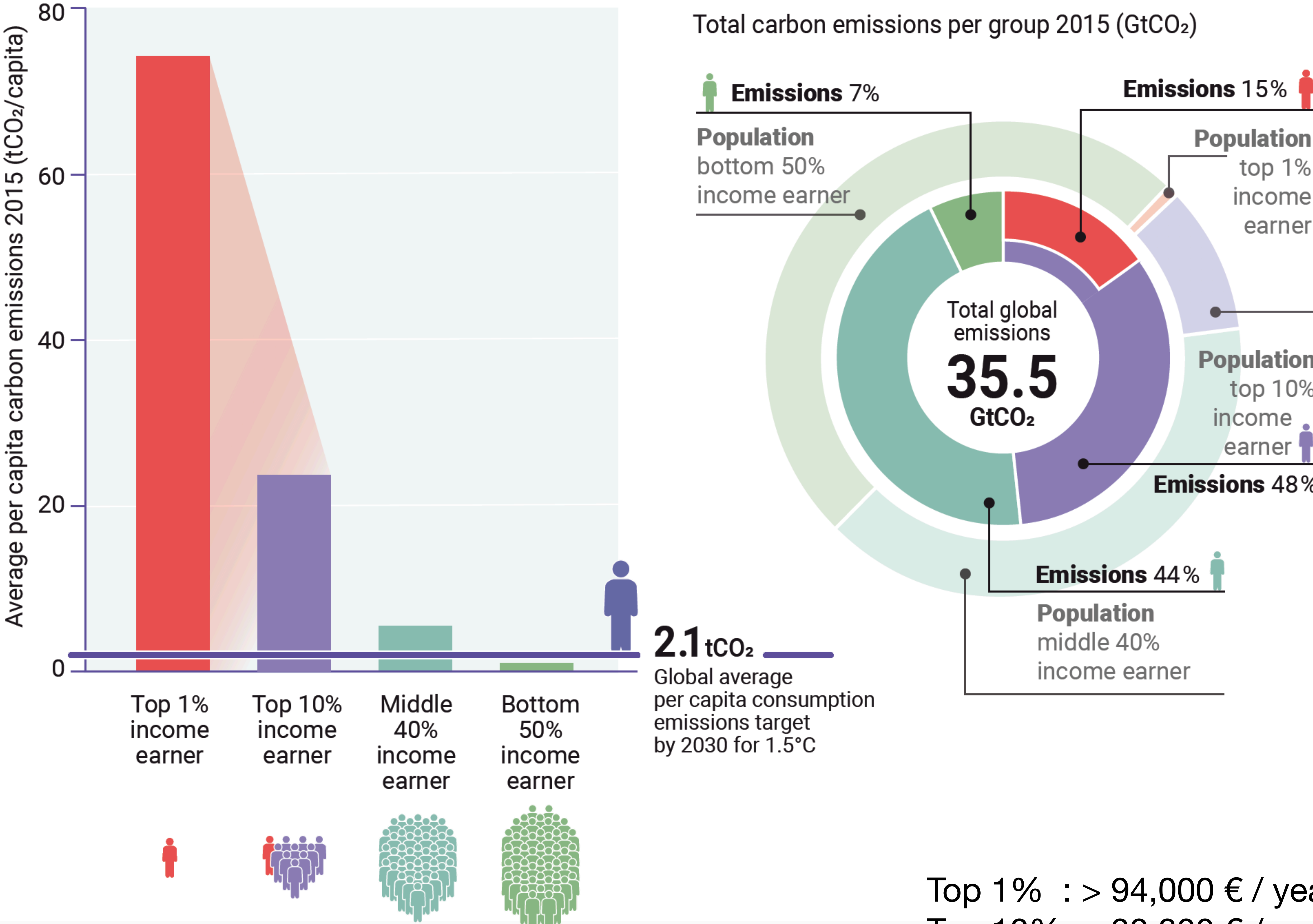
(9) Tree planting threatens rural livelihoods

(10) Tree planting targets the global south to capture emissions from the global north

Fleischman et al. (2021)

Jones (2021)

