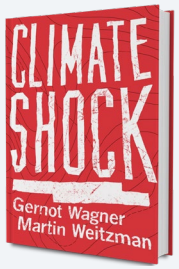
Climate Risks, Uncertainties, and Opportunities



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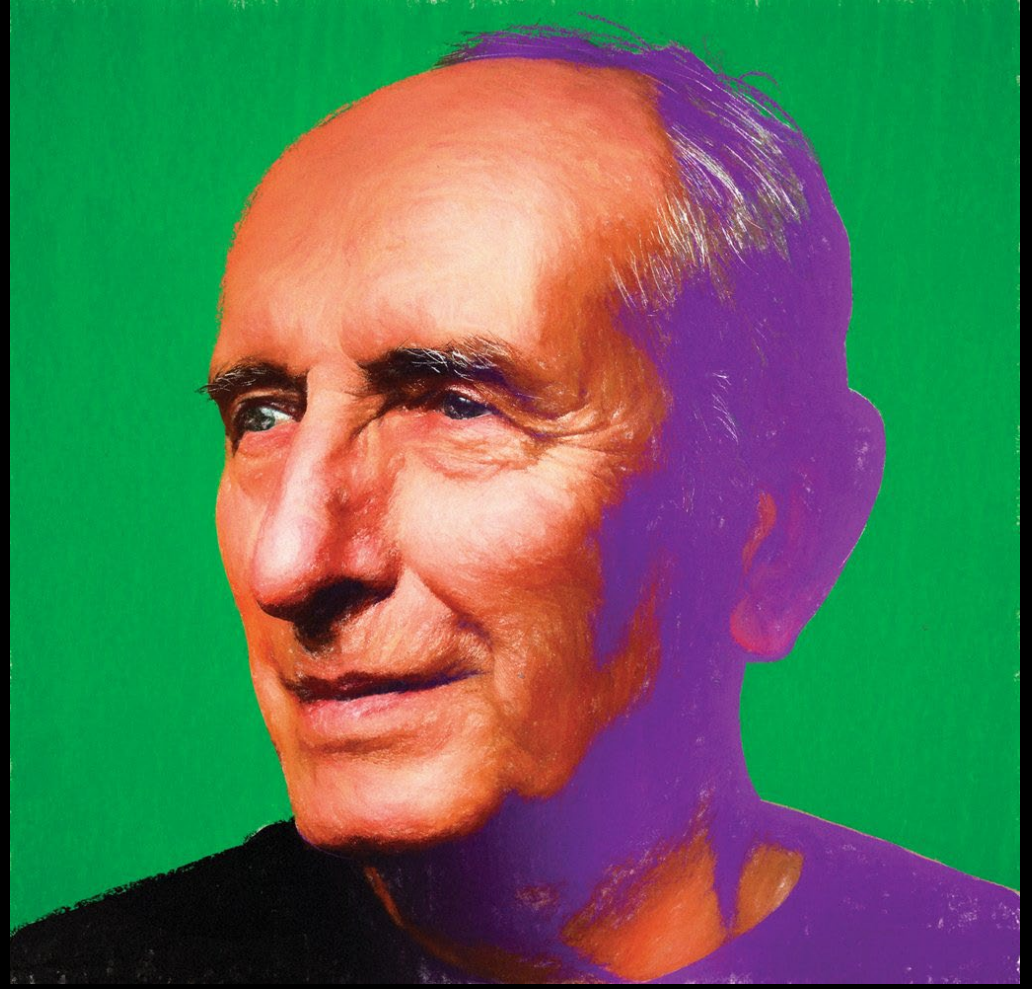
Rich Lesser, Global Chair, Boston Consulting Group, at Columbia Business School, 2022

strikes that she helped inspire. “There’s this false image that I’m an angry, depressed teenager,” says Thunberg, whose rapid rise is the subject of “I Am Greta,” a new documentary on Hulu. “But why would I be depressed when I’m trying to do my best to change things?”

NYT Magazine (2020), nyti.ms/38oA9hX



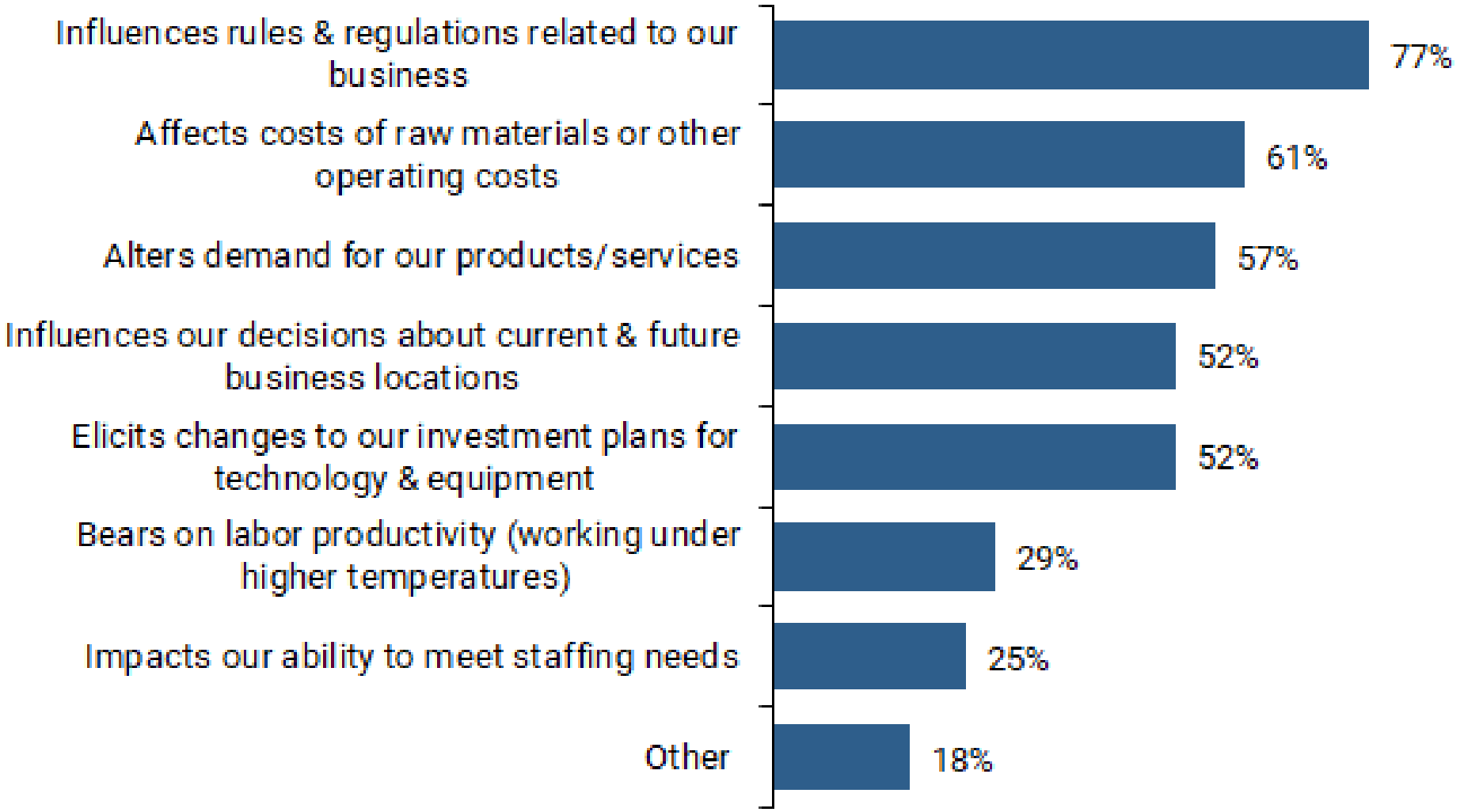
global warming. “I am not talking about what *could* be done,” says Smil, who is 78 and who counts Bill Gates among his many devotees. “I’m looking at the world as it *is*.”

