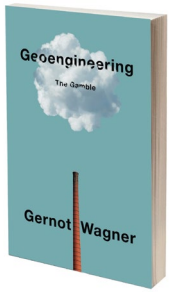
Nuclear power, geoengineering, and green moral hazards



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gwagner.com

Green Moral Hazards

Gernot Wagner[a,b] and Daniel Zizzamia[c]

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ABSTRACT

Moral hazards are ubiquitous. Green ones typically involve technological fixes: Environmentalists often see 'technofixes' as morally fraught because they absolve actors from taking more difficult steps toward systemic solutions. Carbon removal and especially solar geoengineering are only the latest example of green moral hazards throughout history. We here explore dismissing (solar) geoengineering as a moral hazard is unproductive. Instead, especially technologies. We argue that technology should use it as an paid to the underlying environ actively invoking its opposite

KEYWORDS

Risk compensation; environmentalism; climate carbon removal; geoengineering

Green

Risky Climate

Foreign Policy

The Hazard of Environmental Morality Edit

December 24th, 2018

Efforts to combat ... above ...

...e pragmatic

Merk

...octrine is

...ed at all

...are, for

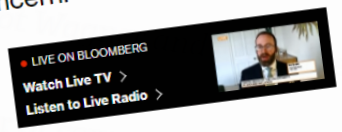
Fear of Geoengineering Is Really Anxiety About Cutting Carbon

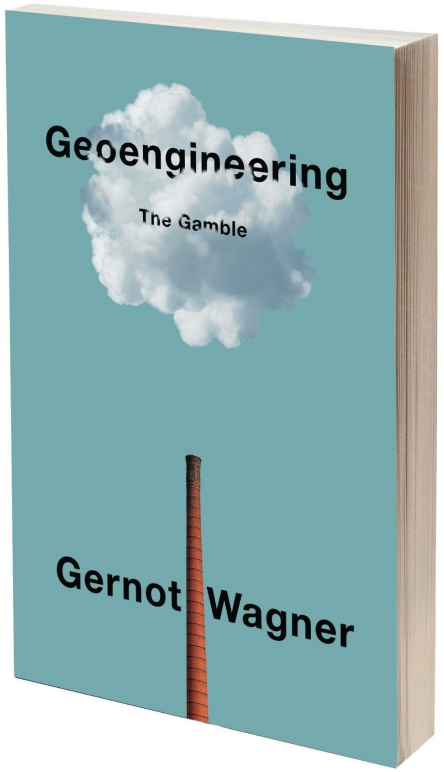
Research into unproven technofixes isn't a replacement for eliminating emissions, even if the debate over geoengineering is stuck on that concern.

The geoengineering debate is caught in false choice between cutting emissions, like those from cars, and researching the dire possibility of resorting to technofixes such as reflecting back a portion of sunlight. *Photographer: Samuel Corum/Bloomberg*

By Gernot Wagner

June 25, 2021, 6:00 AM EDT






Andrej Karpathy
@karpathy
I forgot how cool European cities are. More compact, denser, more unique / interesting, cleaner, safer, pedestrian/bike friendly, a lot more pedestrian only plazas with people relaxing / hanging out. A lot more of outside is an outdoor living space, not just transportation space.
8:16 AM · Apr 2, 2022 · Twitter for iPhone
479 Retweets
204 Quote Tweets
8,686 Likes

Gernot Wagner ✓
@GernotWagner

Tesla AI guy goes on European vacation, sees light that is smart urban design

> 
> **Andrej Karpathy** ✓ @karpathy · Apr 2
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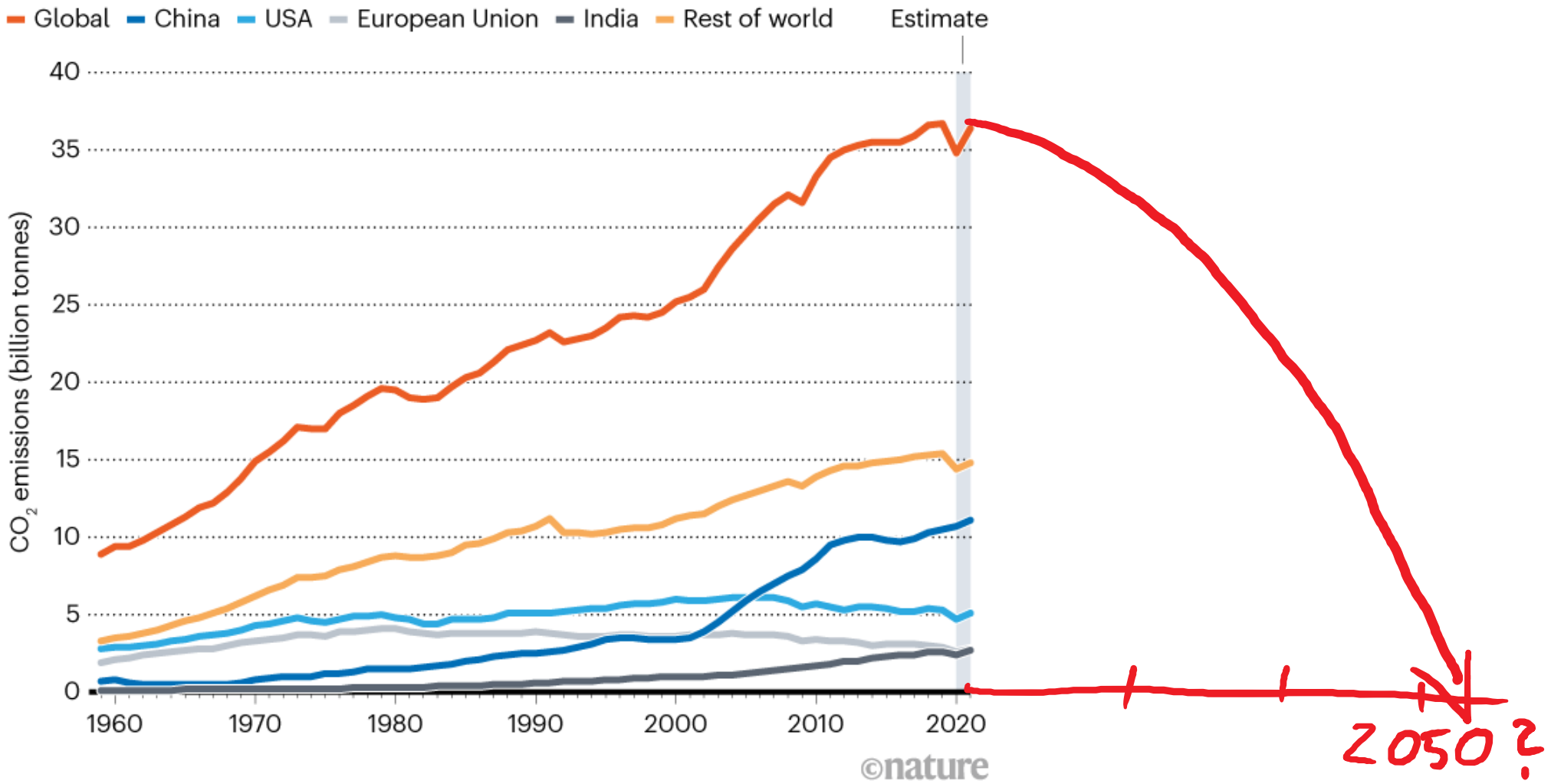
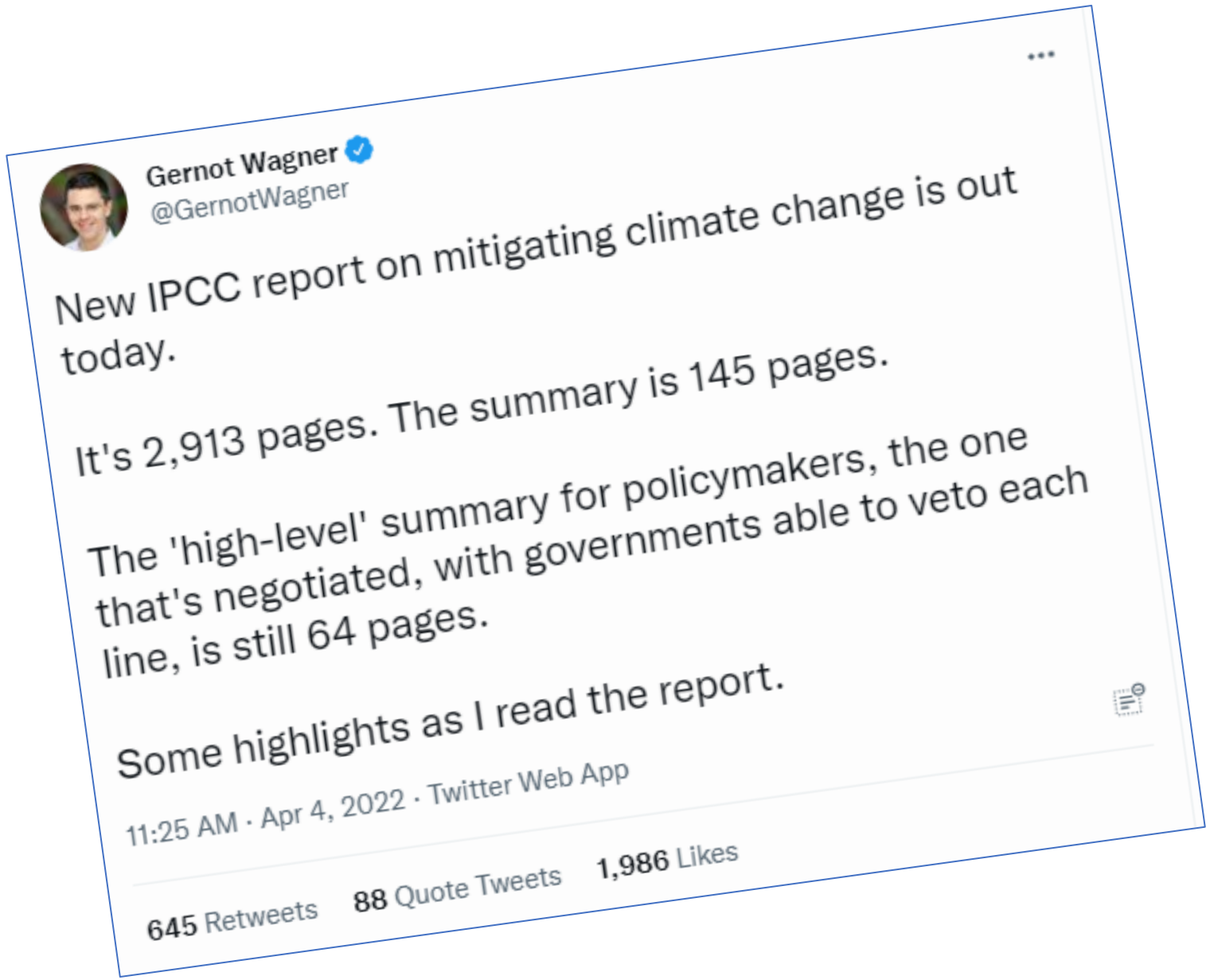