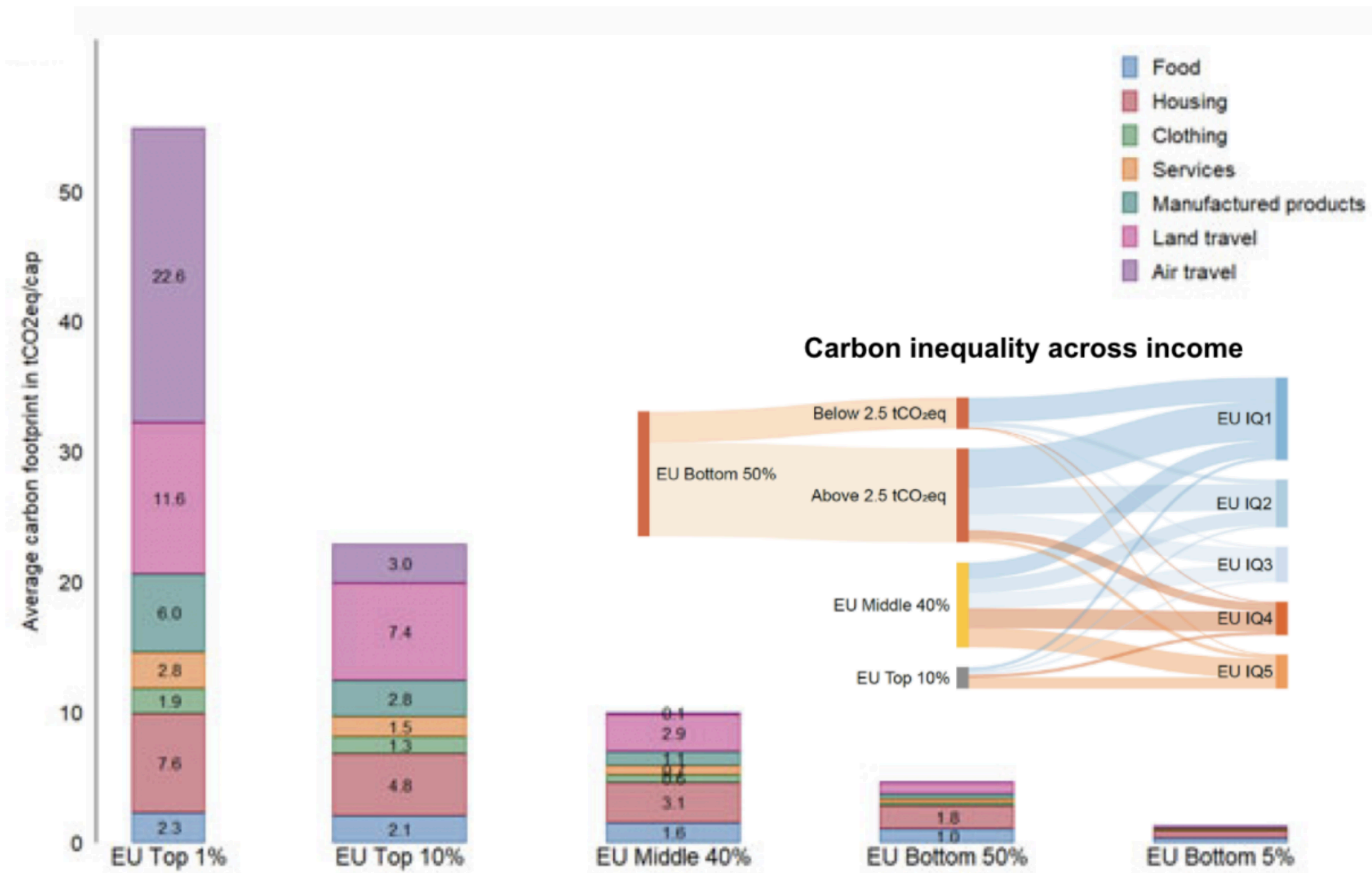
Carbon Inequality



Top 1% : > 94,000 € / year
Top 10%: > 32,800 € / year

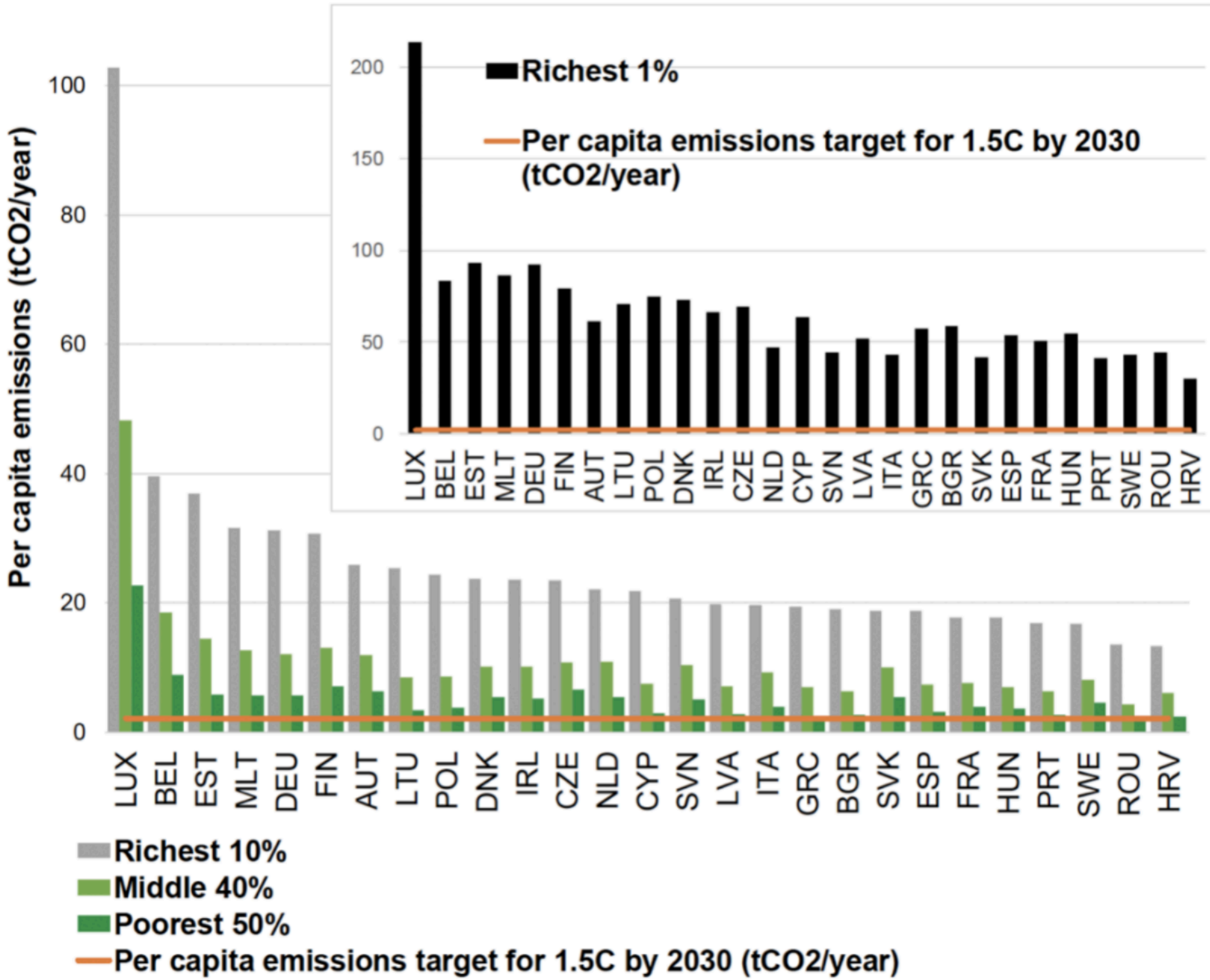
Capstick et al. (2020)

Carbon inequality across EU households

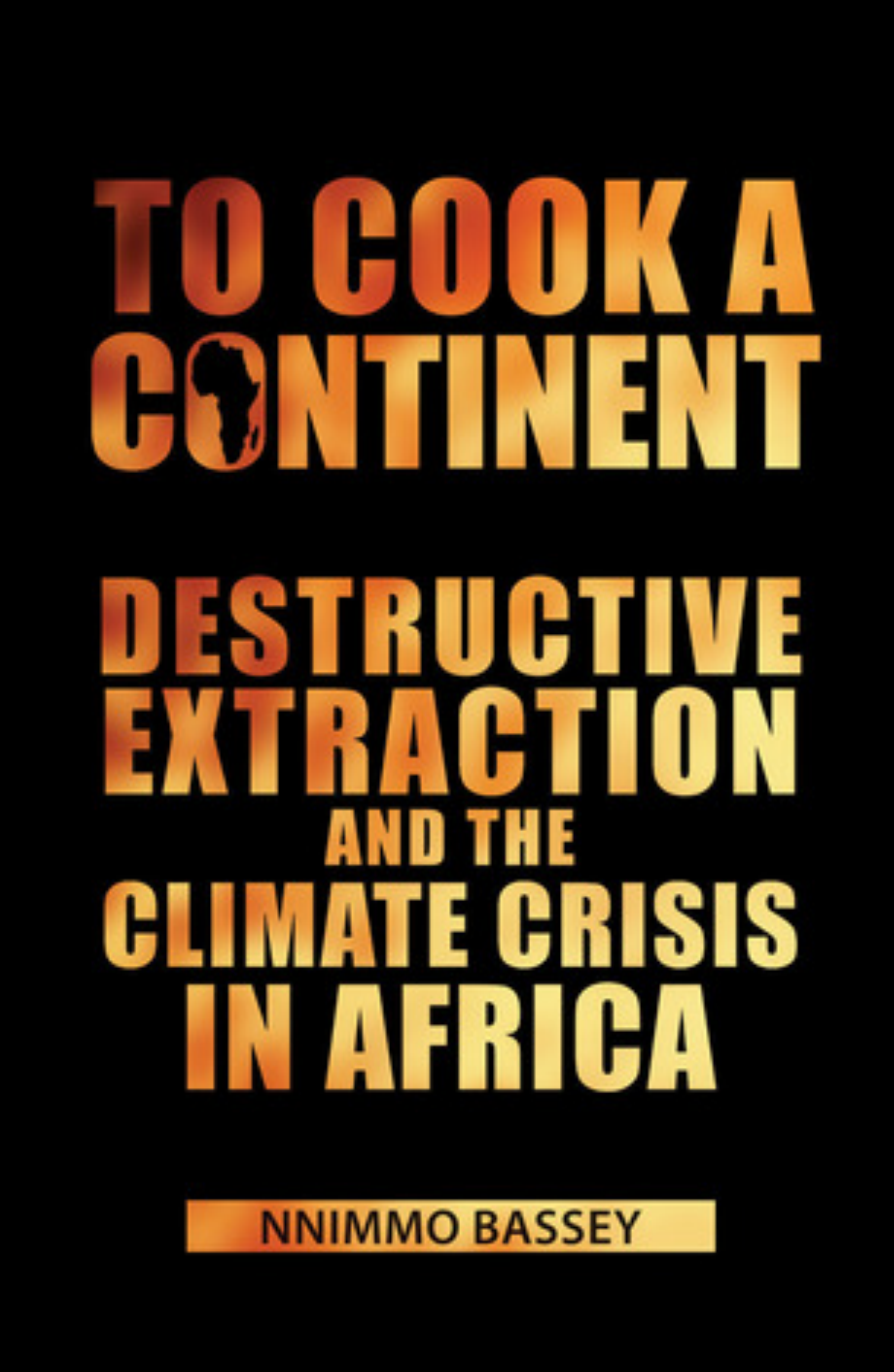


Ivanova & Wood (2020)