NYT Magazine (2022), nyti.ms/3kdBbAf

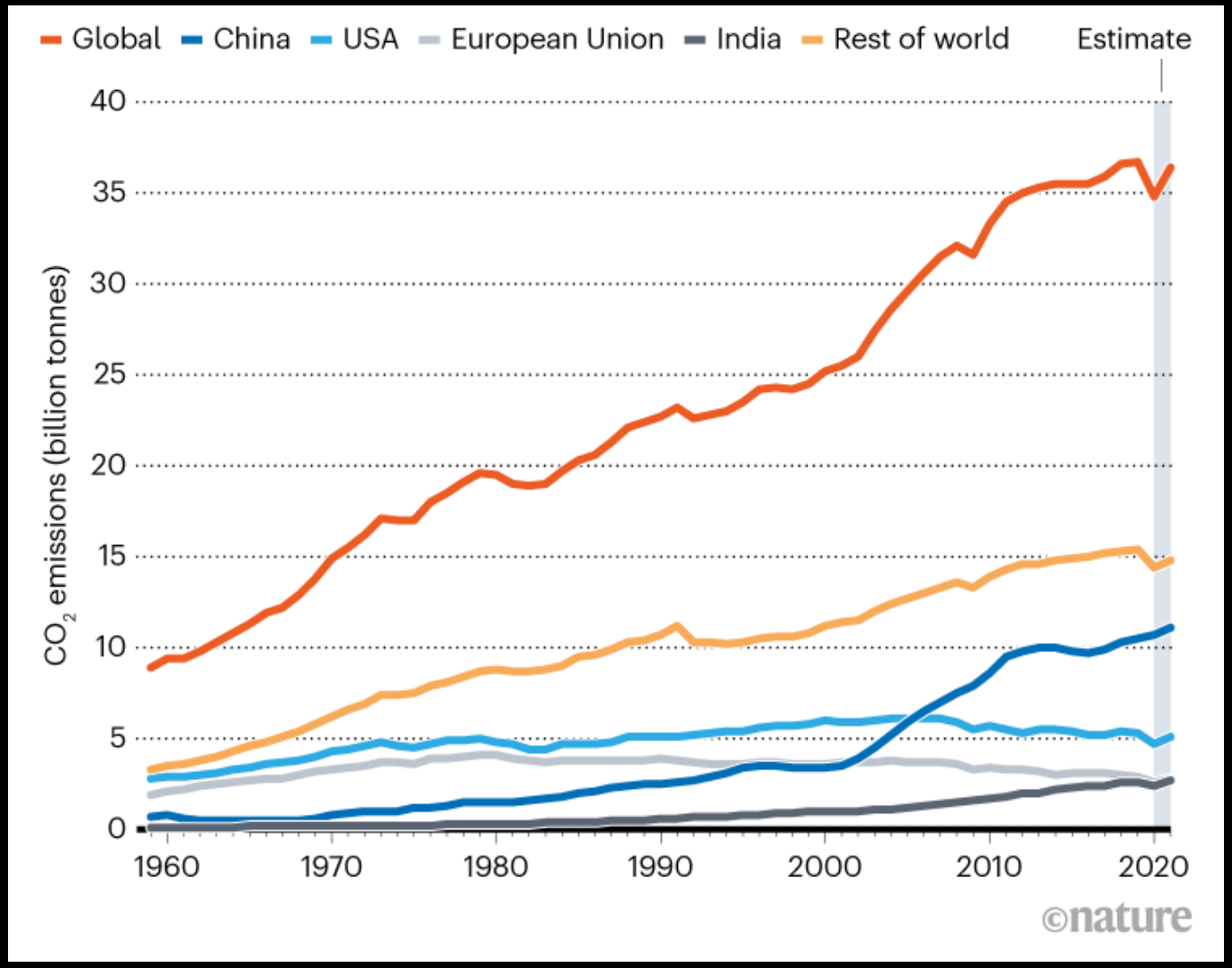
Climate Risk
vs
Policy Risk

Climate Risk
&
Policy Risk

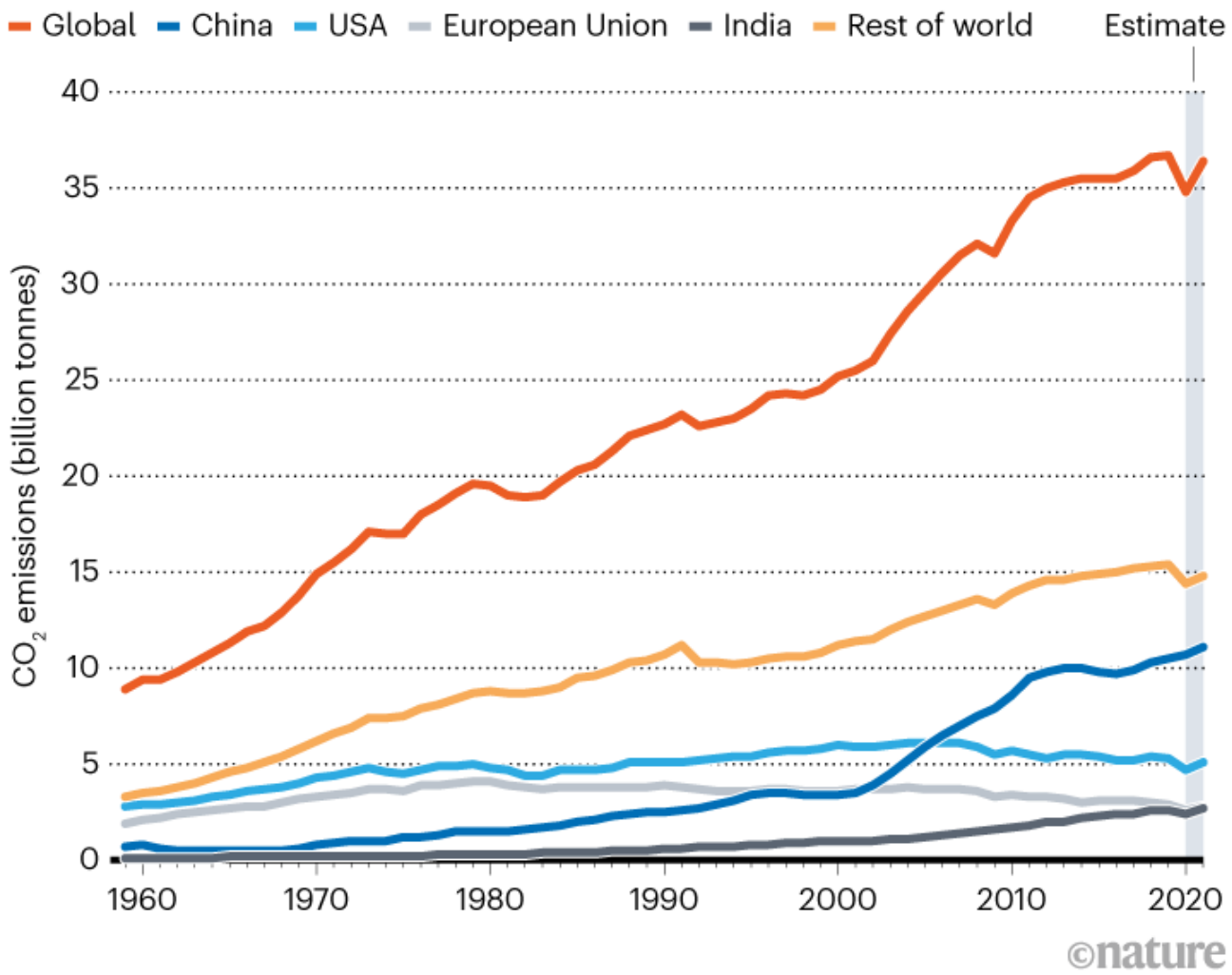
How does climate change affect or is expected to affect your business's revenue, costs, and investments?



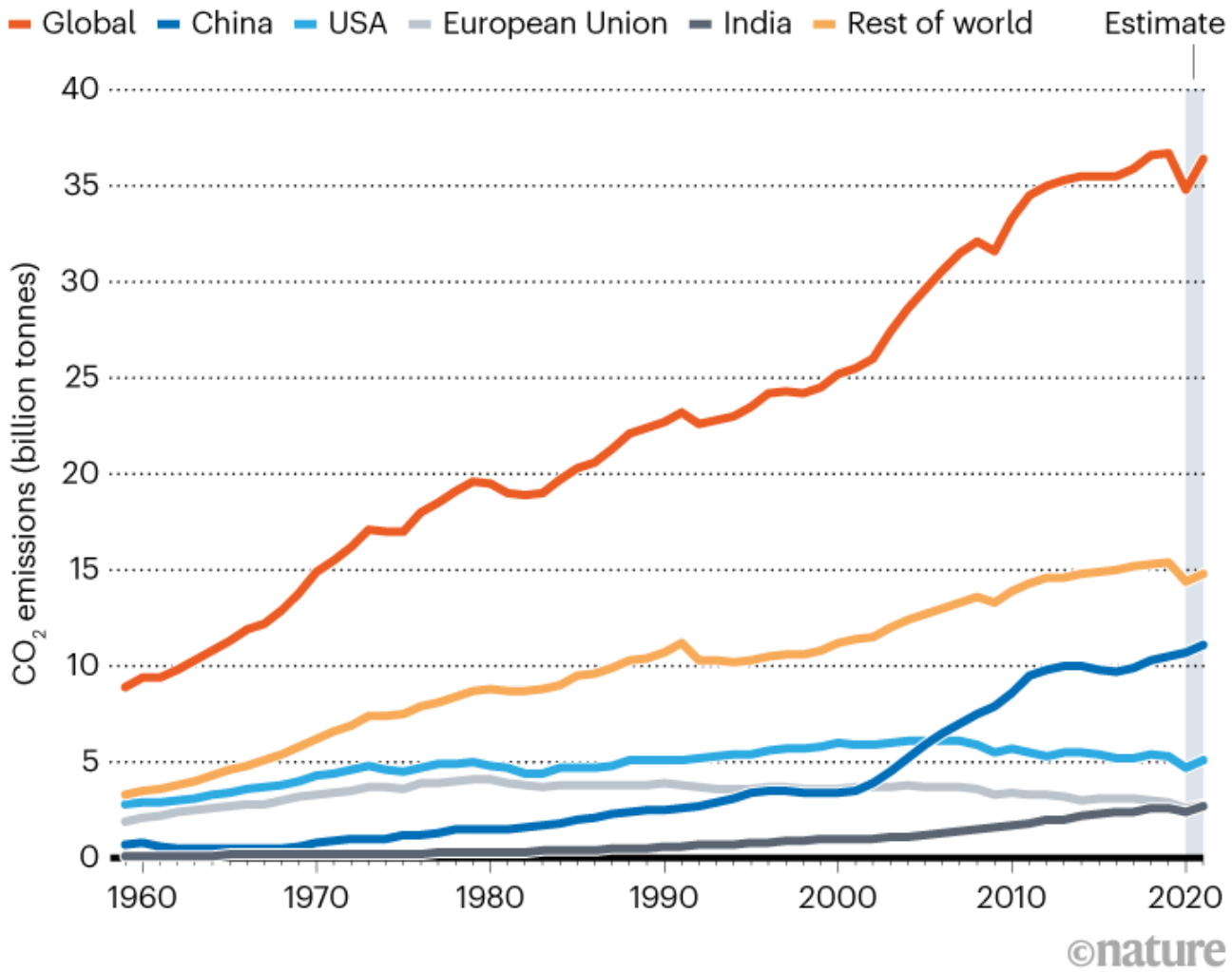
Source: San Francisco Fed's Survey on Climate Risk 2021



Source: Global Carbon Project



Source: Global Carbon Project



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

Known knowns are bad

Unknowns, unknowables, risks & uncertainties make it worse

~$200 / tCO_2

~$200(!?) Social Cost of CO_2

Based on 2% discount rate, subject to external review

Table ES.1: Estimates of the Social Cost of Greenhouse Gases (SC-GHG), 2020-2080 (2020 dollars)

	SC-GHG and Near-term Ramsey Discount Rate								
	$SC\text{-}CO_2$ *(2020 dollars per metric ton of CO_2)*			$SC\text{-}CH_4$ *(2020 dollars per metric ton of CH_4)*			$SC\text{-}N_2O$ *(2020 dollars per metric ton of N_2O)*		
Emission Year	2.5%	2.0%	1.5%	2.5%	2.0%	1.5%	2.5%	2.0%	1.5%
2020	120	190	340	1,300	1,600	2,300	35,000	54,000	87,000
2030	140	230	380	1,900	2,400	3,200	45,000	66,000	100,000
2040	170	270	430	2,700	3,300	4,200	55,000	79,000	120,000
2050	200	310	480	3,500	4,200	5,300	66,000	93,000	140,000
2060	230	350	530	4,300	5,100	6,300	76,000	110,000	150,000
2070	260	380	570	5,000	5,900	7,200	85,000	120,000	170,000
2080	280	410	600	5,800	6,800	8,200	95,000	130,000	180,000

Values of $SC\text{-}CO_2$, $SC\text{-}CH_4$, and $SC\text{-}N_2O$ are rounded to two significant figures. The annual unrounded estimates are available in Appendix A.4 and at: www.epa.gov/environmental-economics/scghg.