Source: Global Carbon Project + umpteen climate-econ model runs


Gernot Wagner
@GernotWagner
New IPCC report on mitigating climate change is out today.
It's 2,913 pages. The summary is 145 pages.
The 'high-level' summary for policymakers, the one that's negotiated, with governments able to veto each line, is still 64 pages.
Some highlights as I read the report.
11:25 AM · Apr 4, 2022 · Twitter Web App
645 Retweets
88 Quote Tweets
1,986 Likes

Stop burning fossil fuels. Sell more electric cars. Make buildings greener. Save more forests. The world is already awash in scientific advice on how to address the widening risks of global warming. Yet this week's report from the UN's Intergovernmental Panel on Climate Change is different. At nearly 3,000 pages, it is the most comprehensive analysis of what can be done to ward off dangerous levels of warming since the Paris climate accord was agreed in 2015. It will help to shape climate policy debates for years to come.

Its message is both stark and compelling. The window for limiting global warming to 1.5C is closing fast. Global emissions should ideally peak within just three years. Greener lifestyles can help, but more sweeping structural changes are needed. Gas, oil and especially coal use must fall steeply.

The good news is that a lot of what is needed is under way. The study shows prices of green alternatives to fossil fuels have not merely dipped, but plunged. Between 2010 and 2019, solar power and lithium ion battery costs fell by 85 per cent, while wind energy dropped by 55 per cent. Solar panels and wind turbines can now compete with fossil-fuelled power generation in many places and the deployment of green technologies has ballooned.

Some of this growth is due to an impressive expansion of climate policies and laws since the last big IPCC assessment was finalised in 2014. This in turn has led to the avoidance of emissions and pumped up investment in low-carbon infrastructure.

At least 18 countries have reduced their emissions for more than a decade, sometimes by 4 per cent a year, a rate in line with what is needed globally to keep temperatures at safer levels. If all countries acted to limit warming to 2C or less, the authors say global GDP would be just a few percentage points lower by 2050. And that calculation does not take account of the economic benefits of avoiding climate damage and lowering the cost of adapting to higher temperatures.

Most encouragingly, the growth in greenhouse gas emissions has slowed, from an annual average of 2.1 per cent at the start of this century to 1.3 per cent between 2010 and 2019. Yet this is not nearly enough. Progress in some countries has been outweighed by soaring emissions elsewhere. Climate finance for poorer countries is lacking. For all the vows of action, the authors say the world is on track for a catastrophic 3.2C of warming by the end of the century — more than double the 1.5C limit agreed in the Paris accord.

To have a chance of meeting that 1.5C goal, emissions need to peak by 2025 at the latest and fall by an unprecedented 43 per cent by 2030. Even then, the report says it is "almost inevitable" that the 1.5C threshold will be exceeded, at least temporarily — a sobering prospect given the weather extremes that have occurred at just 1.1C of warming.

The scale of change needed is colossal. Aiming for 1.5C requires coal use to drop by 95 per cent, oil by 60 per cent and gas by 45 per cent by 2050. These goals look even harder to reach at a time of high inflation, though the war in Ukraine might conceivably speed up a green transition as western markets cut off Russian fossil fuels.

The science of climate change is now well understood, as are the technical solutions. The larger problem is politics, as the IPCC itself showed. Its report was held up by wrangling among the 195 countries approving it, some of which depend heavily on fossil fuels or lack the resources to build a greener economy. After more than a century of unsustainable energy and land use, the world has begun to turn. New ways of shifting even faster must now be found.

situated in the power sector, most remaining fossil fuel CO2 emissions in pathways that likely limit warming to 2°C and below are from non-electric energy – most importantly from the industry and transportation sectors (high confidence). Decommissioning and reduced utilisation of existing fossil fuel installations in the power sector as well as cancellation of new installations are required to align future CO2 emissions from the power sector with projections in these pathways (high confidence).

B.7.2 In modelled global pathways that limit warming to 2°C (>67%) or lower, most remaining fossil fuel CO2 emissions until the time of global net zero CO2 emissions are projected to occur outside the power sector, mainly in industry and transport. Decommissioning and reduced utilisation of existing fossil fuel based power sector infrastructure, retrofitting existing installations with CCS [FOOTNOTE 37] switches to low carbon fuels, and cancellation of new coal installations without CCS are major options that can contribute to aligning future CO2 emissions from the power sector with emissions in the assessed global modelled least-cost pathways. The

IPCC AR6 WGIII “Technical Summary” vs “Summary for Policymakers”, ipcc.ch/report/ar6/wg3

Many options available now in all sectors are estimated to offer substantial potential to reduce net emissions by 2030. Relative potentials and costs will vary across countries and in the longer term compared to 2030.