Carbon inequality across EU member states

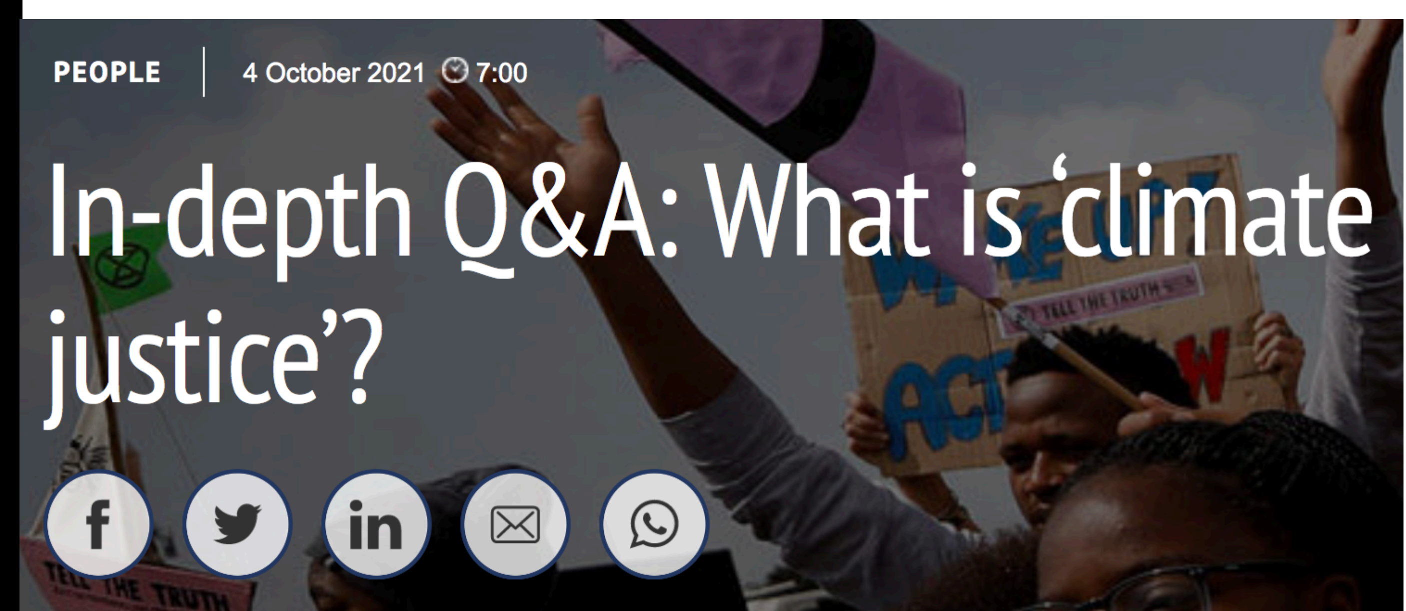


Gore & Alestig (2020)

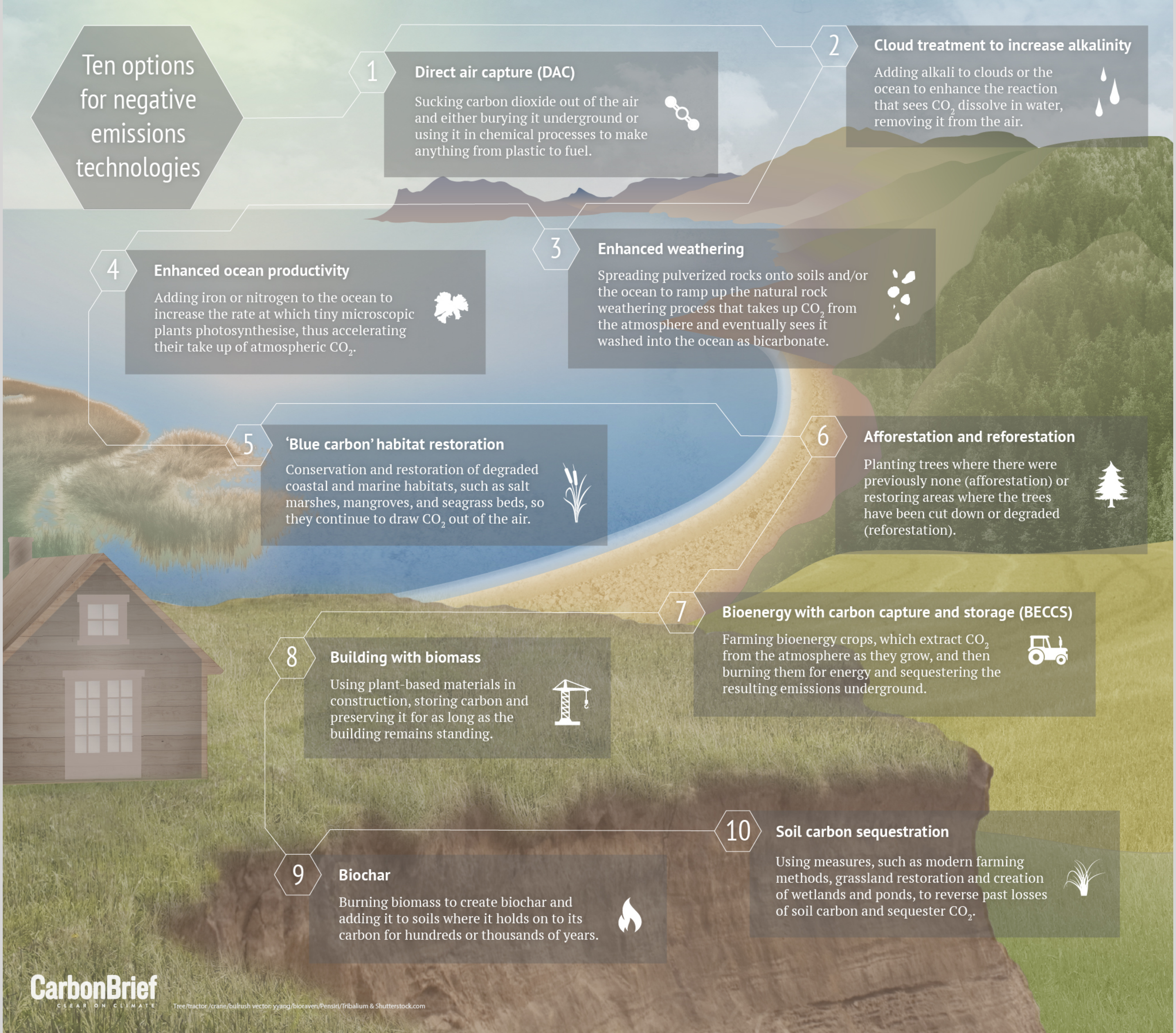


<u>Talk</u>

<u>Learning From Ladakh</u>



Negative Emissions Technology


Ten options for negative emissions technologies
1 Direct air capture (DAC)
Sucking carbon dioxide out of the air and either burying it underground or using it in chemical processes to make anything from plastic to fuel.
2 Cloud treatment to increase alkalinity
Adding alkali to clouds or the ocean to enhance the reaction that sees CO_2 dissolve in water, removing it from the air.
3 Enhanced weathering
Spreading pulverized rocks onto soils and/or the ocean to ramp up the natural rock weathering process that takes up CO_2 from the atmosphere and eventually sees it washed into the ocean as bicarbonate.
4 Enhanced ocean productivity
Adding iron or nitrogen to the ocean to increase the rate at which tiny microscopic plants photosynthesise, thus accelerating their take up of atmospheric CO_2.
5 'Blue carbon' habitat restoration
Conservation and restoration of degraded coastal and marine habitats, such as salt marshes, mangroves, and seagrass beds, so they continue to draw CO_2 out of the air.
6 Afforestation and reforestation
Planting trees where there were previously none (afforestation) or restoring areas where the trees have been cut down or degraded (reforestation).
7 Bioenergy with carbon capture and storage (BECCS)
Farming bioenergy crops, which extract CO_2 from the atmosphere as they grow, and then burning them for energy and sequestering the resulting emissions underground.
8 Building with biomass
Using plant-based materials in construction, storing carbon and preserving it for as long as the building remains standing.
9 Biochar
Burning biomass to create biochar and adding it to soils where it holds on to its carbon for hundreds or thousands of years.
10 Soil carbon sequestration
Using measures, such as modern farming methods, grassland restoration and creation of wetlands and ponds, to reverse past losses of soil carbon and sequester CO_2.
CarbonBrief
CLEAR ON CLIMATE
Tree/tractor/crane/bulrush vector: yyang/bioraven/Pensiri/Tribalium & Shutterstock.com