~$200 U.S. EPA $SC\text{-}CO_2$, subject to external peer review

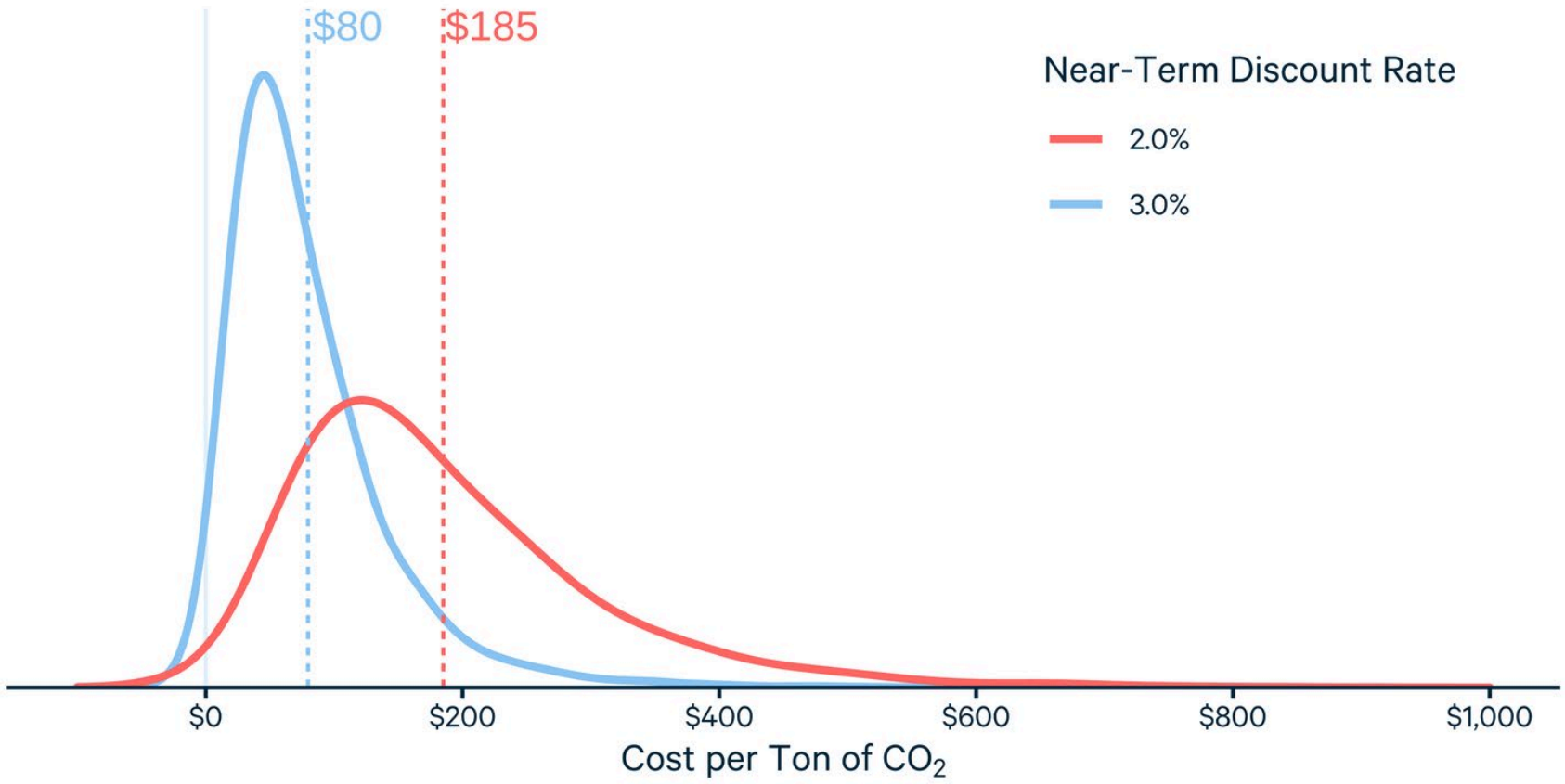
Source: EPA External Review Draft of Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances (September 2022)

>~$200 / tCO_2 :

- Climate damage quantification
  - including tipping points
- Tail risks
- Discounting
- Risk calibration, equity, etc.

~$185 Social Cost of CO_2

Based on 2% constant discount rate, with most of the increase due to discounting



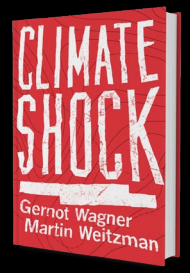
~$50 to ~$80 from updated damages,
~$80 to ~$185 from discounting

Source: Rennert *et al* "Comprehensive Evidence Implies a Higher Social Cost of CO_2" (*Nature*, September 2022).

>~$200 / tCO_2 :

Climate damage quantification

including tipping points



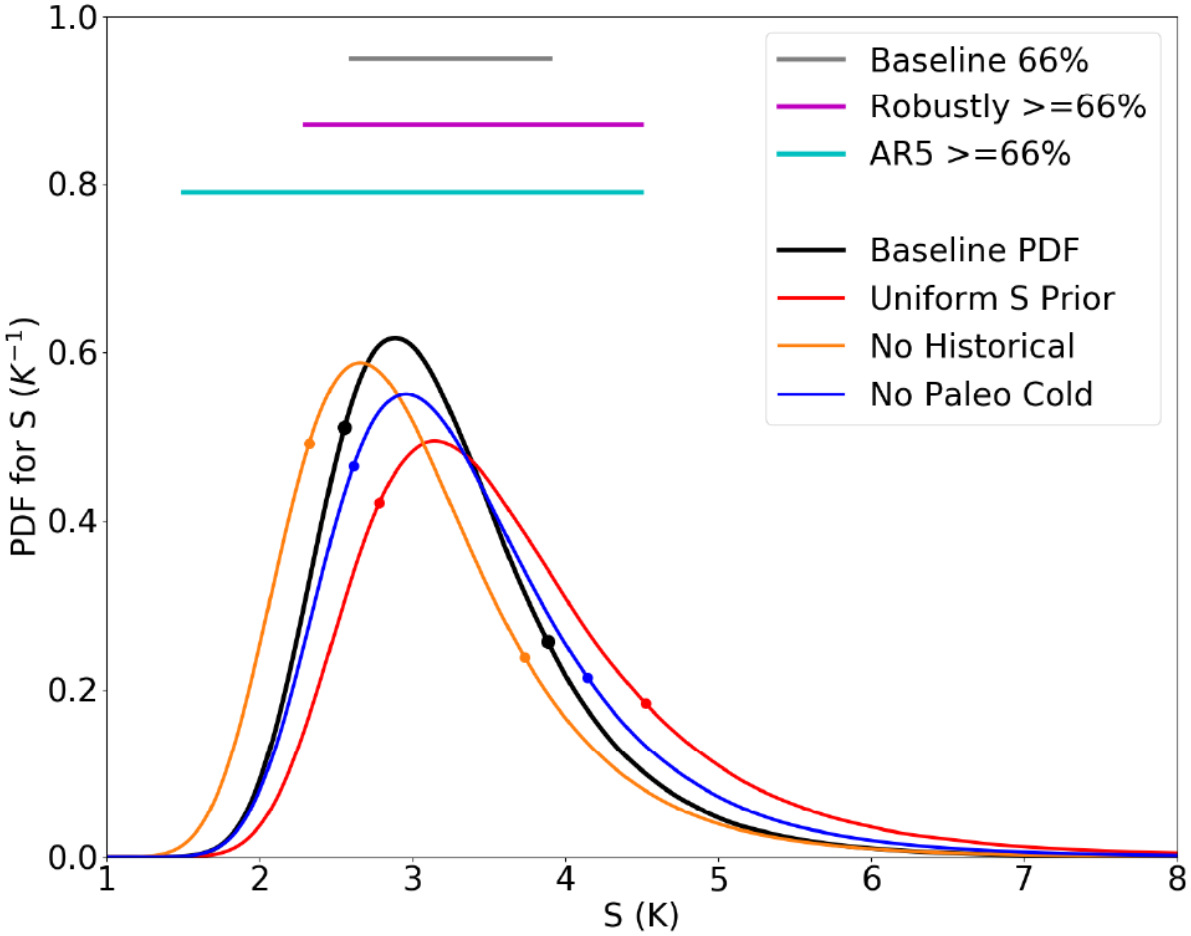
Tail risks

Discounting

Risk calibration, equity, etc.