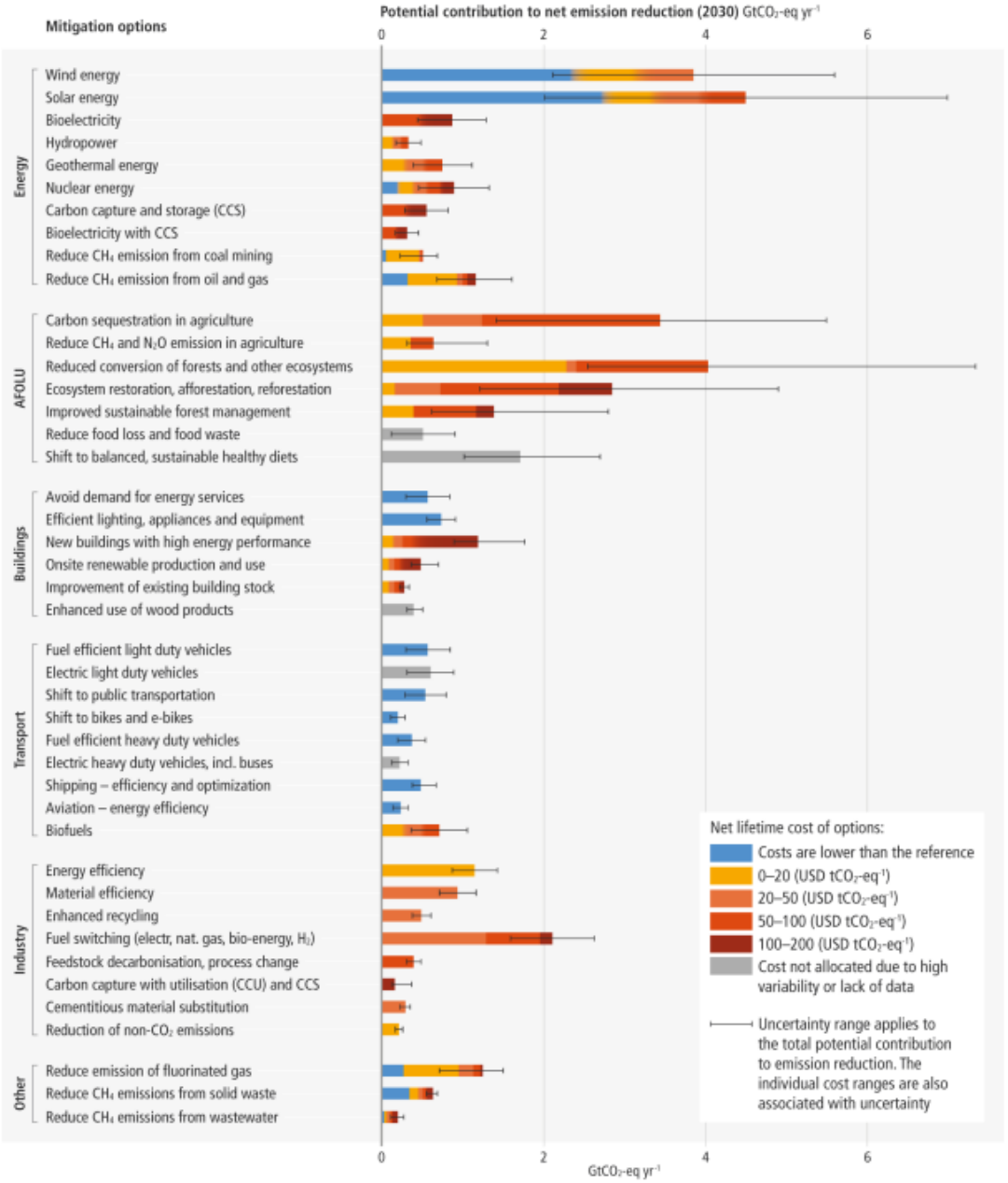


Figure SPM.7: Overview of mitigation options and their estimated ranges of costs and potentials in 2030.

IPCC AR6 WGIII, ipcc.ch/report/ar6/wg3

Plan A

Cut CO_2, methane et al.

Adapt

Carbon removal

→ “net-zero” emissions

	Model	650 CO2-e		550 CO2-e				450 CO2-e			
		Full	Delay	Full		Delay		Full		Delay	
		Not-to-Exceed	Not-to-Exceed	Overshoot	Not-to Exceed	Overshoot	Not-To-Exceed	Overshoot	Not-to Exceed	Overshoot	Not-To-Exceed
1	ETSAP-TIAM	+	+	+	+	+	+	+	+	+	XX
2	FUND	+	+	+	+	+	+	+	XX	XX	XX
3	GTEM	+	+	+	+	+	XX	+	XX	XX	XX
4	IMAGE	+	+	+	+	+	+	XX	XX	XX	XX
	IMAGE-BC	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	+	XX	XX	XX
5	MERGE Optimistic	+	+	+	+	XX	XX	XX	XX	XX	XX
	MERGE Pessimistic	+	+	+	+	+	+	XX	XX	XX	XX
6	MESSAGE	+	+	+	+	+	XX	+	XX	XX	XX
	MESSAGE - NOBECS	+	-N/A-	+	+	-N/A-	-N/A-	+	XX	XX	XX
7	MiniCAM Base	+	+	+	+	+	XX	+	+	+	XX
	MiniCAM LoTech	+	+	+	+	+	XX	+	XX	XX	XX
8	POLES	+	+	+	+	+	XX	XX	XX	XX	XX
9	SGM	+	+	+	+	+	+	XX	XX	XX	XX
10	WITCH	+	+	+	+	+	+	XX	XX	XX	XX

Clark et al (2009), Stanford Energy Modeling Forum 22

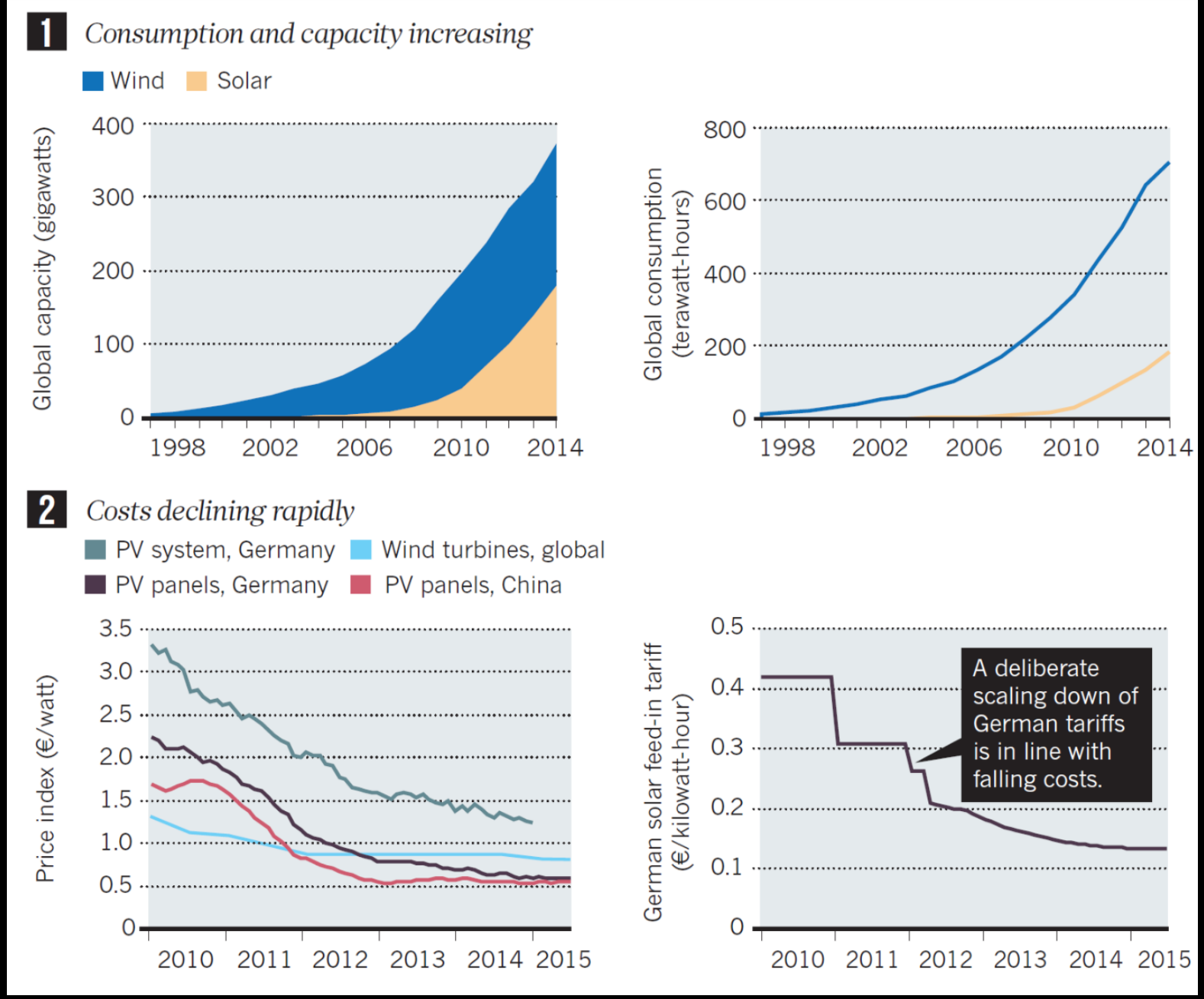
450 ppm CO_2e "unachievable" (circa 2009)