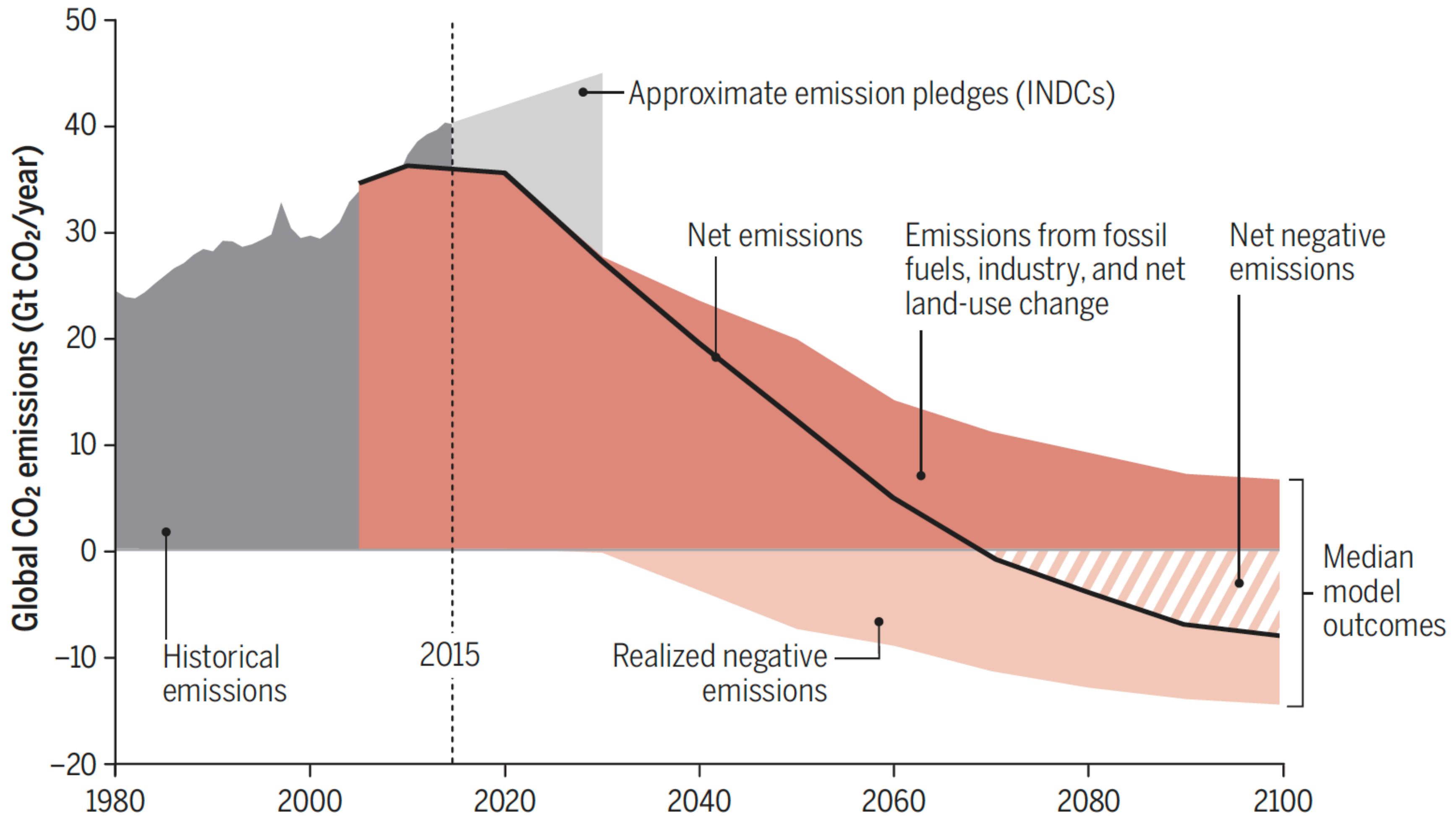
Source

Peters Talk

Anderson Interview

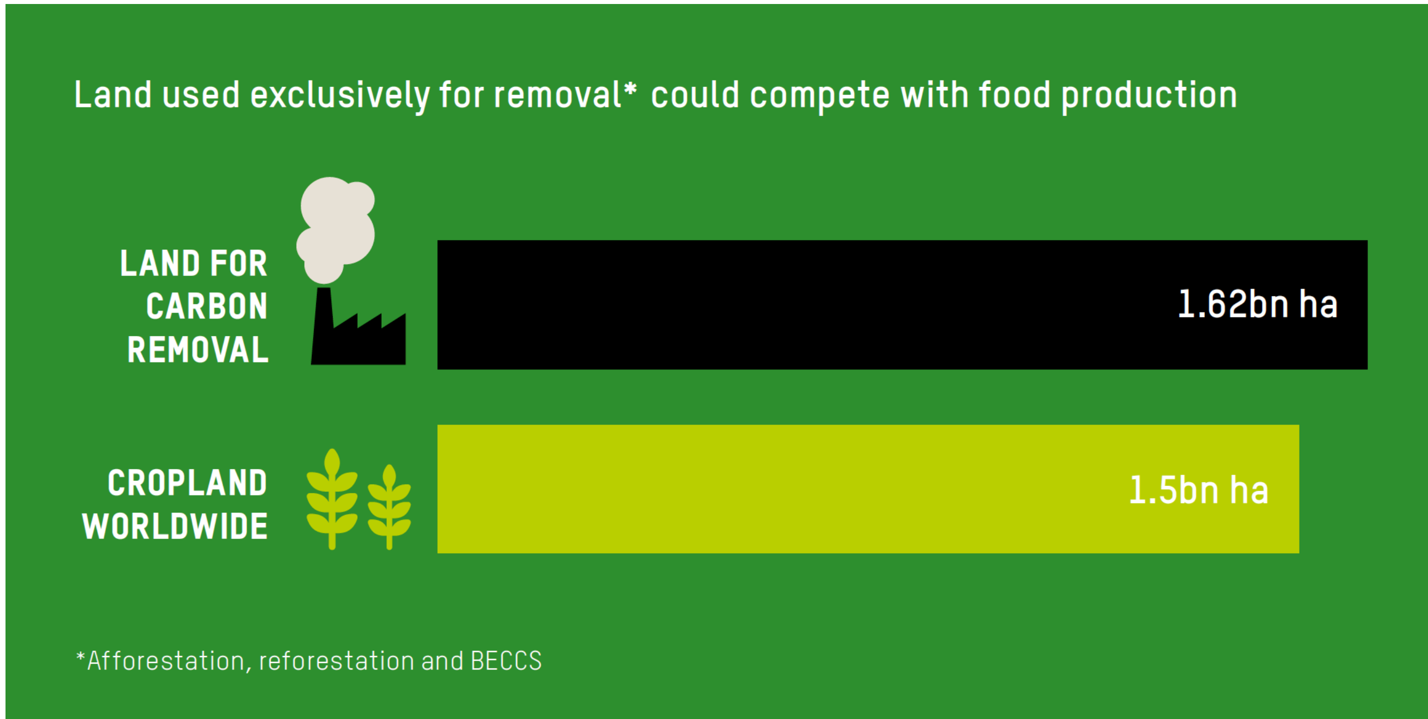
No quick fixes

Modelers generally report net carbon emissions, unintentionally hiding the scale of negative emissions. Separating out the positive CO_2 emissions from fossil fuel combustion, industry, and land-use change reveals the scale of negative CO_2 emissions in the model scenarios (*16*). INDCs, Intended Nationally Determined Contributions.



"Negative-emission technologies are not an insurance policy, but rather an unjust and high-stakes gamble."

- Anderson & Peters (2016)



Hickman (2016)

Sen & Dabi (2021)

Economics

Keen Podcast

Hickel Podcast

The appallingly bad neoclassical economics of climate change

Steve Keen

Institute for Strategy, Resilience and Security, University College London, London, UK

ABSTRACT

Forecasts by economists of the economic damage from climate change have been notably sanguine, compared to warnings by scientists about damage to the biosphere. This is because economists made their own predictions of damages, using three spurious methods: assuming that about 90% of GDP will be unaffected by climate change, because it happens indoors; using the relationship between temperature and GDP today as a proxy for the impact of global warming over time; and using surveys that diluted extreme warnings from scientists with optimistic expectations from economists. Nordhaus has misrepresented the scientific literature to justify the using a smooth function to describe the damage to GDP from climate change. Correcting for these errors makes it feasible that the economic damages from climate change are at least an order of magnitude worse than forecast by economists, and may be so great as to threaten the survival of human civilization.