Climate sensitivity “likely” between ~2-4.5°C

Latest assessment narrows 66% “likely” range from 1.5-4.5°C



Tail risk might dwarf importance of “likely” range

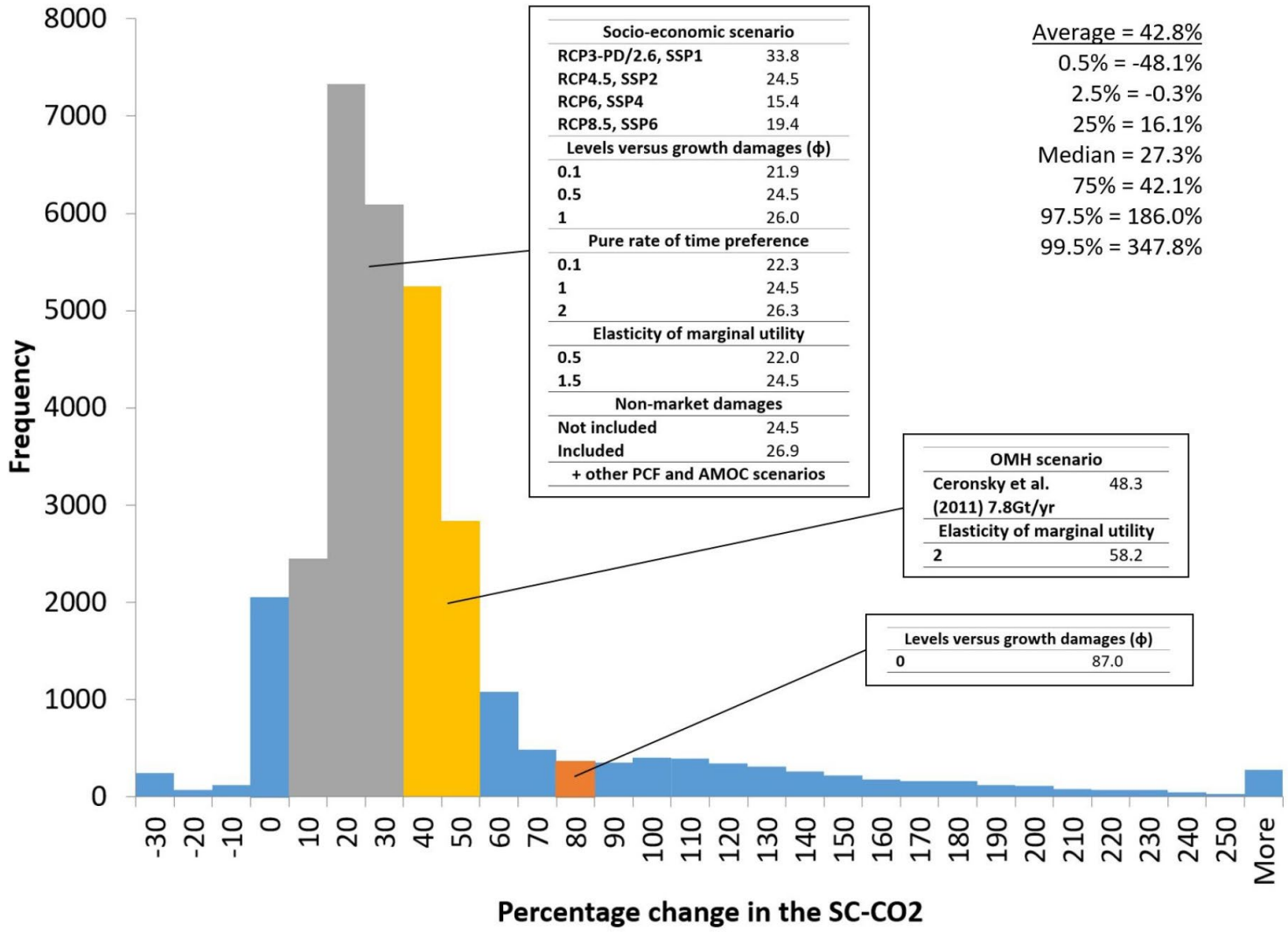
Source: Sherwood et al (2020)

>~$200 / tCO_2 :

- Climate damage quantification
  - including tipping points
- Tail risks
- Discounting
- Risk calibration, equity, etc.

Economic impacts of tipping points in the climate system

Tipping points increase SCC by between ~27-43%, with large, right-skewed distribution



Source: Dietz, Rising, Stoerk & Wagner (*PNAS* 2021), gwagner.com/tipping-economics

$> \$200 / tCO_2$

~ $200 / tCO_2

=

~8-10% of

global GDP

> $150 / car entering NYC*

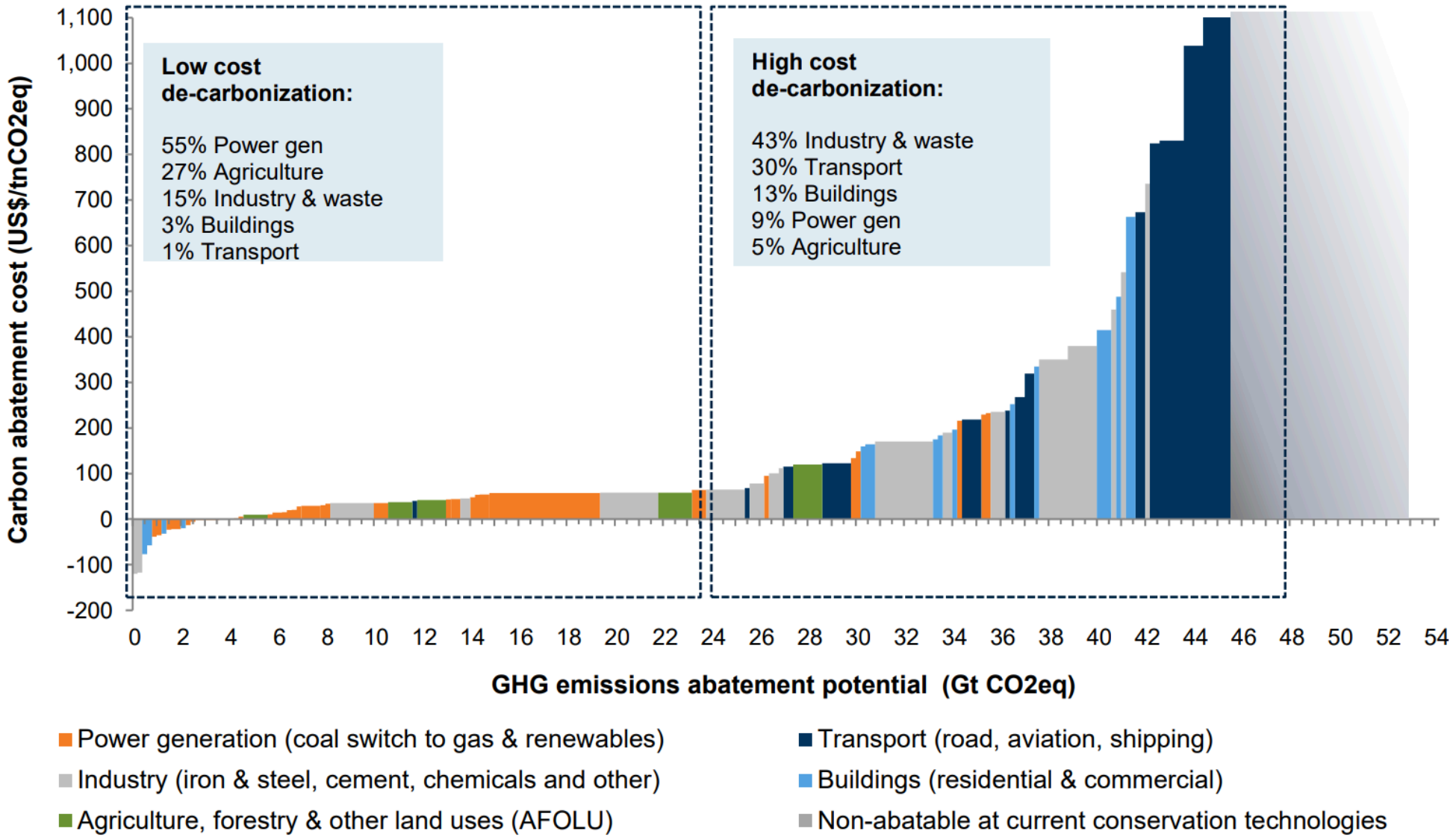
* Manhattan below 60th Street

Tail risks dwarf all else

Climate policy = insurance

Climate policy = opportunity

GS Carbon Abatement Cost Curve



Source: Goldman Sachs Global Investment Research

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.