"Full" participation scenario assumes maximum global $1,000/ton CO_2 tax starting 2012; delay assumes *only* Annex I

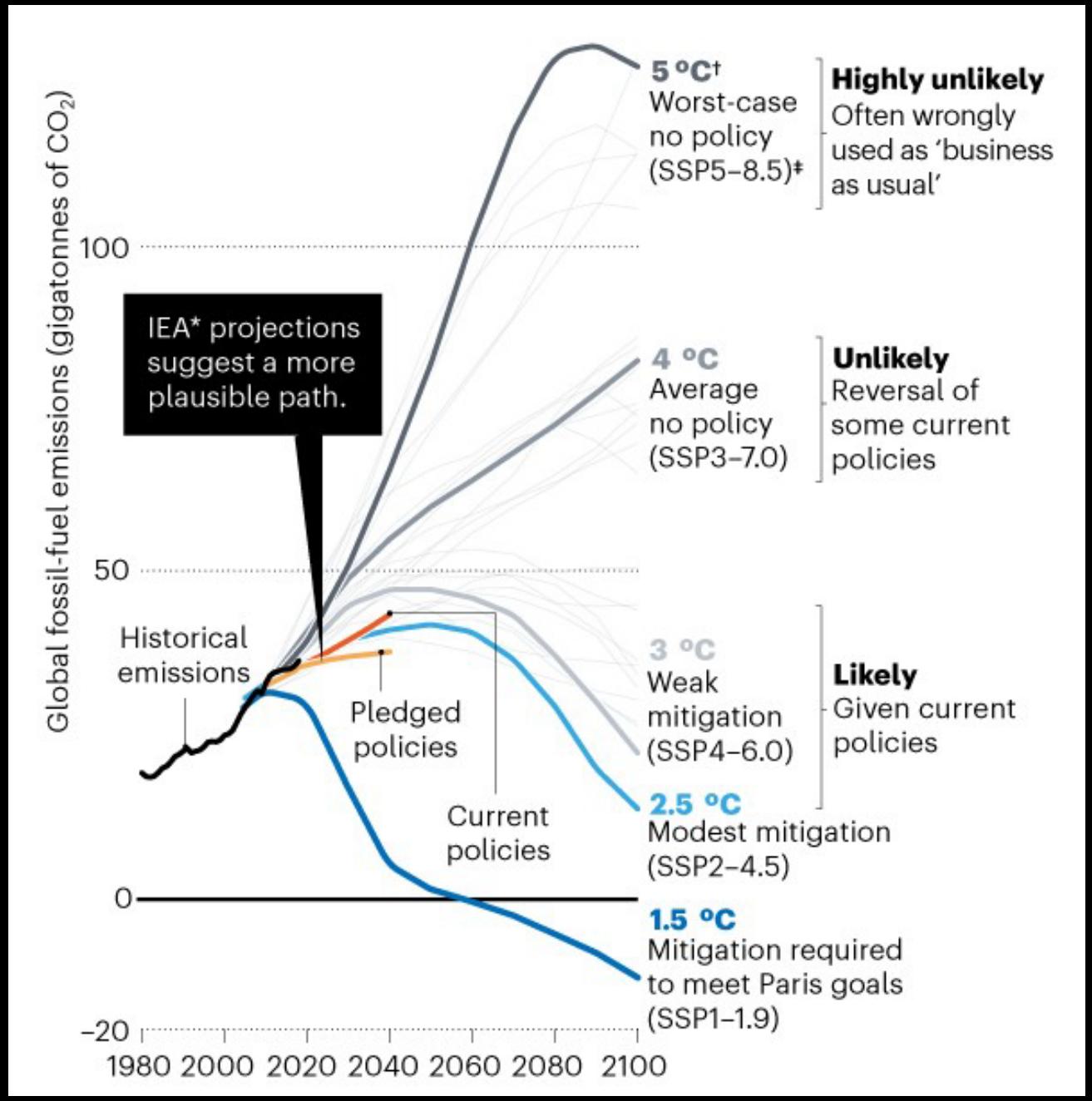
	Model	650 CO2-e		550 CO2-e				450 CO2-e			
		Full	Delay	Full		Delay		Full		Delay	
		Not-to-Exceed	Not-to-Exceed	Overshoot	Not-to Exceed	Overshoot	Not-To-Exceed	Overshoot	Not-to Exceed	Overshoot	Not-To-Exceed
1	ETSAP-TIAM	+	+	+	+	+	+	+	+	+	XX
2	FUND	+	+	+	+	+	+	+	XX	XX	XX
3	GTEM	+	+	+	+	+	XX	+	XX	XX	XX
4	IMAGE	+	+	+	+	+	+	XX	XX	XX	XX
	IMAGE-BC	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	+	XX	XX	XX
5	MERGE Optimistic	+	+	+	+	XX	XX	XX	XX	XX	XX
	MERGE Pessimistic	+	+	+	+	+	+	XX	XX	XX	XX
6	MESSAGE	+	+	+	+	+	XX	+	XX	XX	XX
	MESSAGE - NOBECS	+	-N/A-	+	+	-N/A-	-N/A-	+	XX	XX	XX
7	MiniCAM Base	+	+	+	+	+	XX	+	+	+	XX
	MiniCAM LoTech	+	+	+	+	+	XX	+	XX	XX	XX
8	POLES	+	+	+	+	+	XX	XX	XX	XX	XX
9	SGM	+	+	+	+	+	+	XX	XX	XX	XX
10	WITCH	+	+	+	+	+	+	XX	XX	XX	XX

No 450 ppm/2°C with mitigation alone, without massive negative emissions

Clark et al (2009), Stanford Energy Modeling Forum 22



Wagner et al., *Nature* (2015)



Source: Hausfather & Peters, *Nature* (2020)

Plan A

Cut CO_2, methane et al.