KEYWORDS

Climate change; neoclassical economics; William Nordhaus

Development Policy Review

ARTICLE | Free Access

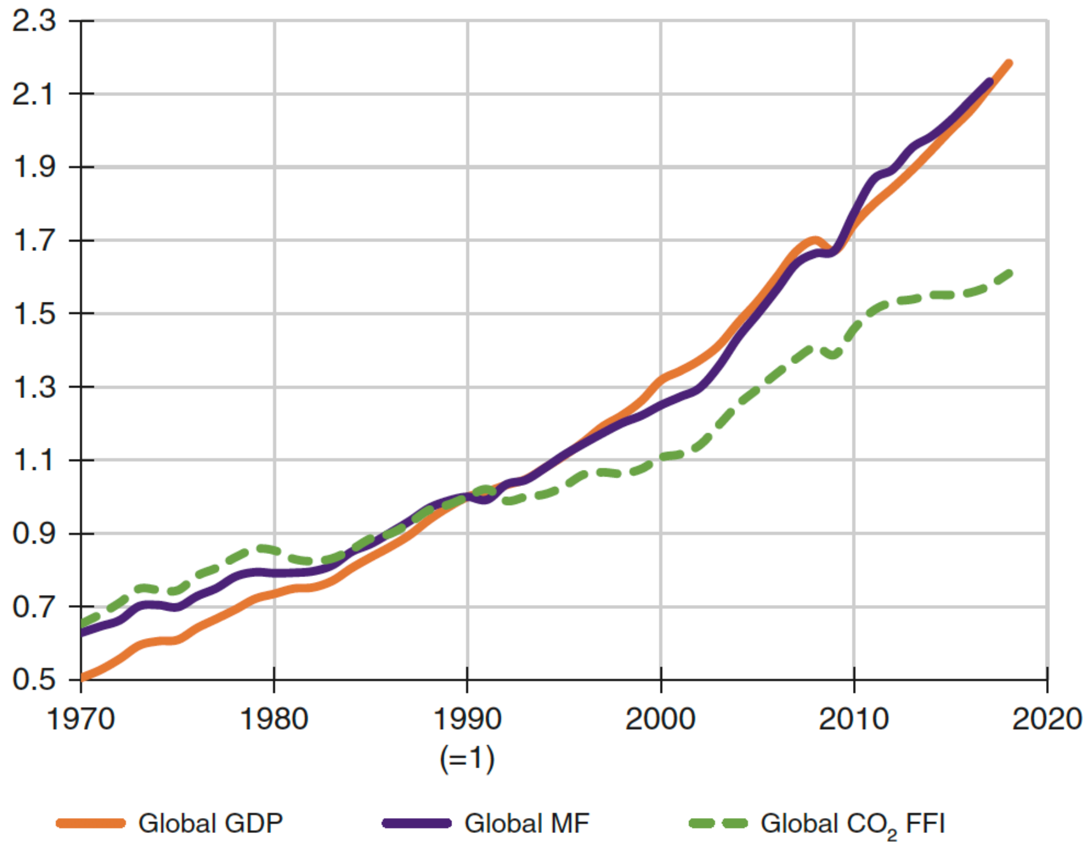
Can we live within environmental limits and still reduce poverty? Degrowth or decoupling?

Jason Hickel, Stéphane Hallegatte,

First published: 07 September 2021 | https://doi.org/10.1111/dpr.12584

Keen (2020)

Hickel & Hallegatte (2021)



PAPER • OPEN ACCESS

A systematic review of the evidence on decoupling of GDP, resource use and GHG emissions, part II: synthesizing the insights

Helmut Haberl[1], Dominik Wiedenhofer[1,9], Doris Virág[1,9], Gerald Kalt[1], Barbara Plank[1], Paul Brockway[2], Tomer Fishman[3], Daniel Hausknost[5], Fridolin Krausmann[1], Bartholomäus Leon-Gruchalski[4], Andreas Mayer[1], Melanie Pichler[1], Anke Schaffartzik[1,6], Tânia Sousa[7], Jan Streeck[1] and Felix Creutzig[8] – Hide full author list

Published 11 June 2020 • © 2020 The Author(s). Published by IOP Publishing Ltd
Environmental Research Letters, Volume 15, Number 6
Citation Helmut Haberl *et al* 2020 *Environ. Res. Lett.* **15** 065003

ECONOMICS

Unraveling the claims for (and against) green growth

Can the global economy grow indefinitely, decoupled from Earth's limitations?

By **Tim Jackson**[1] *and* **Peter A. Victor**[2]

Is Green Growth Possible?

Jason Hickel[a] and Giorgos Kallis[b]

[a]Anthropology, Goldsmiths, University of London, London, UK; [b]ICREA and ICTA-UAB, Universitat Autonoma de Barcelona, Barcelona, Spain

ABSTRACT
The notion of green growth has emerged as a dominant policy response to climate change and ecological breakdown. Green growth theory asserts that continued economic expansion is compatible with our planet's ecology, as technological change and substitution will allow us to absolutely decouple GDP growth from resource use and carbon emissions. This claim is now assumed in national and international policy, including in the Sustainable Development Goals. But empirical evidence on resource use and carbon emissions does not support green growth theory. Examining relevant studies on historical trends and model-based projections, we find that: (1) there is no empirical evidence that absolute decoupling from resource use can be achieved on a global scale against a background of continued economic growth, and (2) absolute decoupling from carbon emissions is highly unlikely to be achieved at a rate rapid enough to prevent global warming over 1.5°C or 2°C, even under optimistic policy conditions. We conclude that green growth is likely to be a misguided objective, and that policymakers need to look toward alternative strategies.

KEYWORDS
Sustainable development; ecological economics; green growth; degrowth; decoupling

Comment | Published: 04 August 2021

Urgent need for post-growth climate mitigation scenarios

Jason Hickel, Paul Brockway, Giorgos Kallis, Lorenz Keyßer, Manfred Lenzen, Aljoša Slameršak, Julia Steinberger & Diana Ürge-Vorsatz

Nature Energy **6**, 766–768 (2021) | Cite this article

Wiedmann et al. (2020); Haberl et al. (2020); Jackson & Victor (2019); Hickel & Kallis (2019); Hickel et al. (2021)