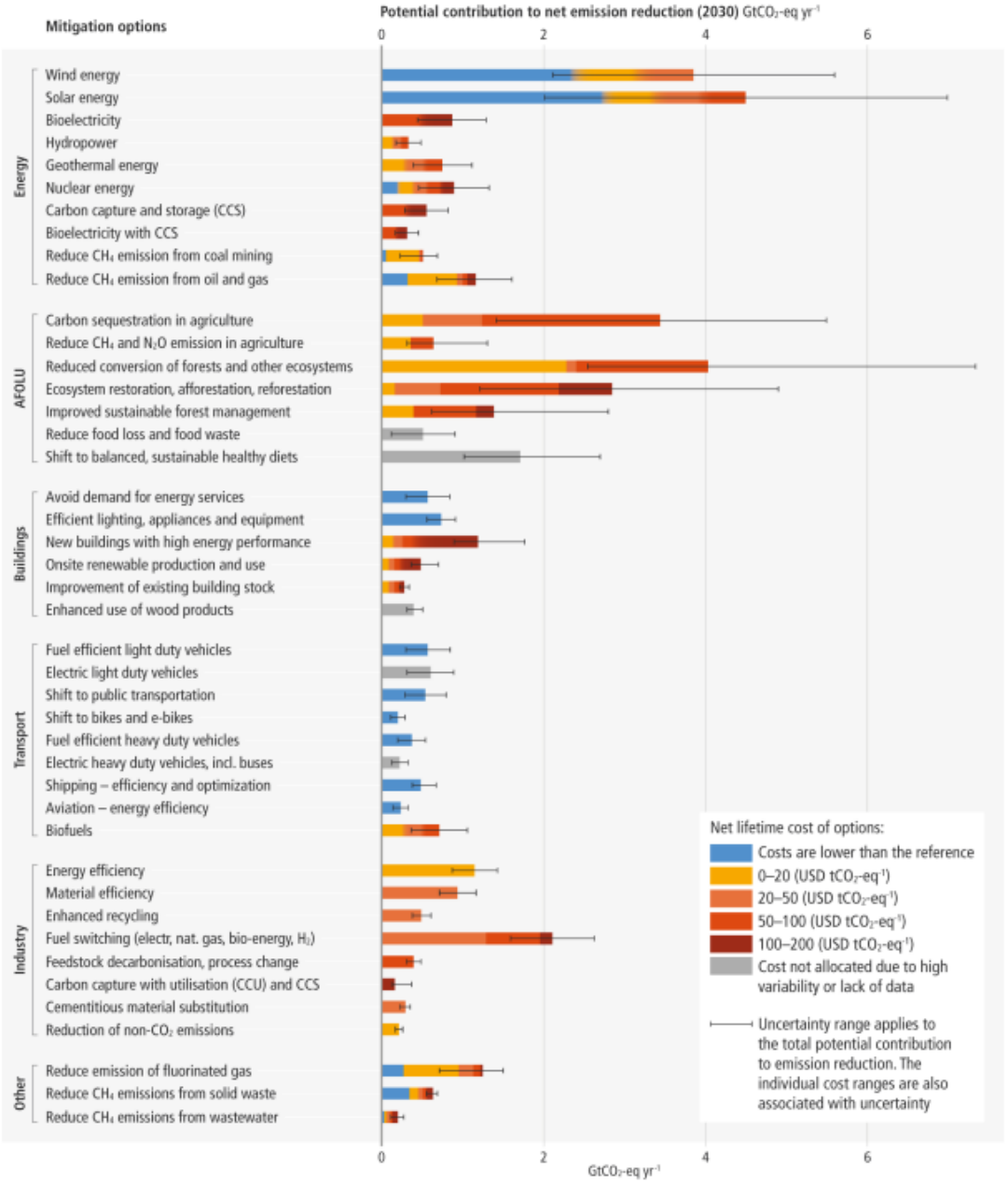
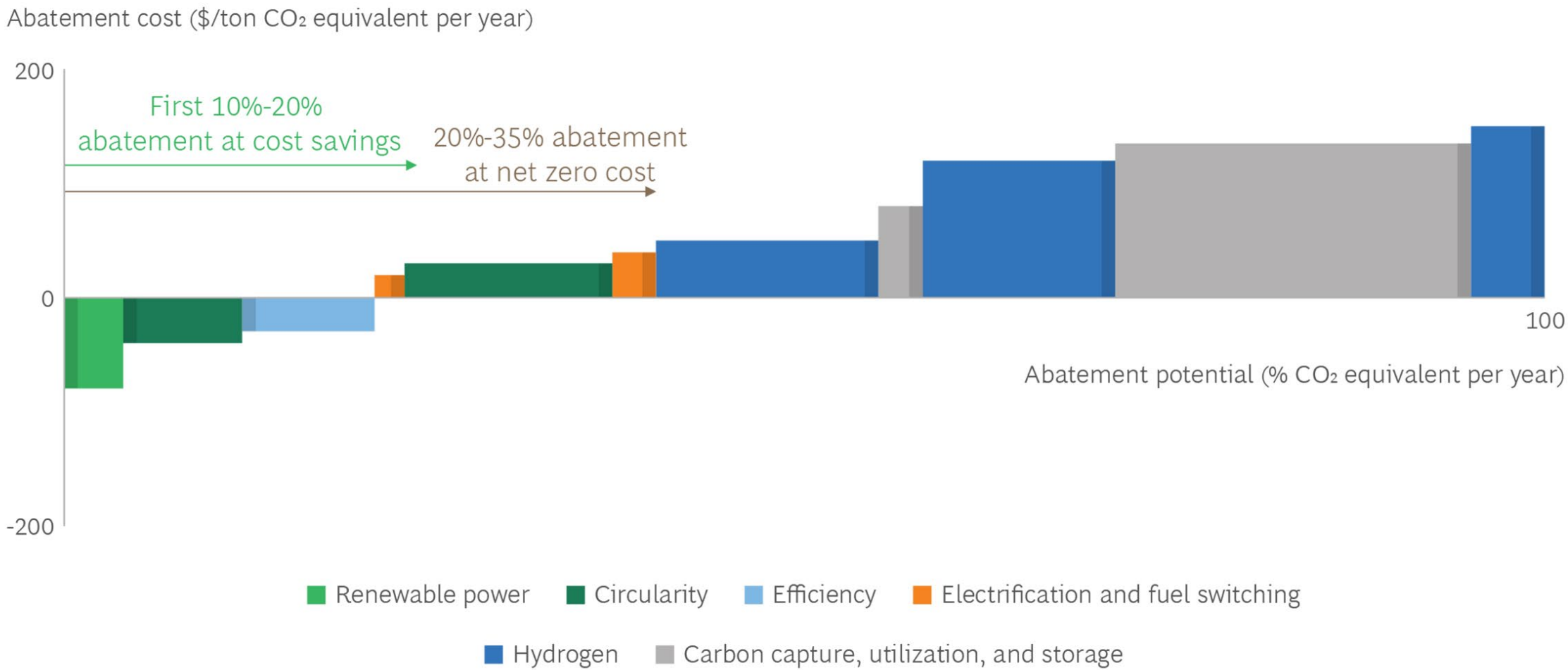


Figure SPM.7: Overview of mitigation options and their estimated ranges of costs and potentials in 2030.

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

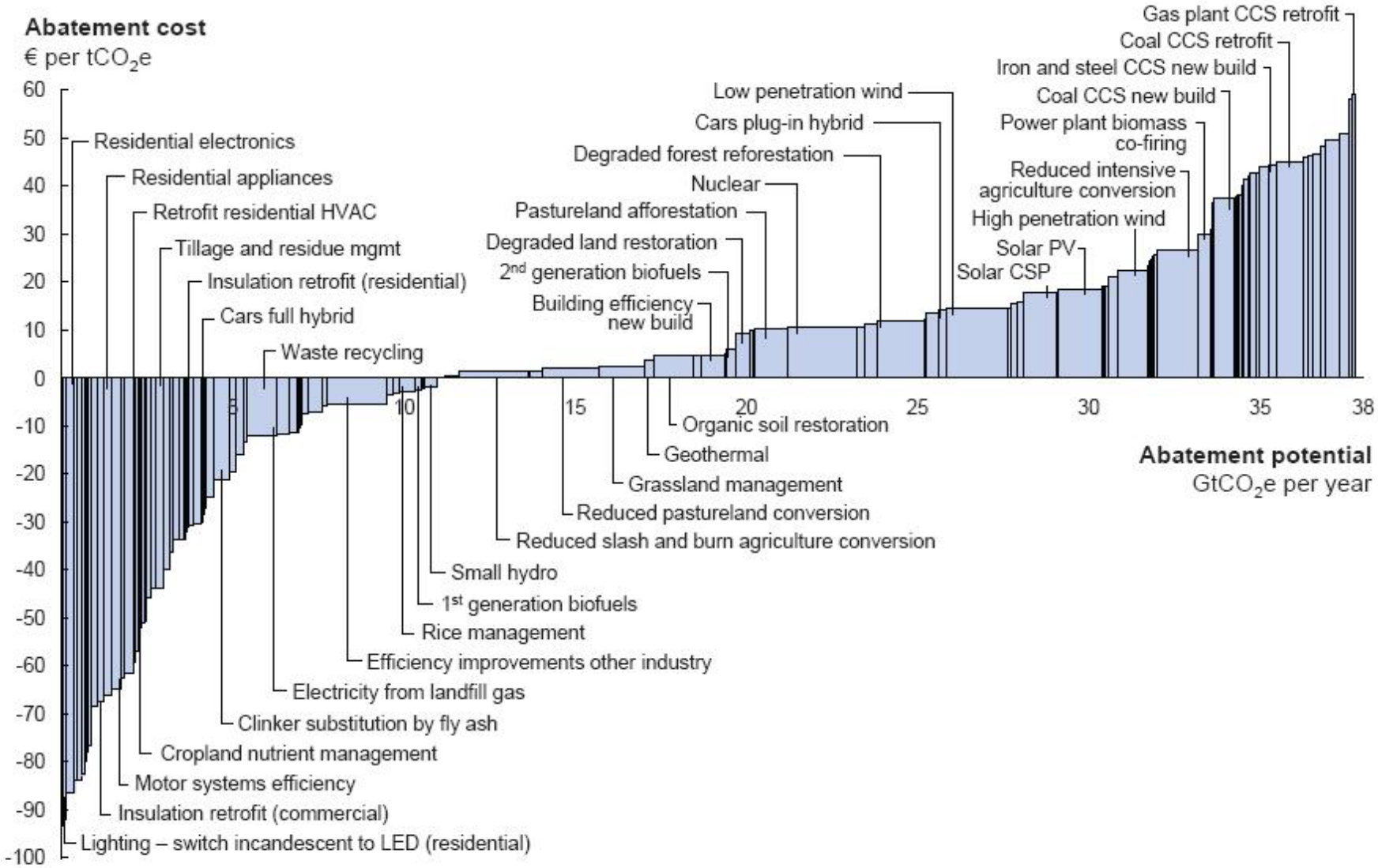
Exhibit 1 - A Chemicals Plant Can Abate One-Third of Emissions at Net Zero Cost



Source: BCG analysis.