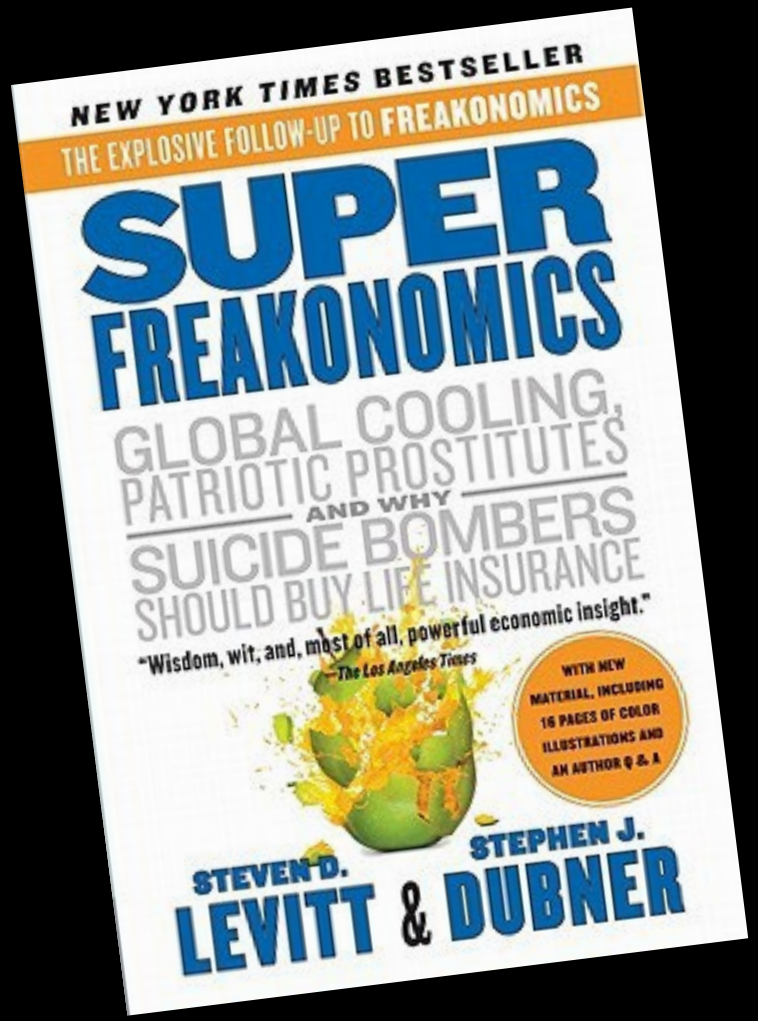
Adapt

Carbon removal

→ “net-zero” emissions

Suffer

There is no Plan B



"Geo-engineering holds forth the promise of addressing global warming concerns for just a few billion dollars a year," said Newt Gingrich, former speaker of the US House of Representatives, in 2008. "We would have an option to address global warming by rewarding scientific innovation. Bring on American ingenuity. Stop the green pig."

Plan A+

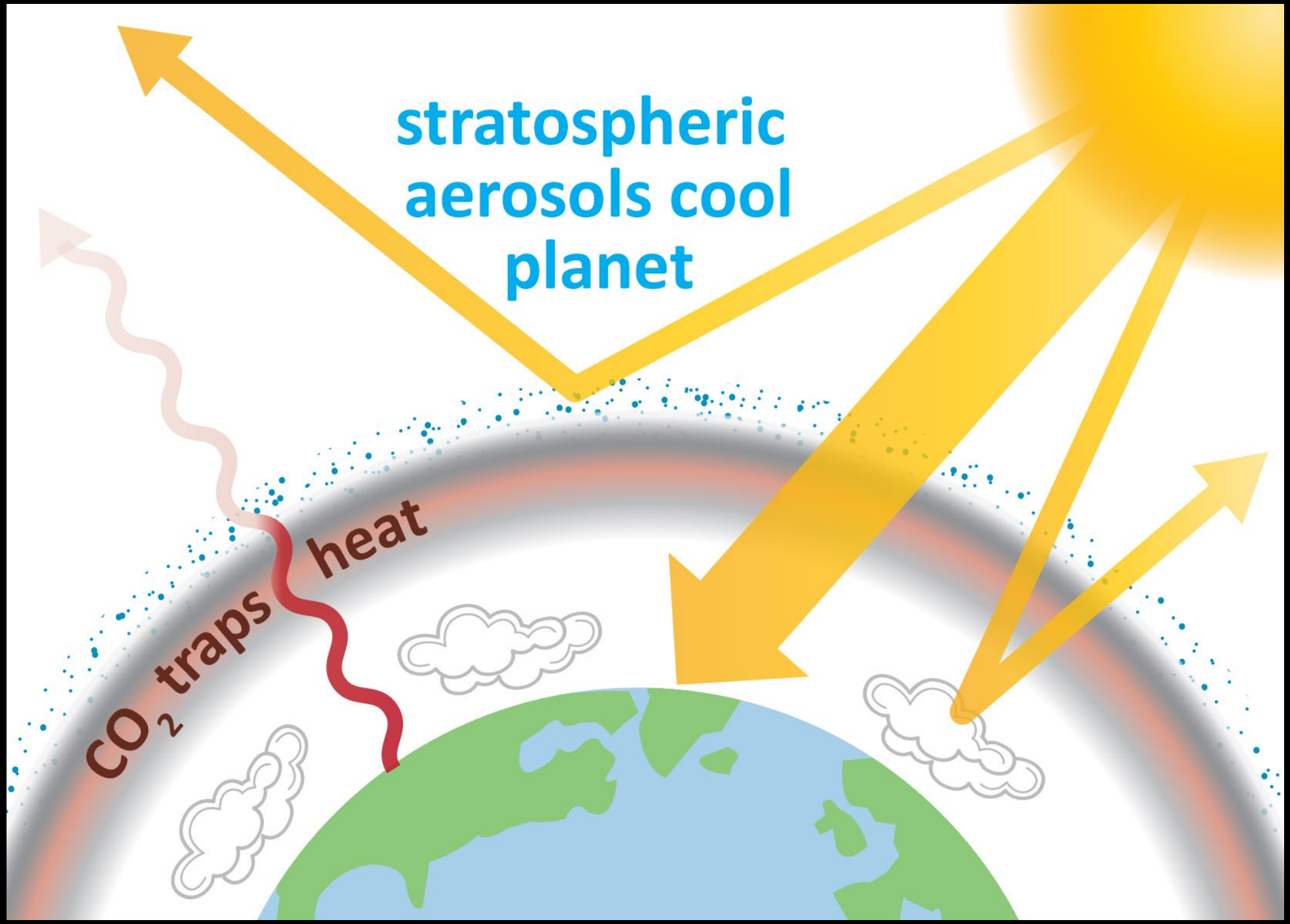
Cut CO_2, methane et al.