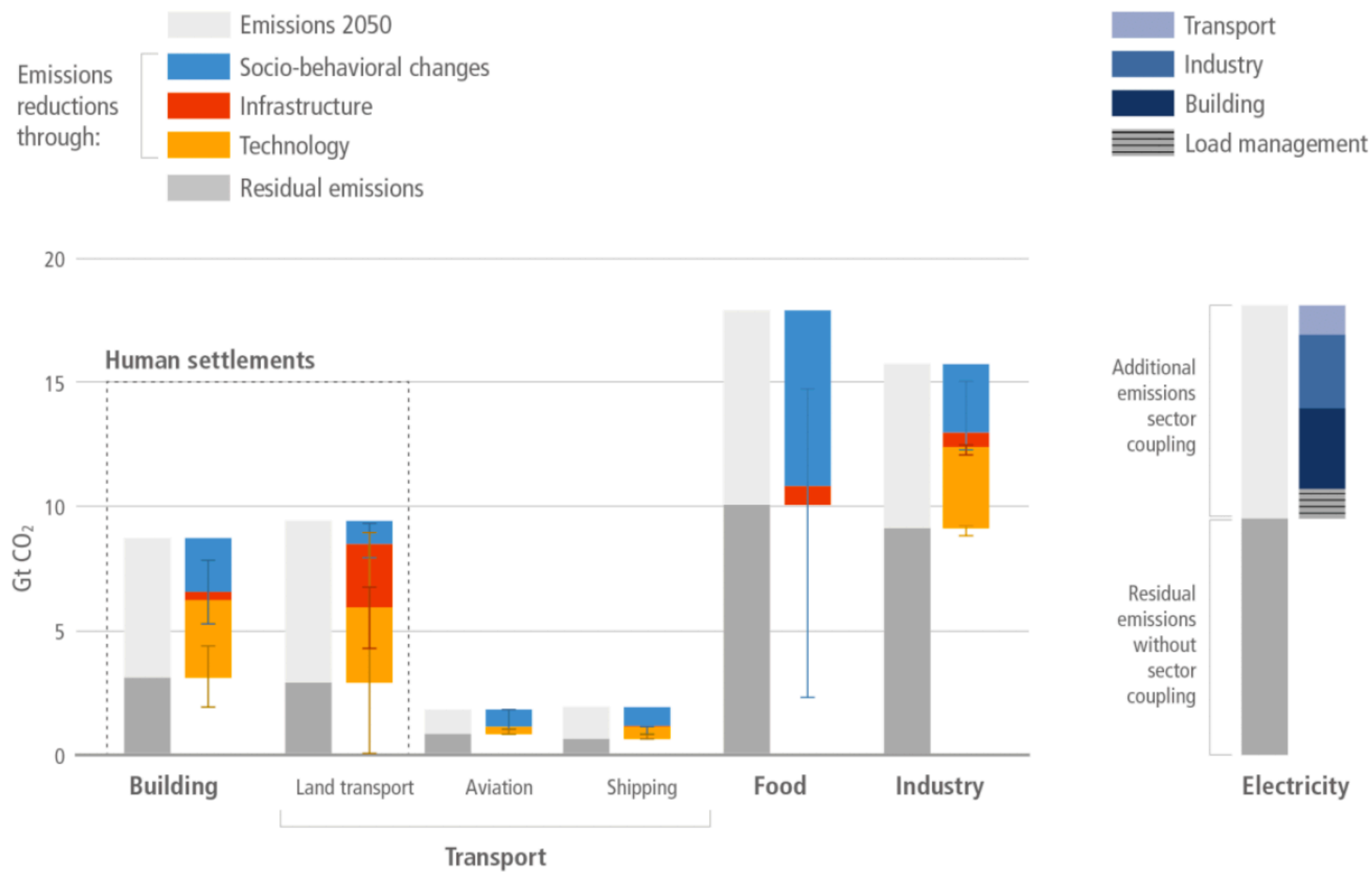
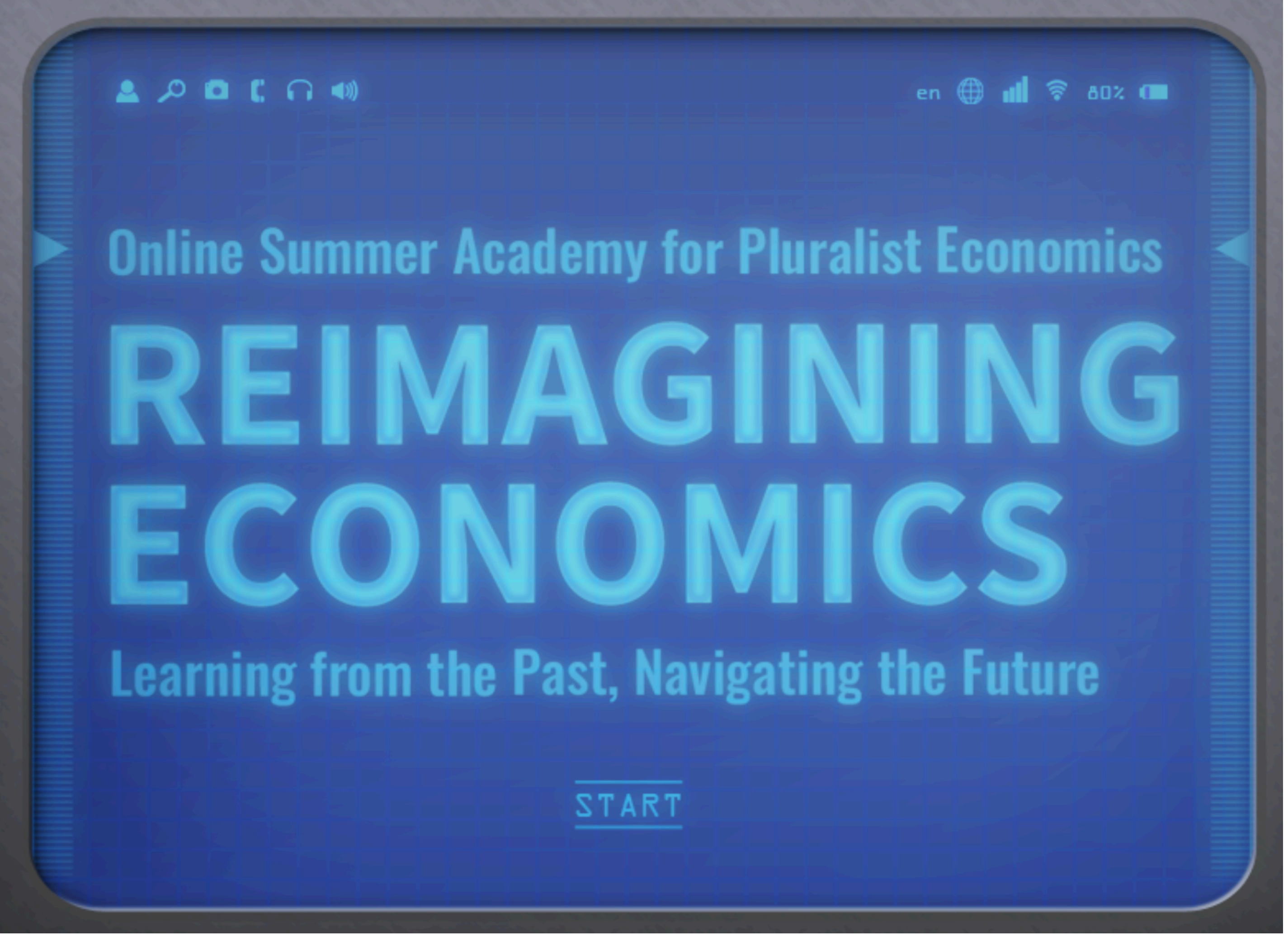
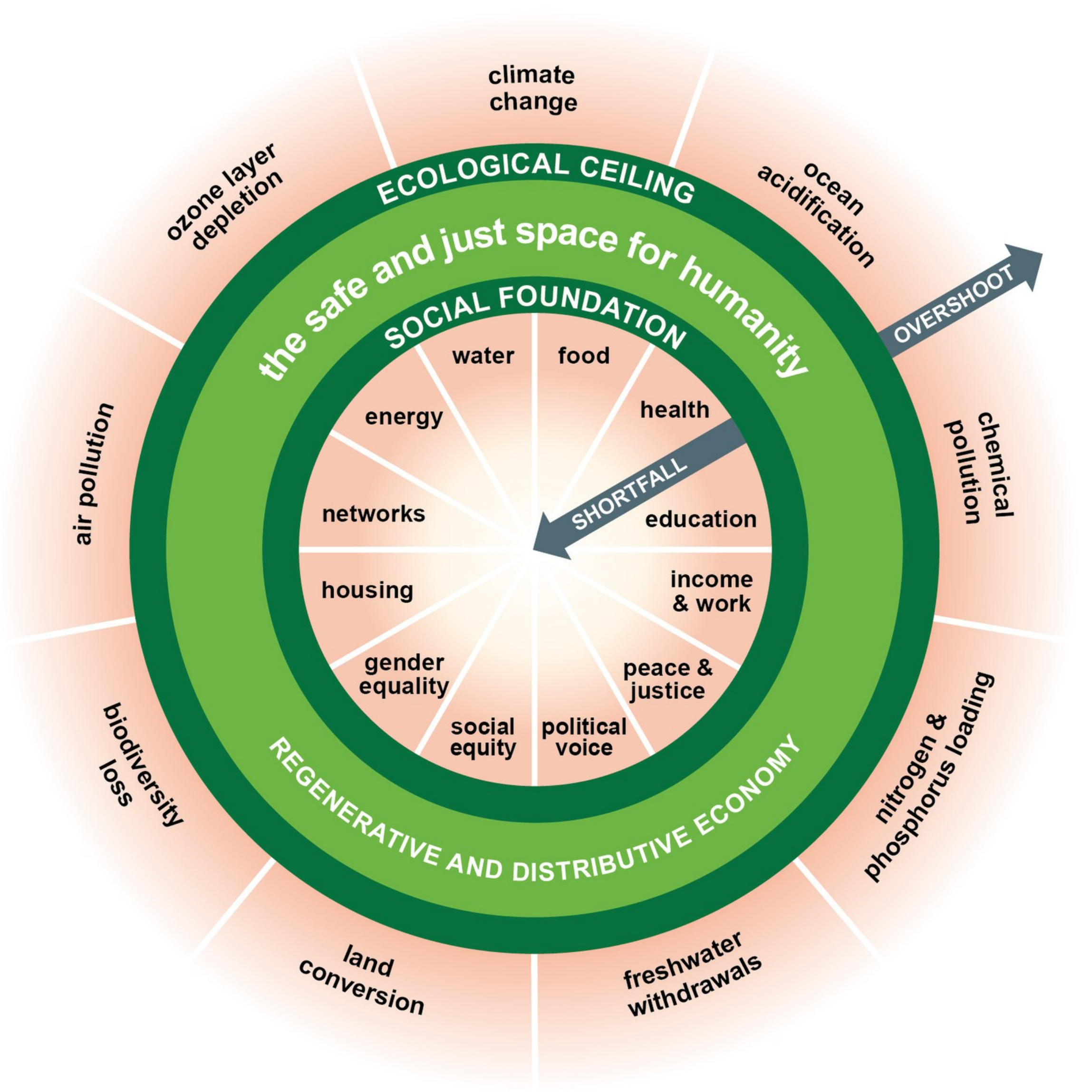