Large abatement opportunities available at low or no cost

McKinsey Global v2.0 effort in 2009 identified 38 $GtCO_2e$ abatement potential in 2030

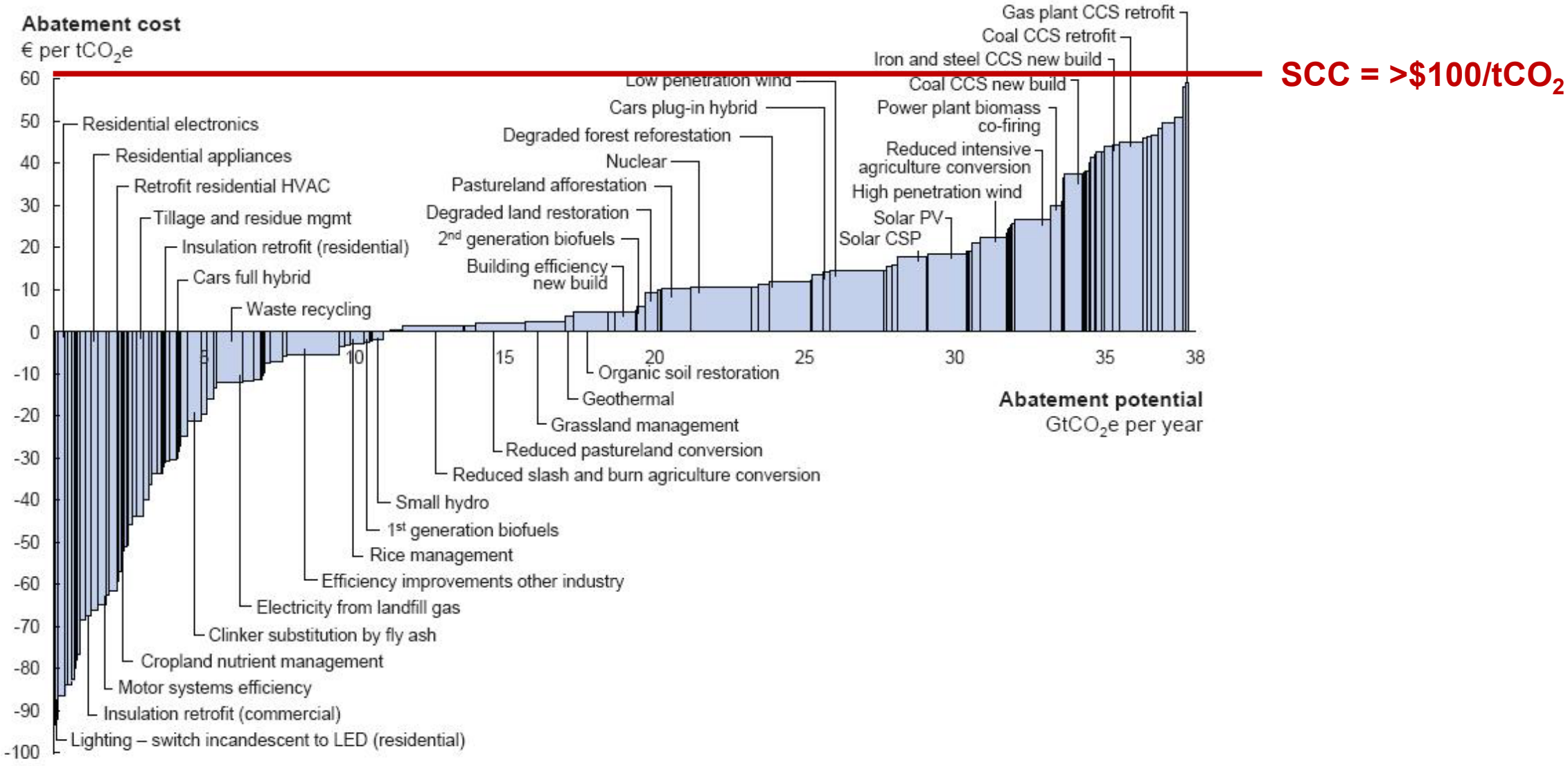


Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO_2e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.

Source: Global GHG Abatement Cost Curve v2.0

Large abatement opportunities available at low or no cost

McKinsey Global v2.0 effort identified 38 $GtCO_2e$ abatement potential in 2030



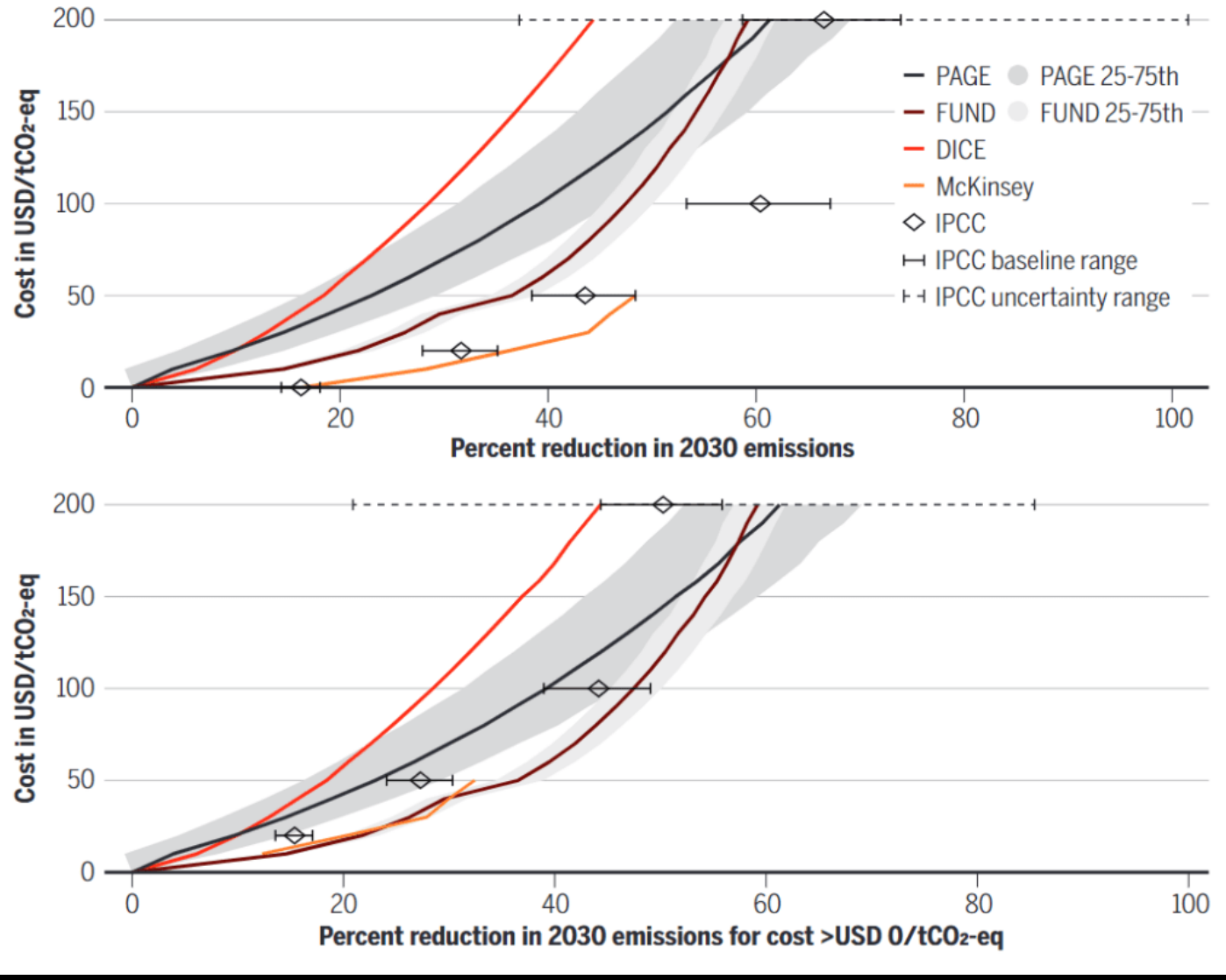
Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO_2e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.

Source: Global GHG Abatement Cost Curve v2.0

How costly, or costless, is climate emissions mitigation? p. 1001

Comparison of global mitigation potentials at different costs

The IPCC results use different baseline emissions to calculate the range of mitigation potentials. The top panel reports the full set of results, and the bottom panel reports only the mitigation potentials with costs >$0 per tonne of CO_2 equivalent (tCO_2-eq). USD reported in 2020 dollars. See supplementary materials.



Source: Kotchen, Rising & Wagner. “The costs of “costless” climate mitigation.” *Science* (30 November 2023).


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
> 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.