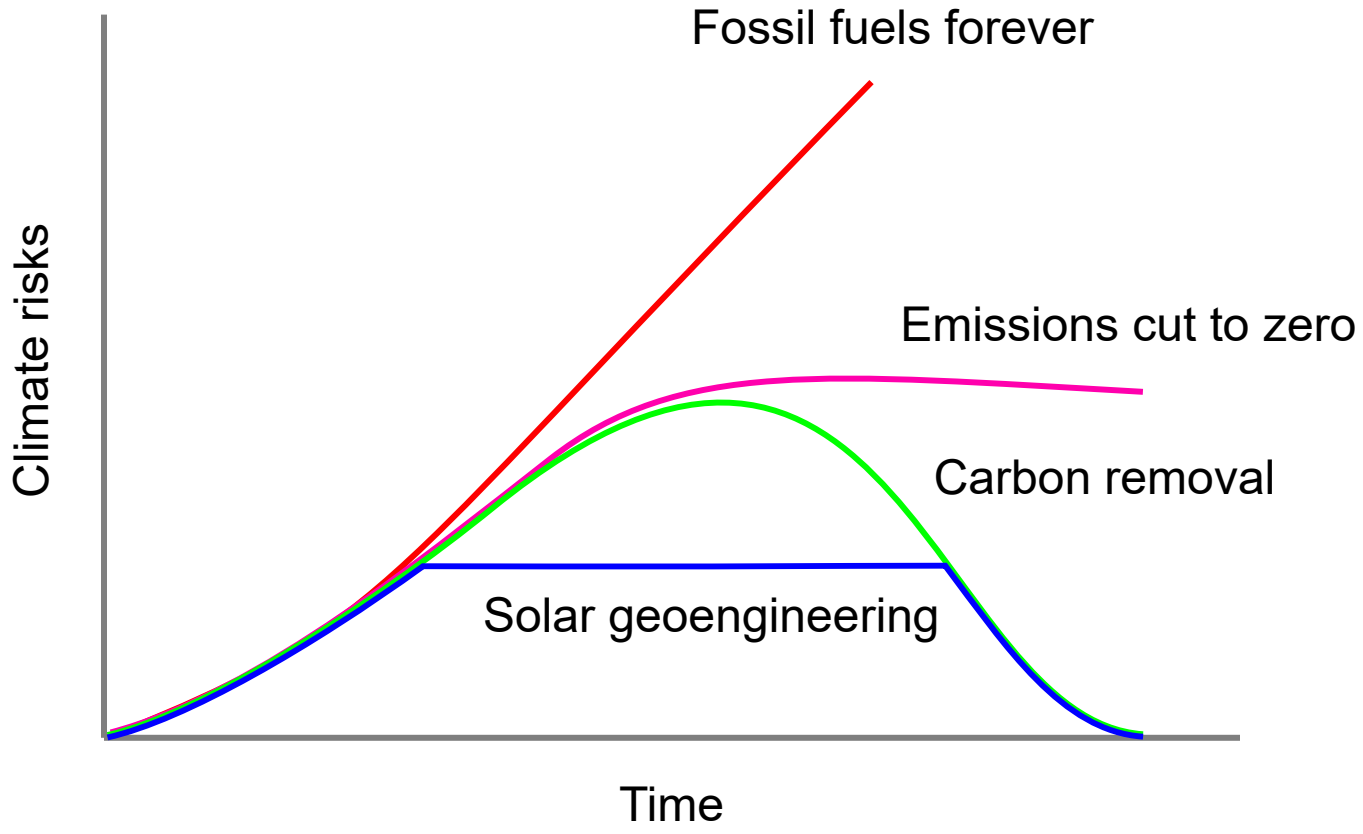
Adapt

Carbon removal

→ “net-zero” emissions

Solar Geoengineering(?)


stratospheric
aerosols cool
planet
CO_2 traps heat

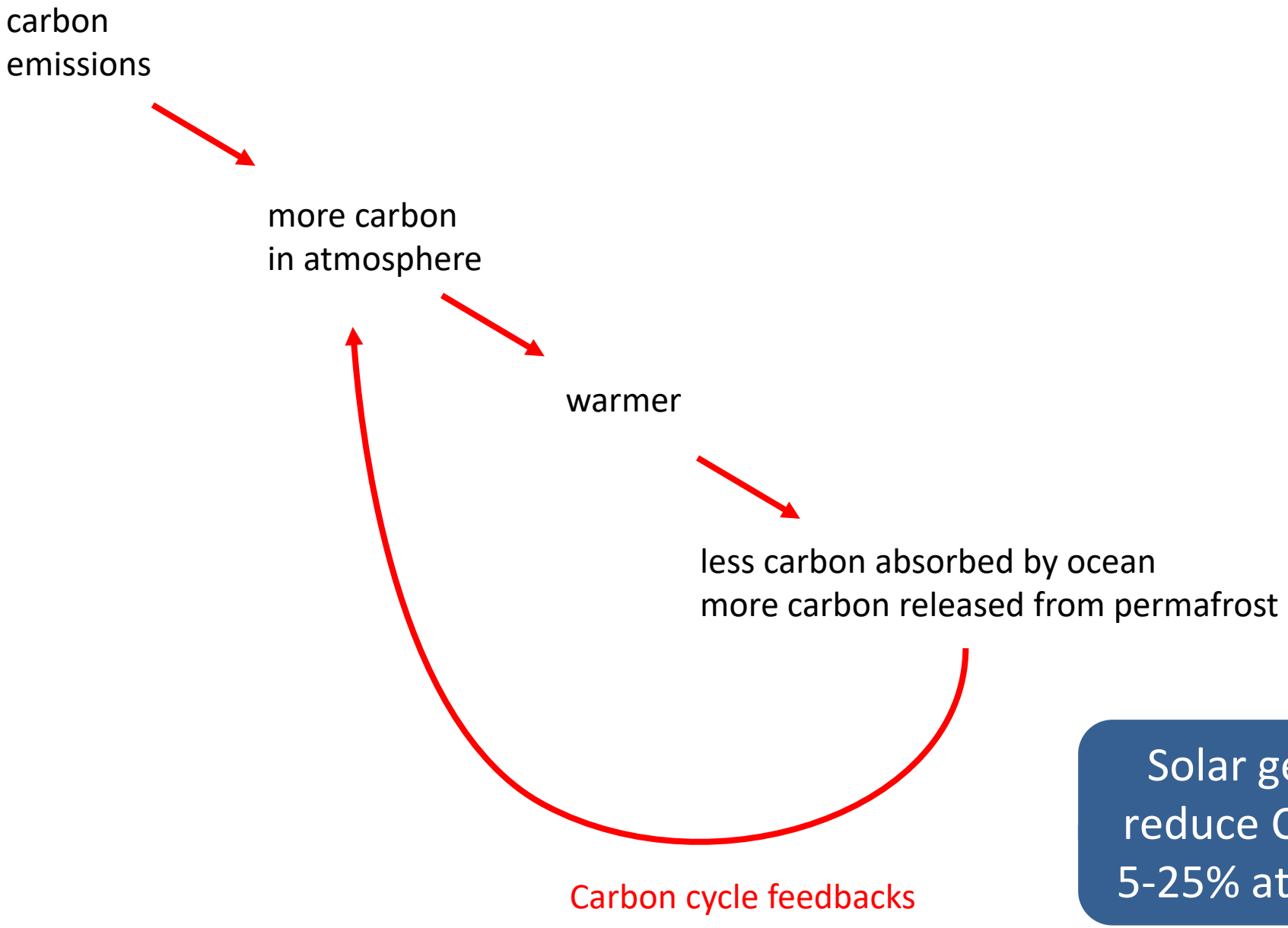


Source: John Shepherd's "napkin diagram" at 2010 Asilomar conference; this version: SGRP

Mitigation v SG

(i) Hard tradeoffs

(ii) “Moral hazard”



Solar geoengineering might reduce CO_2 burden in 2100 by 5-25% at a cost of <0.5 $/t$CO_2$

Source: Keith, Wagner & Zabel, *Nature Climate Change* (September 2017)

Mitigation v SG

(i) Hard tradeoffs

(ii) “Moral hazard”

“Moral hazard” theoretically well-founded

Long history of the idea

- There are tradeoffs
- Long history in economics, introduced to solar geoengineering by Keith, “History and Prospect” (2000)
- Actually a misnomer, it’s “lack of self-control”
- Some “moral hazard”—tradeoff, really—is rational

Wagner & Weitzman, *Climate Shock* (2015)

What do people think when they think about solar geoengineering?

A review of 30+ prior solar geoengineering surveys

1. Public unfamiliar with SRM
   - ~20-30% have heard of “geoengineering,” ~2-3% can define it
   - 45% can define “climate engineering” (Mercer, Keith, Sharp 2011)
2. “Nuanced views” of research versus deployment
3. Risk and uncertainty are important
4. “Moral hazard” versus “Inverse Moral Hazard”
   - Most surveys show moral hazard, but…

Burns, Flegal, Keith, Mahajan, Tingley, Wagner, *Earth’s Future* Crutzen+10 (2016)

“Inverse moral hazard”

Germans (n=658) increase voluntary offset purchases when told about stratospheric aerosol injection (SAI)

Table 1. Tobit regression explaining the amount of purchased VCOs.