Figure SPM.8 | Climate change mitigation potentials classified in socio-behavioural, infrastructural, and technological options can reduce GHG emissions by 50-80% in end-use sectors by 2050. Drawing on the full potential requires changes in social norms, the provision in low-carbon infrastructures, and wide-range adoption of granular efficient end-use technologies. Electrification of transport, building and industry sector increases the demand on the electricity sector and associated indirect emissions, while demand side measures and load management compensate for this increased load. Based on review of studies estimating demand-side

Source





Equitable Downscaling to Address the Climate Crisis with a focus on Europe

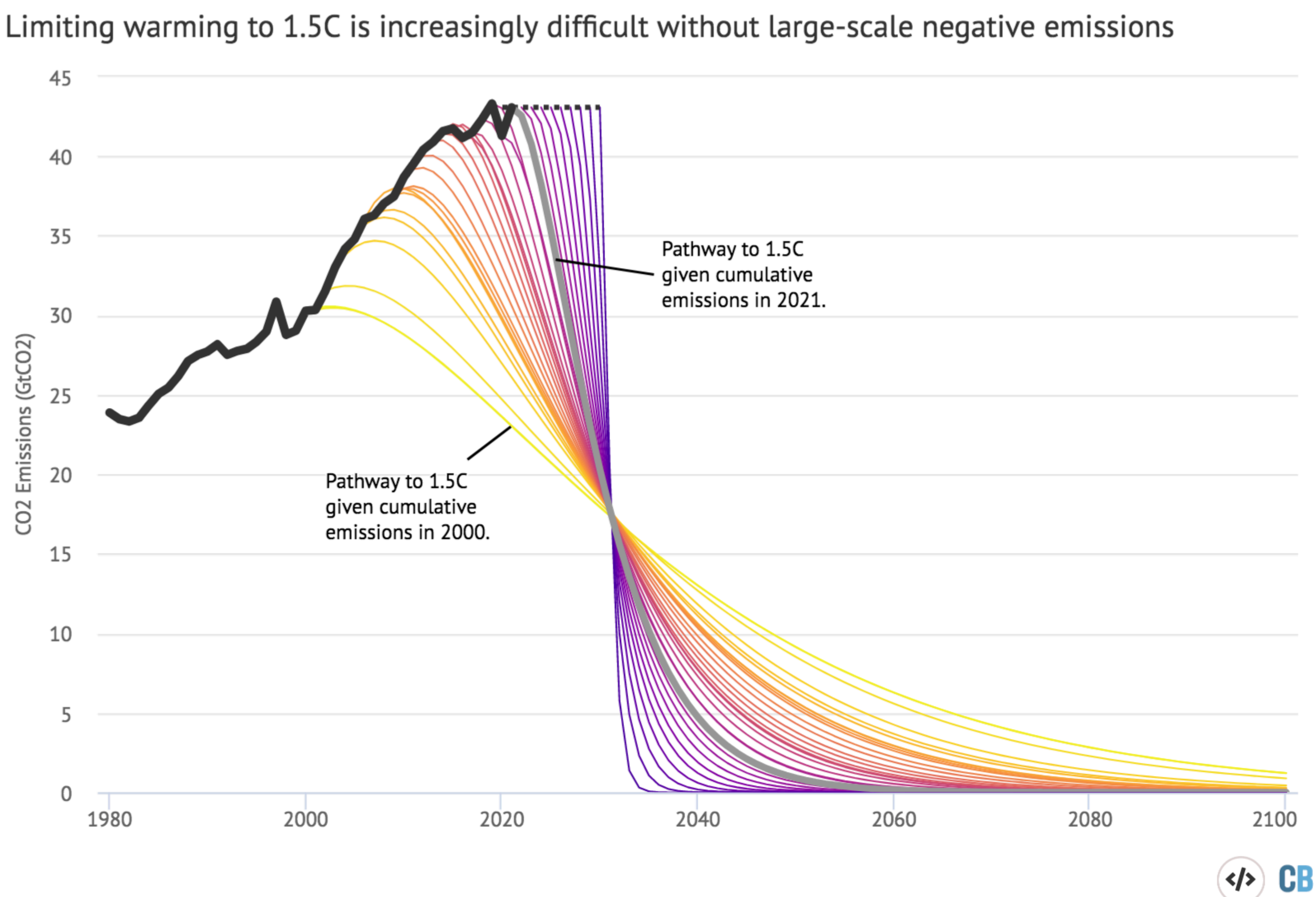
Policy Brief[1]

Andrea Bacilieri, Fabian Dablander, Rayssa Ferrari, Sophie Reisinger, Federico Sibaja, Mara Strenger

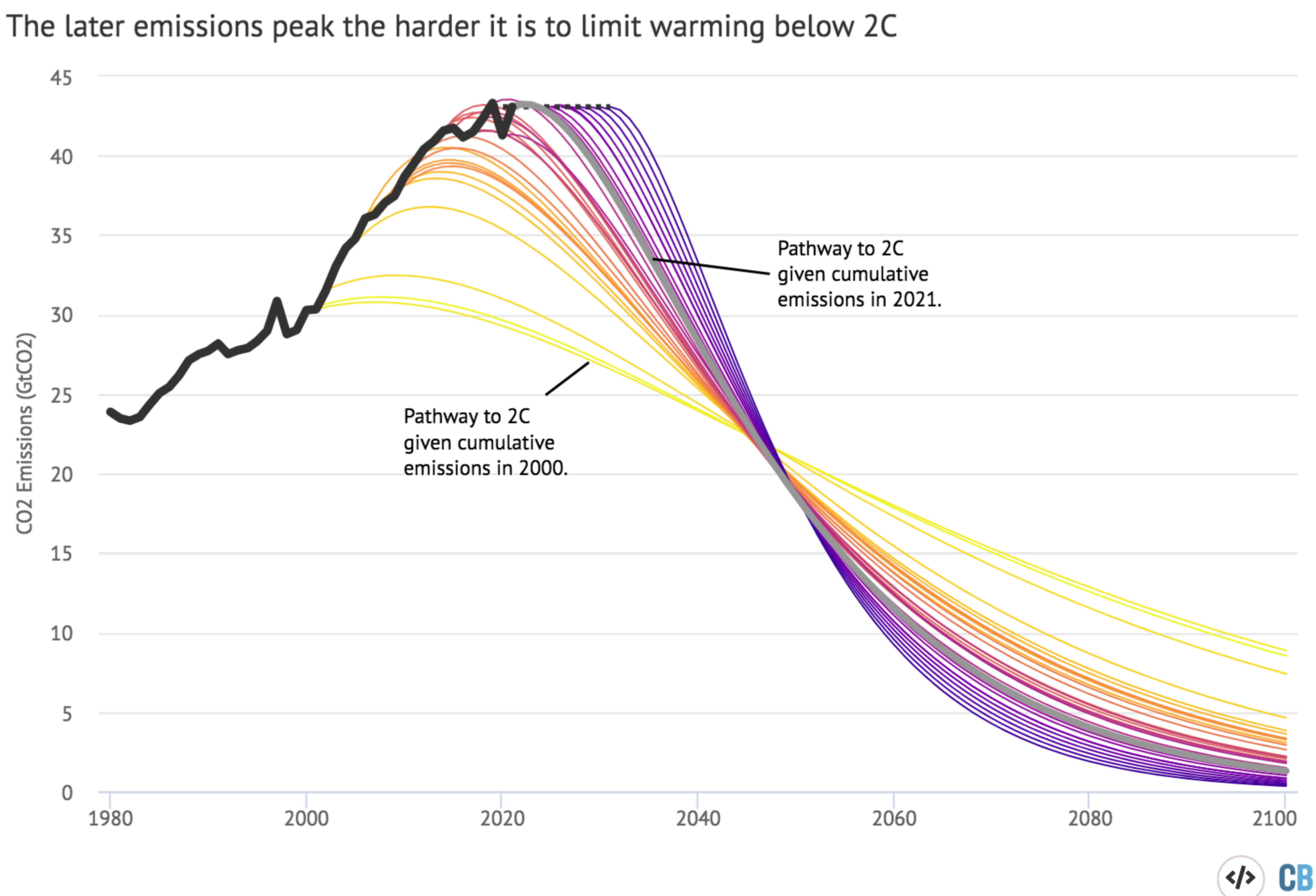
Raworth (2017)

PDF

The Challenge is Enormous



Hausfather (2021)