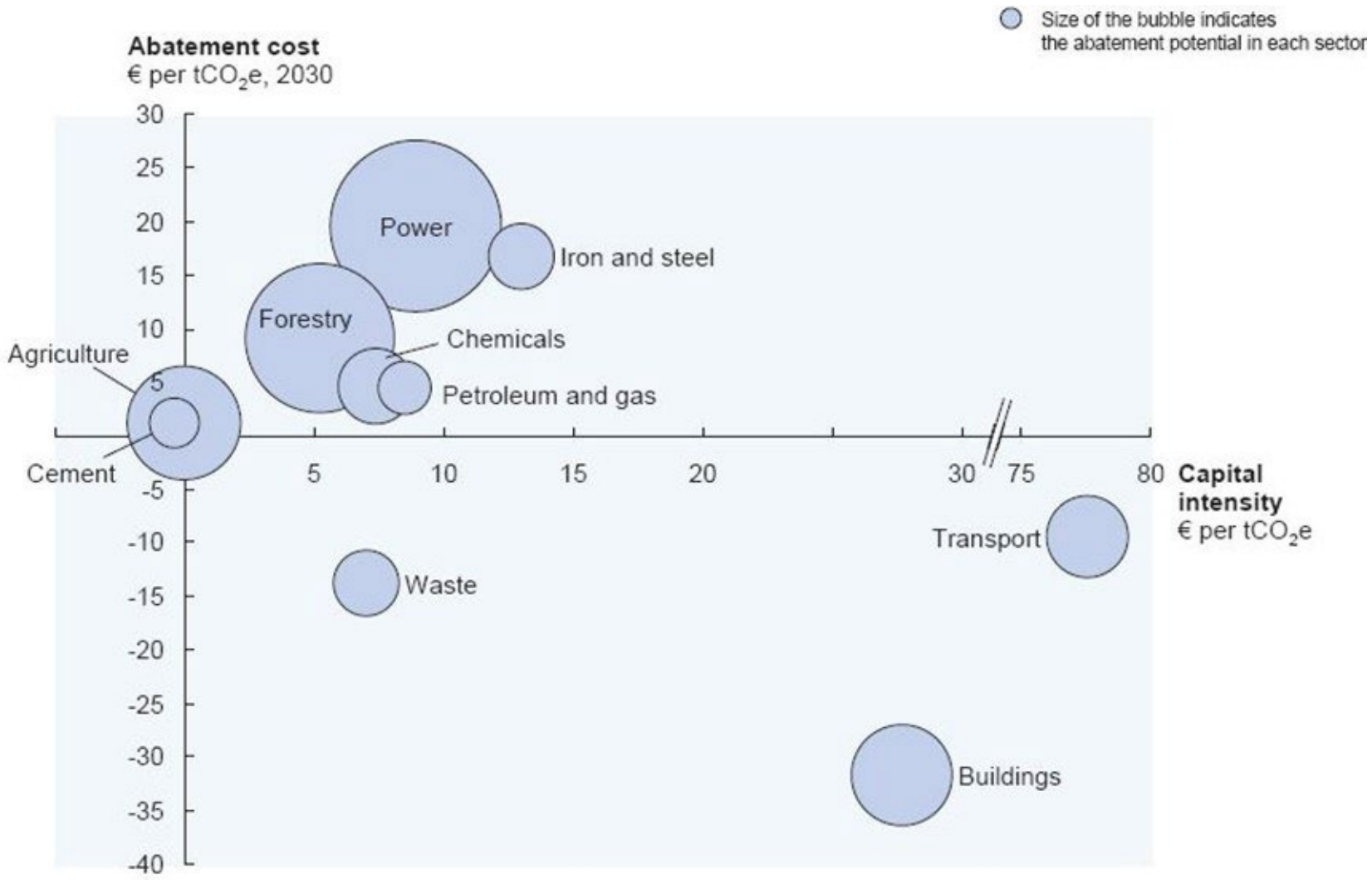
situated in the power sector, most remaining fossil fuel CO2 emissions in pathways that likely limit warming to 2°C and below are from non-electric energy – most importantly from the industry and transportation sectors (high confidence). Decommissioning and reduced utilisation of existing fossil fuel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

Capital intensity varies widely across sectors

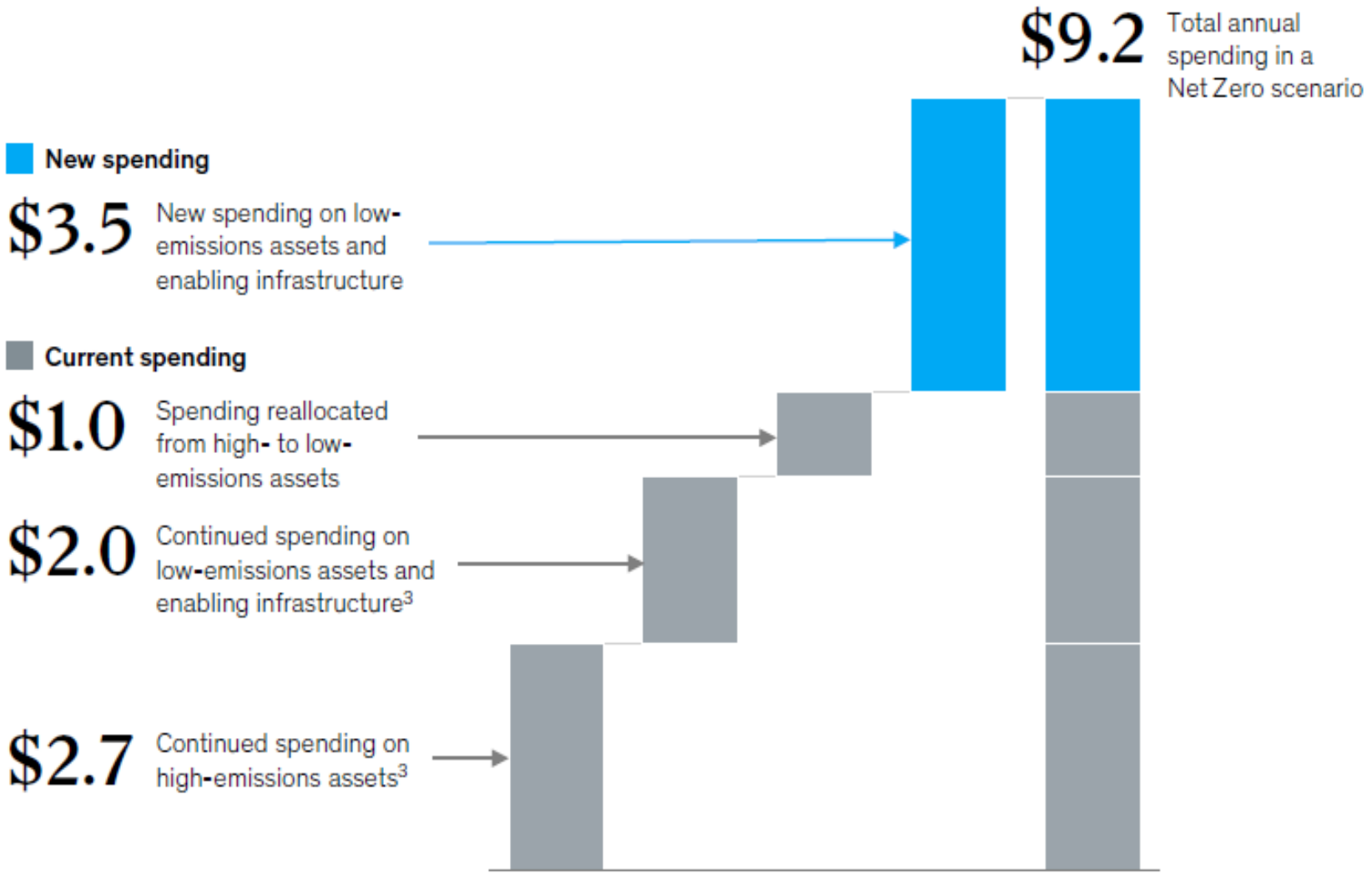
Transport and buildings with largest up-front capital expenditure requirements



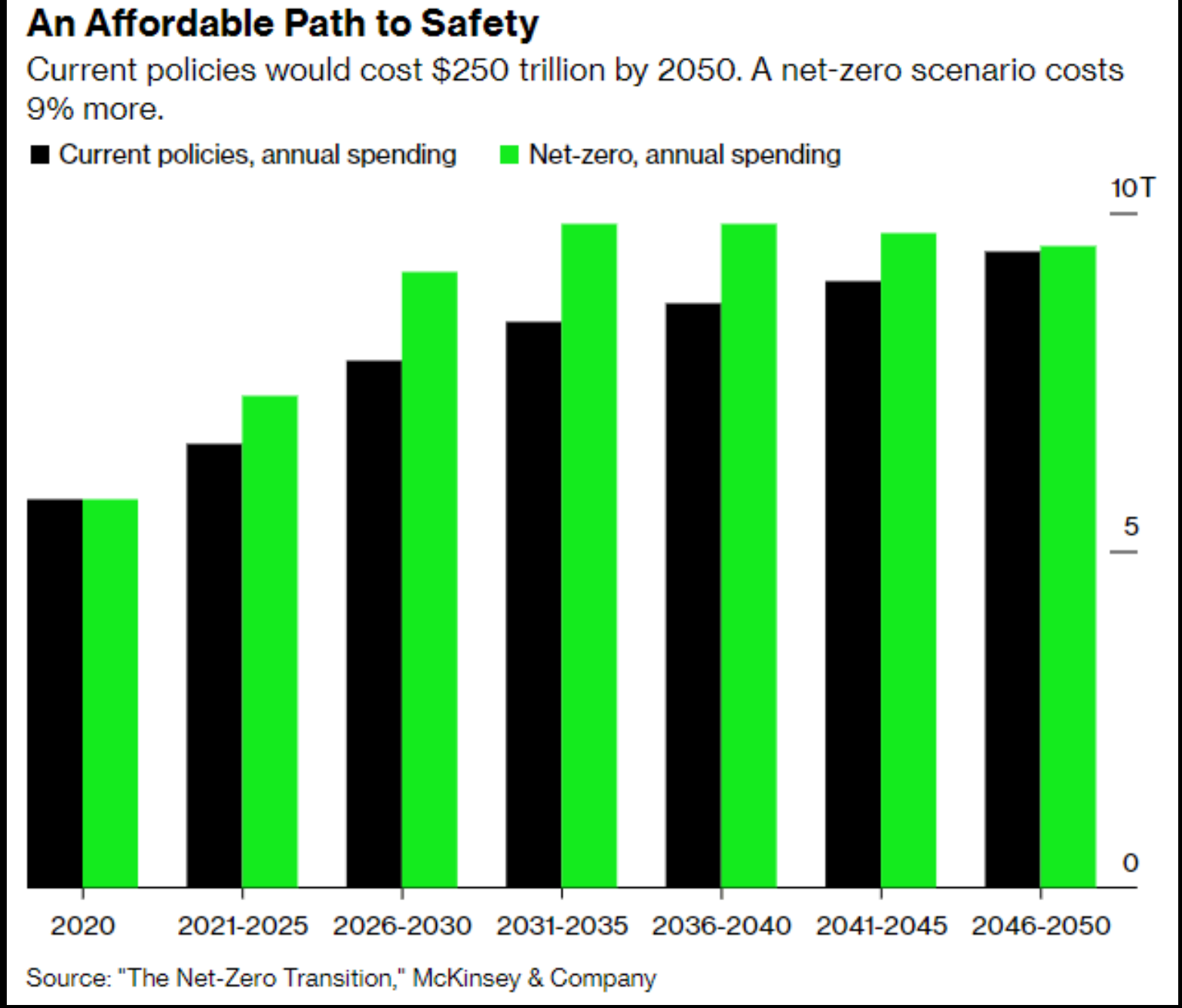
Source: Global GHG Abatement Cost Curve v2.0

Spending on physical assets for energy and land-use systems in the NGFS Net Zero 2050 scenario would rise to about $9.2 trillion annually, or about $3.5 trillion more than today.