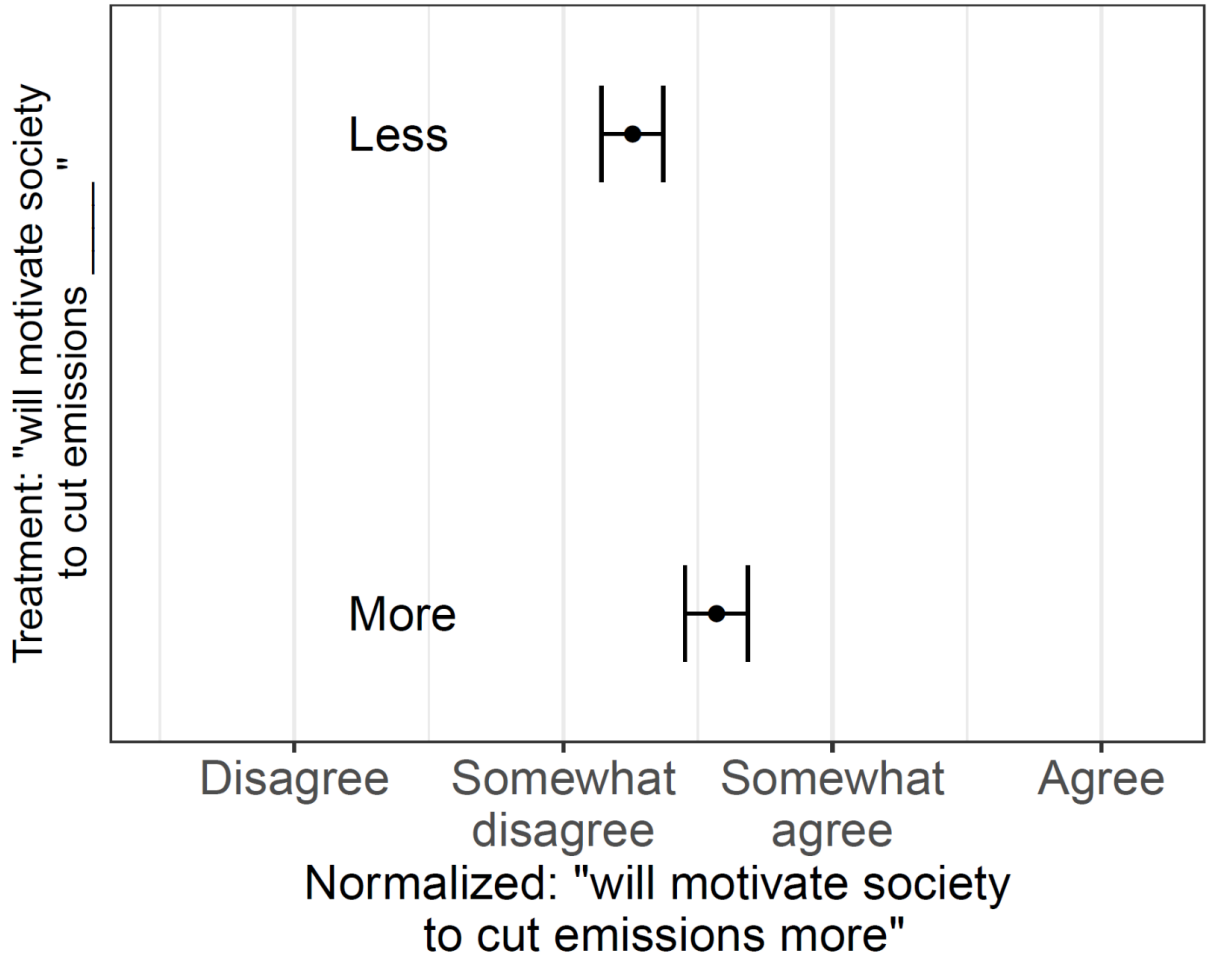
Dependent variable: amount of purchased VCOs	Average marginal effect (AME)
Treatment group	
SAI	0.774**
AUG	0.033
Climate change	
(1) Perception of impacts	0.029
(2) Daily mitigation	0.016
(3) Moral obligation to mitigate	0.782***
Experiment characteristics	
(4) VCO effectiveness	1.145***

Merk, Pönitzsch & Rehdanz, *Environ. Res. Lett.* (2016)

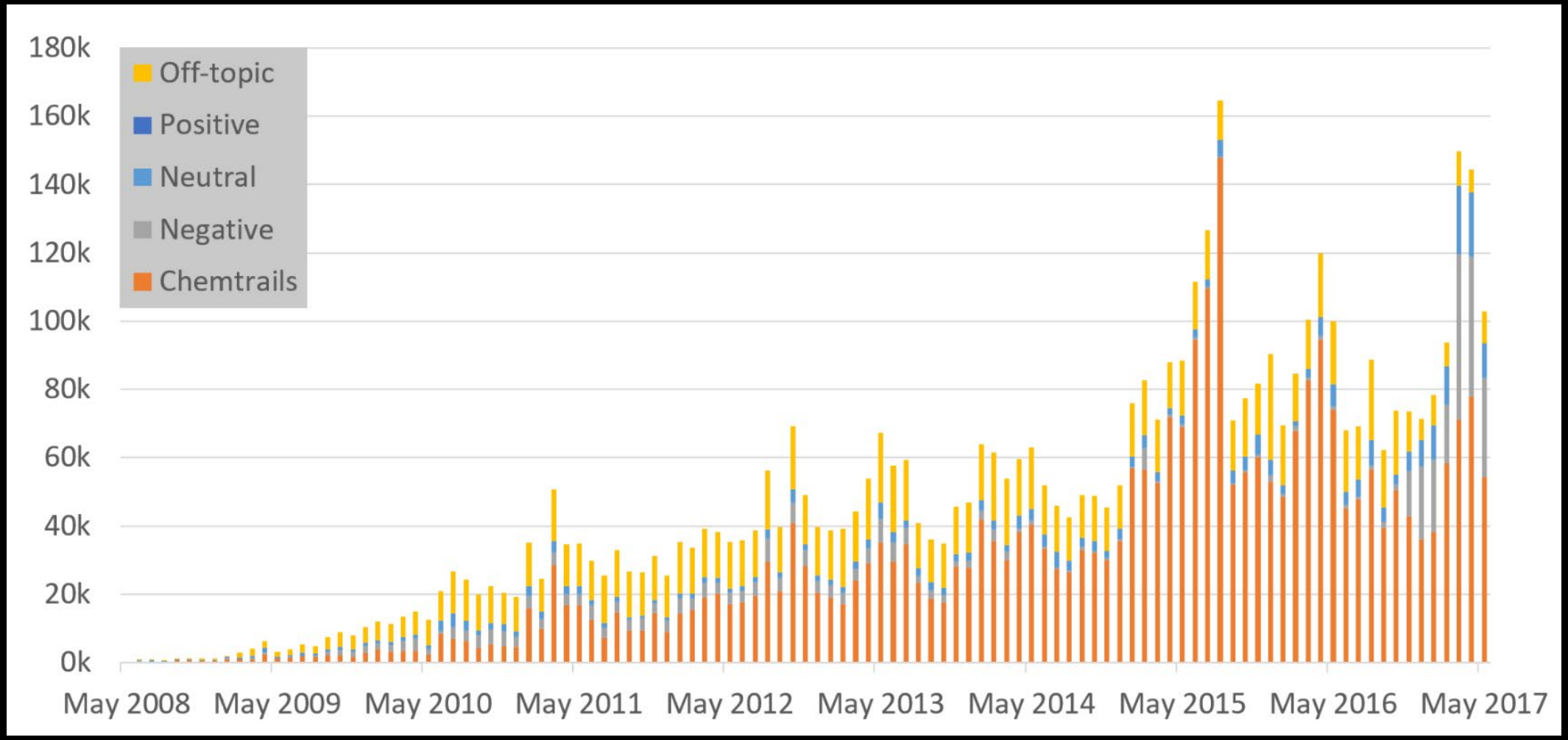
Acquiescence bias may dominate any “moral hazard” finding

n=1,000, part of 36,000-subject 2016 Cooperative Congressional Election Study of US electorate, Oct-Nov 2016

Ask whether solar geoengineering “will motivate society to cut emissions *less*”, get (weak) agreement.
Ask whether it will cut emissions “*more*,” get (weak) agreement.