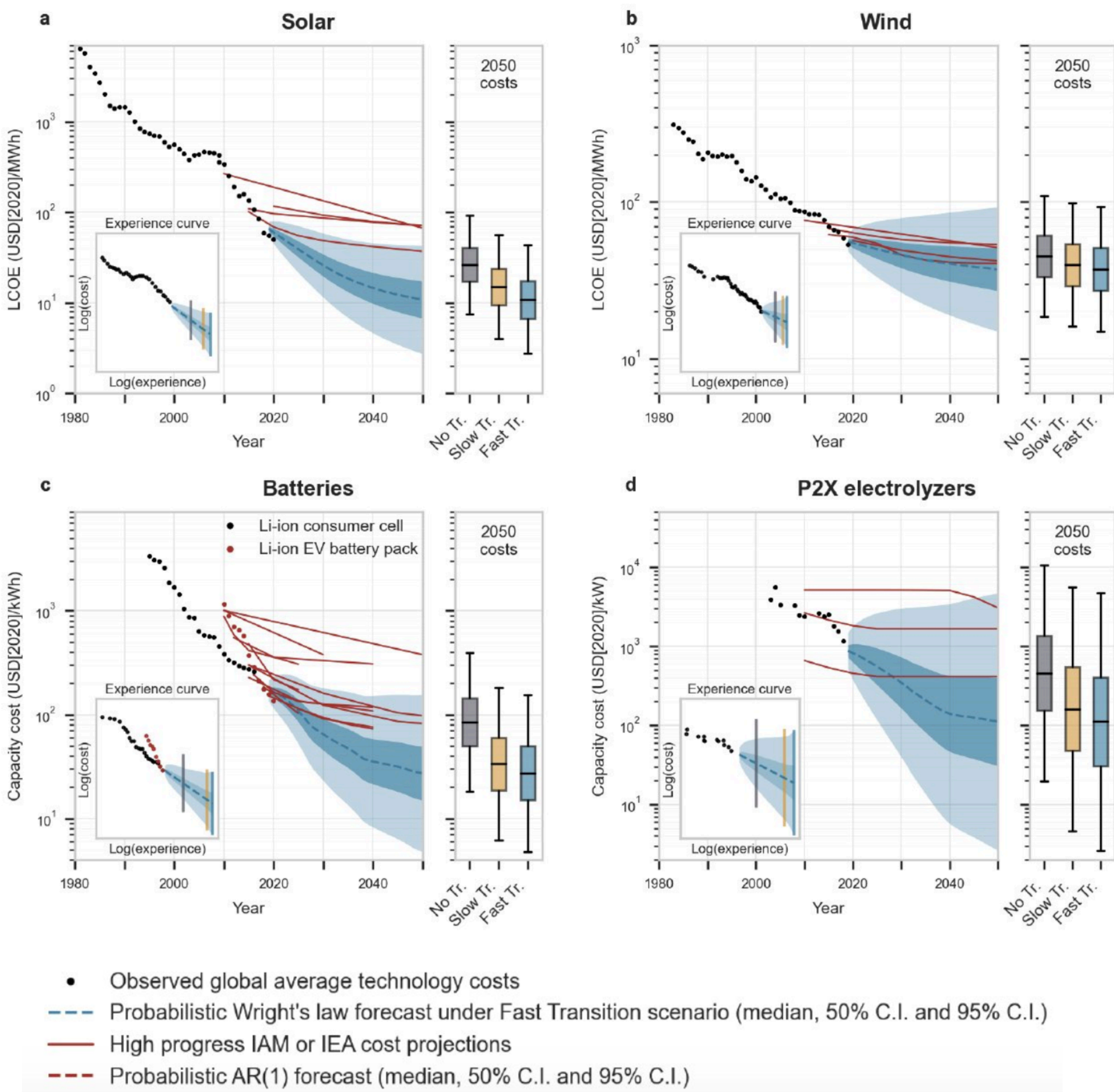


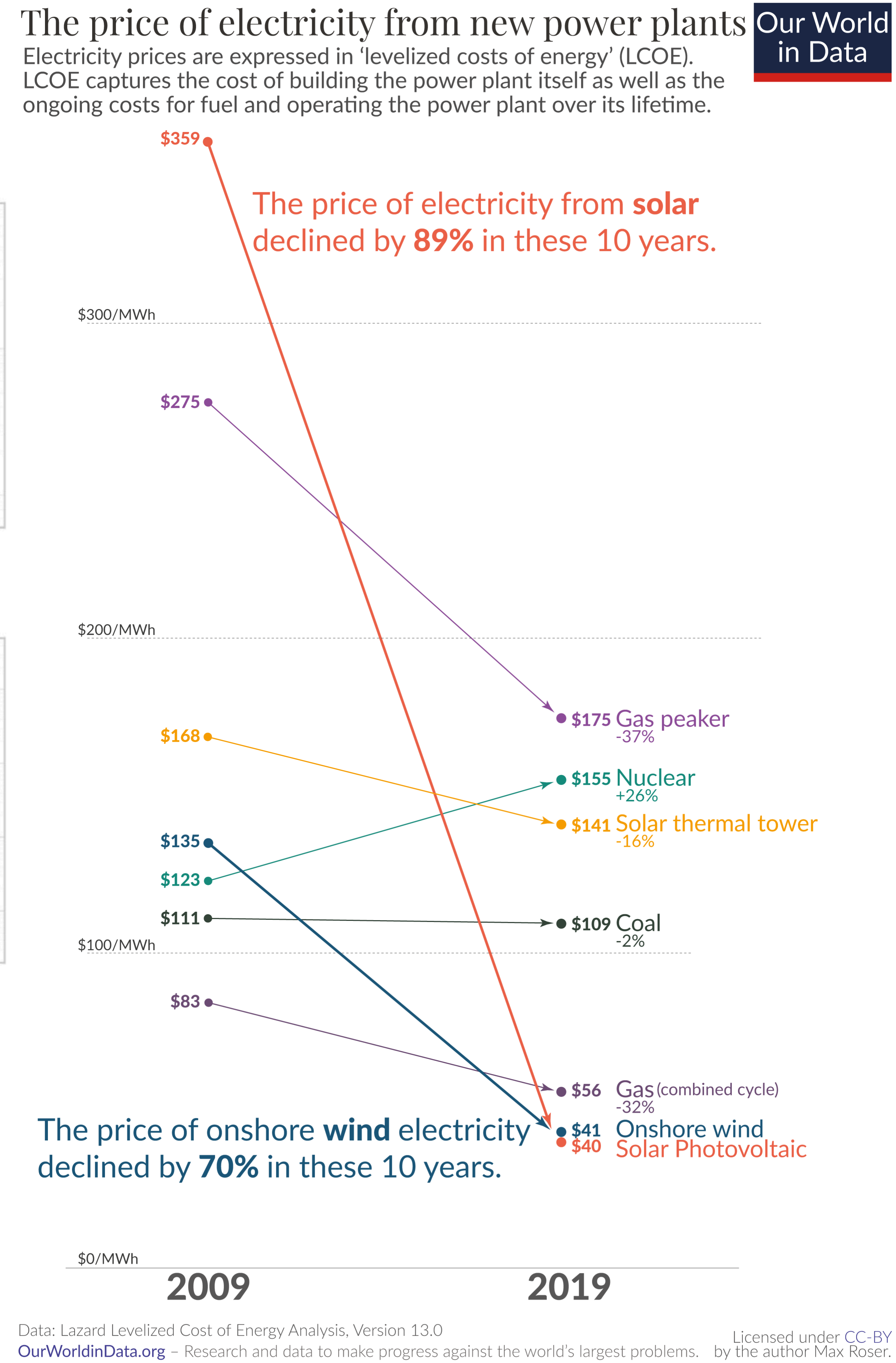
Hausfather (2021)

It's easy to feel pessimistic about the climate. But we've got two big things on our side

Bill McKibben

McKibben (2021)





Read et al. (2021); Roser (2020)

“We need a billion climate activists.”

- Peter Kalmus

Humans ‘pushing Earth close to tipping point’, say most in G20

Global survey finds 74% also want climate crises and protecting nature prioritised over jobs and profit

The Guardian

Reporting

“We can despair and plunge into paralysis or we can become stubborn optimists with a fierce conviction that no matter how difficult, we must and we can rise to the challenge.”

- Christiana Figueres

“All we have to decide is what to do with the time that is given to us.”

- Gandalf

Thank You!