Annual spending on physical assets for energy and land-use systems[1] in a Net Zero 2050 scenario,[2] average 2021–50, $ trillion



McKinsey's 2022 *The Net-Zero Transition* report



Wagner, "The Cost to Reach Net Zero By 2050 Is Actually a Bargain," *Bloomberg Green* Risky Climate (28 January 2022)

Transition costs additional <$1T / yr, shifting ~$8T / yr

U.S. IRA alone ~$1.2T / 10 yr, leveraging ~$3T in private capital

Negative climatic tipping points, meet the positive socio-economic ones the IRA is jumpstarting

- The challenge: Addressing ‘fossilflation’ while keeping ‘greenflation’ in check
- U.S. green industrial policies & the global green industrial policy race
- Direct effects are important (get $8k rebate for your heat pump, $2.5k to improve electric wiring, … $250b in DOE loans, etc.), but:
- It’s the external effects, norm changes, positive socio-economic tipping points that will truly make the difference

The Washington Post
Democracy Dies in Darkness

Opinion | 3 ways America can spend Biden's clean-energy windfall faster

By Gernot Wagner and Julio Friedmann
March 13, 2023 at 6:00 a.m. EDT

1. Nationalize clean energy projects
2. Reform the permitting process
3. **Help local governments use federal money**

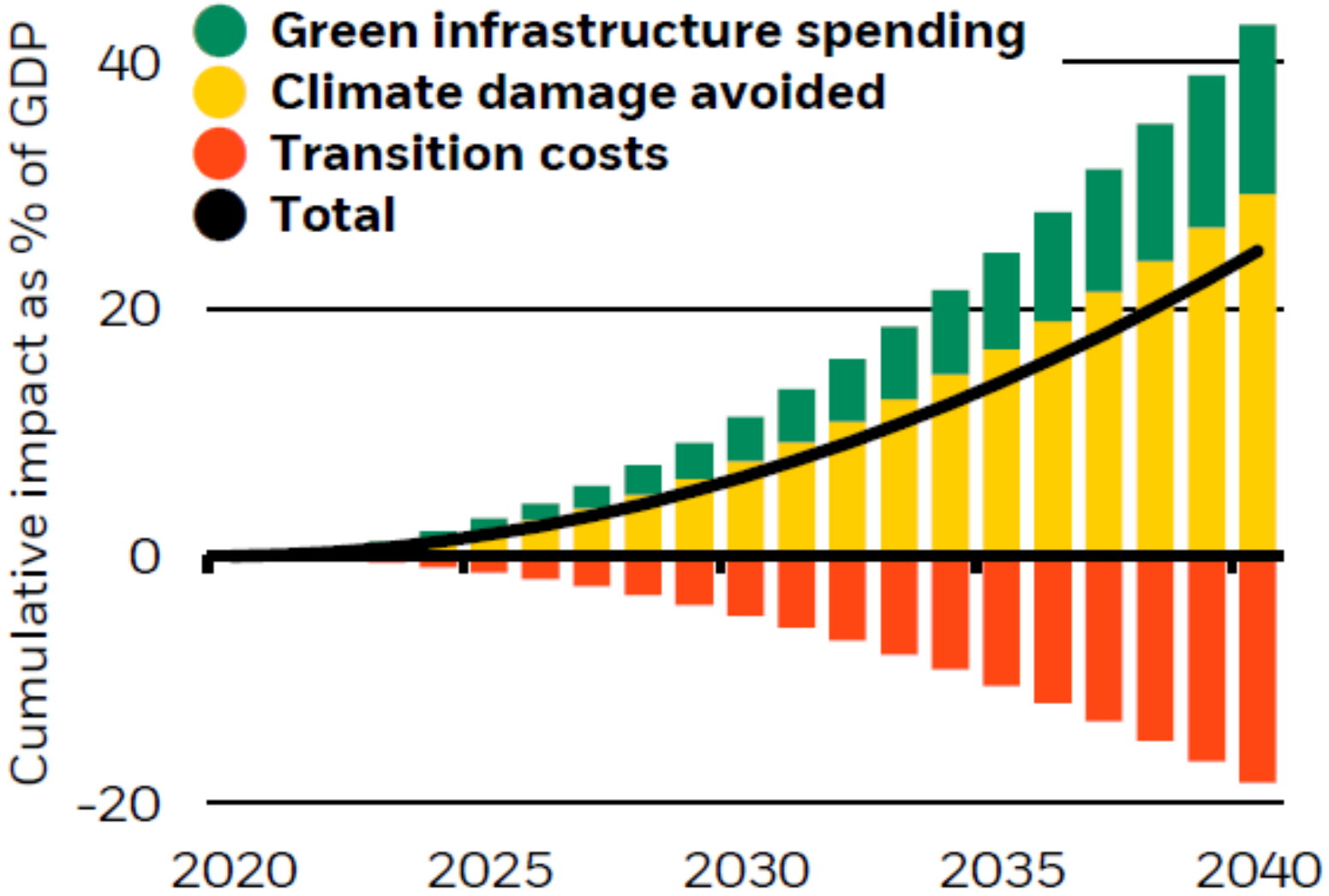
Wagner & Friedmann, *WaPo* (13 March 2023)

BlackRock®

Managing the net-zero transition

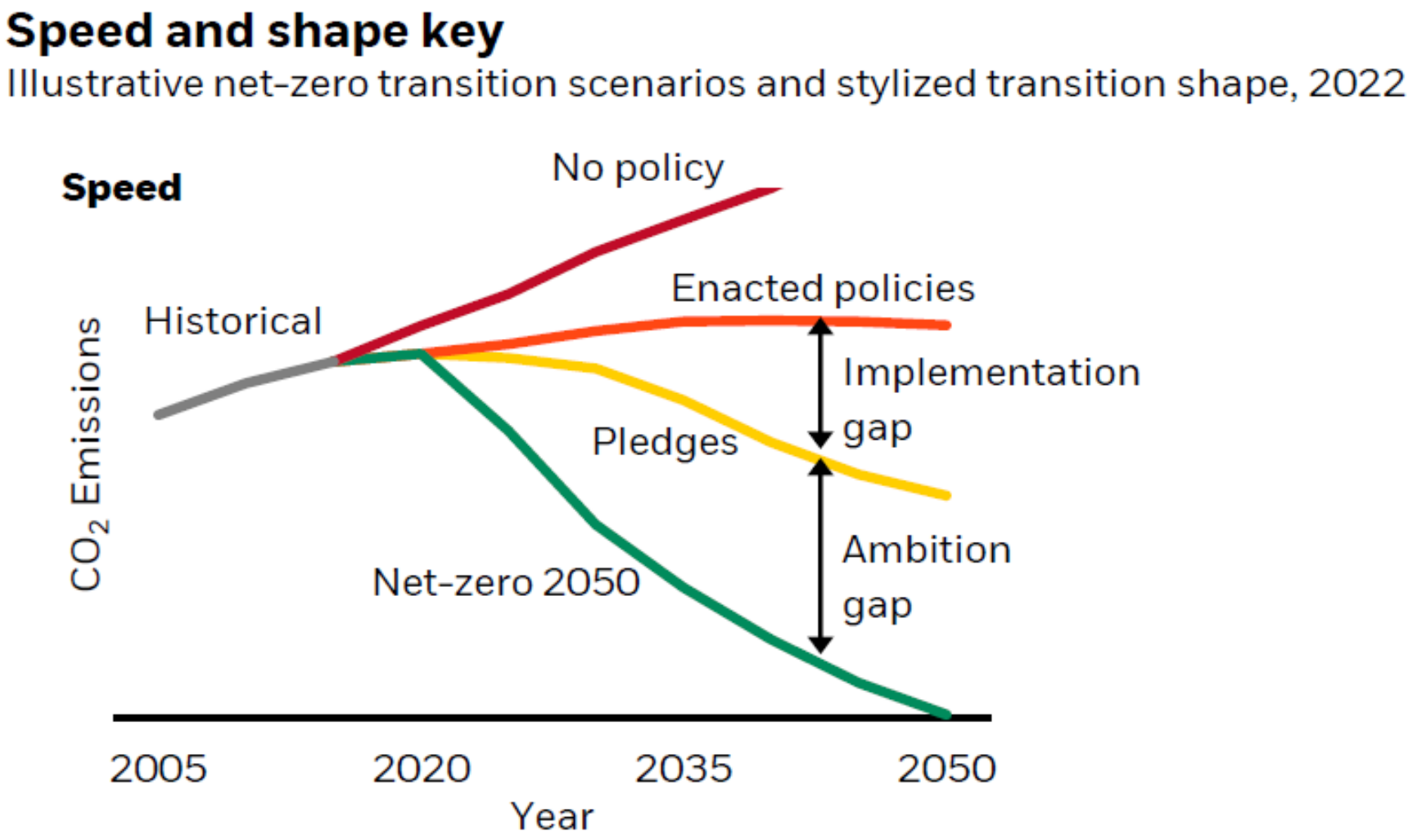
Transition results in net economic gain

Estimated cumulative GDP impact of transition, 2020-40



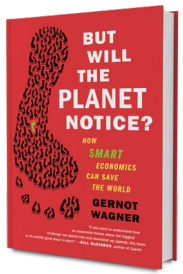
Key Climate Finance Questions

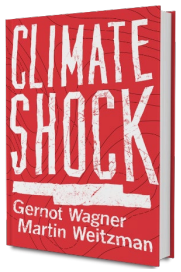
BlackRock's *Managing the net-zero transition* as "target" vs "forecast"

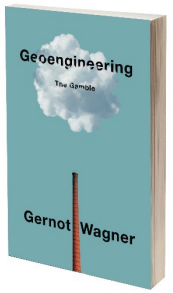


Source: "Managing the net-zero transition" (BlackRock 2022)

Source: Rich Lesser, Global Chair, Boston Consulting Group







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