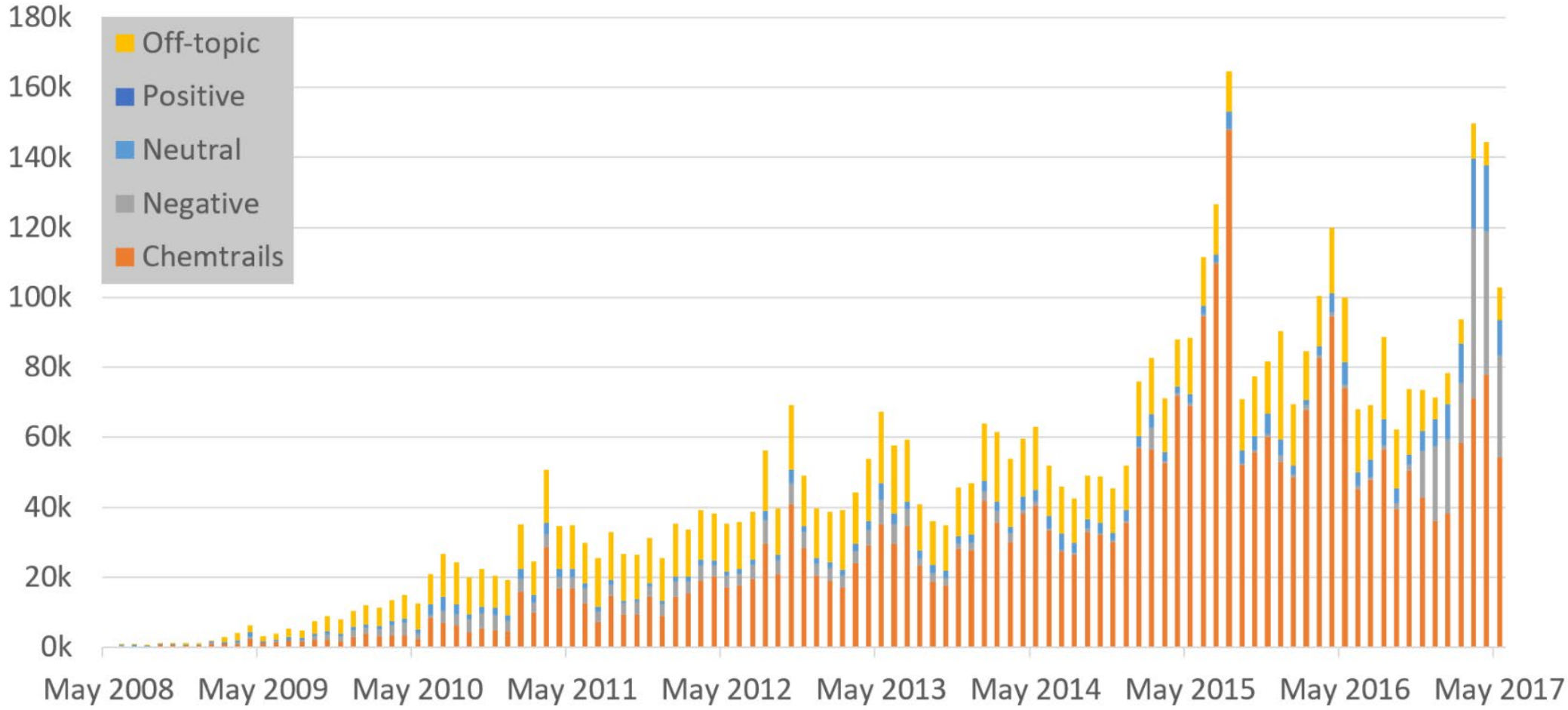
Mahajan, Tingley, Wagner, “Fast, cheap, and imperfect? U.S. public opinion about solar geoengineering” (*2018*)



Tingley & Wagner (2017)

Chemtrails conspiracy dominates social media geoengineering discourse

Analysis of totality of Twitter, (public) Facebook, YouTube, and other social media feeds



Tingley & Wagner (2017)

Green
Risky Climate

Fear of Geoengineering Is Really Anxiety About Cutting Carbon

Research into unproven technofixes isn't a replacement for eliminating emissions, even if the debate over geoengineering is stuck on that concern.

The geoengineering debate is caught in false choice between cutting emissions, like those from cars, and researching the dire possibility of resorting to technofixes such as reflecting back a portion of sunlight. *Photographer: Samuel Corum/Bloomberg*

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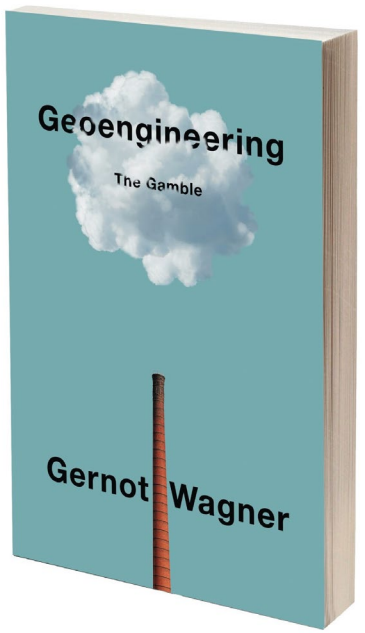

Nuclear

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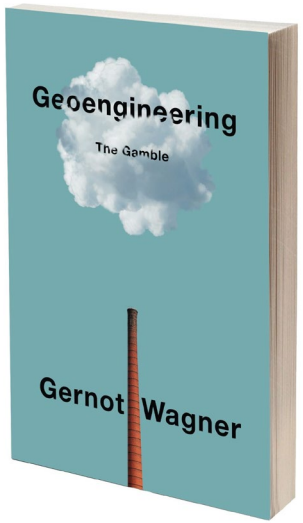

Sources: Wagner (*Bloomberg,* 2021), Wagner & Zizzamia (*Ethics, Policy & Environment* 2021), Wagner *Geoengineering: the Gamble* (2021)

Most any ‘technofix’

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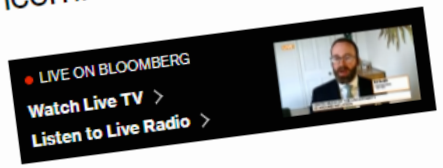

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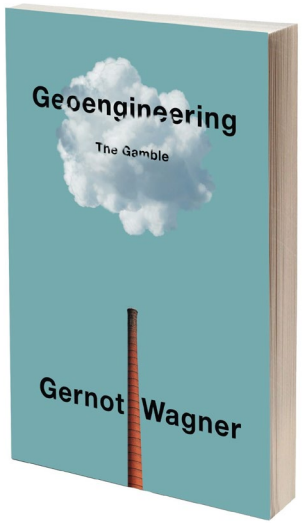

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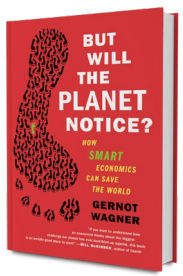

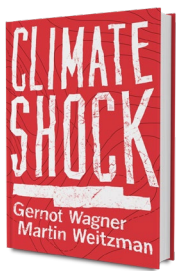

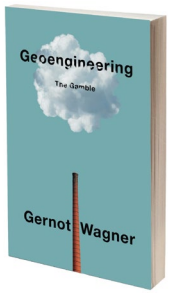

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