Business & Society: Climate Change

April 17, 2024, 4:05-5:35 p.m.

4:05 - 4:30 **Climate risks & opportunity**

4:30 - 5:00 **Climate policy**

Guest: Bob Litterman

5:00 - 5:35 **Discussion**

Gernot Wagner
gwagner@columbia.edu
gwagner.com

Leaders | A $25trn hit

Global warming is coming for your home

Who will pay for the damage?

The potential costs stem from policies designed to reduce the emissions of houses as well as from climate-related damage. They are enormous. By one estimate, climate change and the fight against it could wipe out 9% of the value of the world's housing by 2050—which amounts to $25trn, not much less than America's annual GDP. It is a huge bill hanging over people's lives and the global financial system. And it looks destined to trigger an almighty fight over who should pay up.

Source: Current *Economist* cover

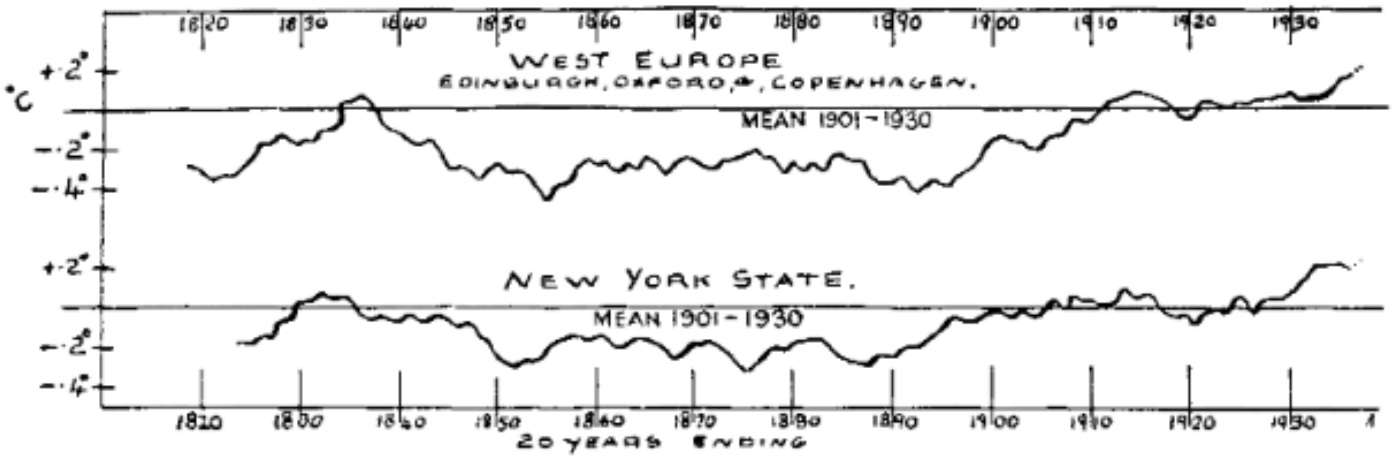


FIG. 3.—The most reliable long period temperature records. Twenty-year moving departures from the mean, 1901-1930.

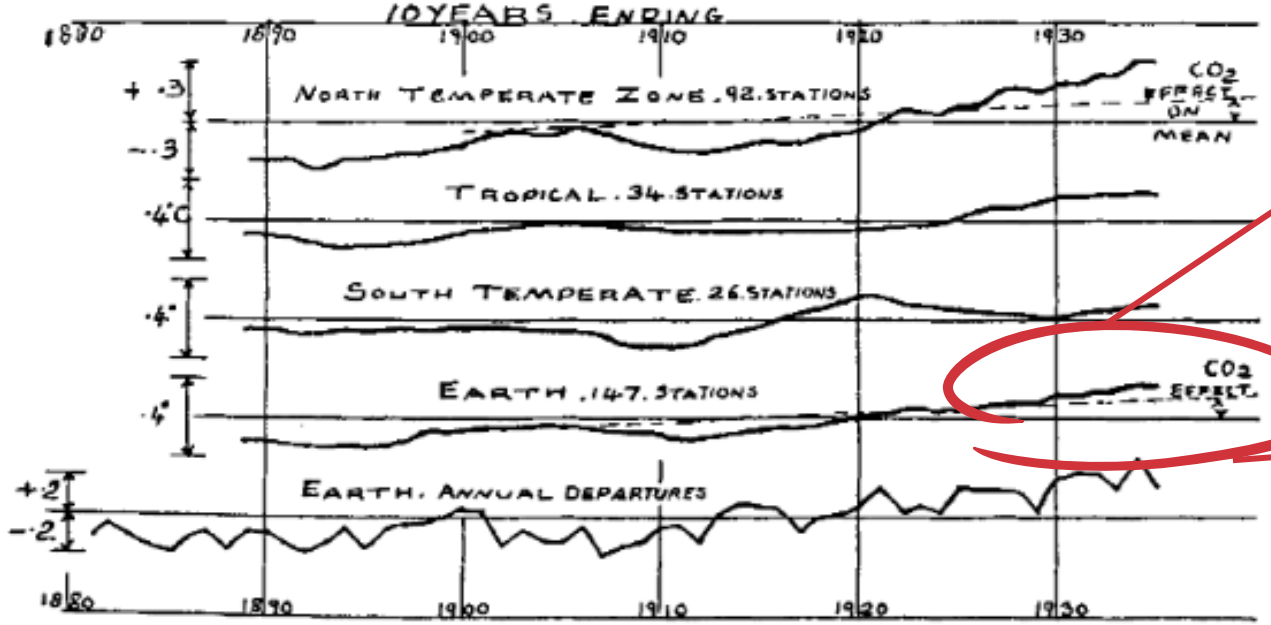


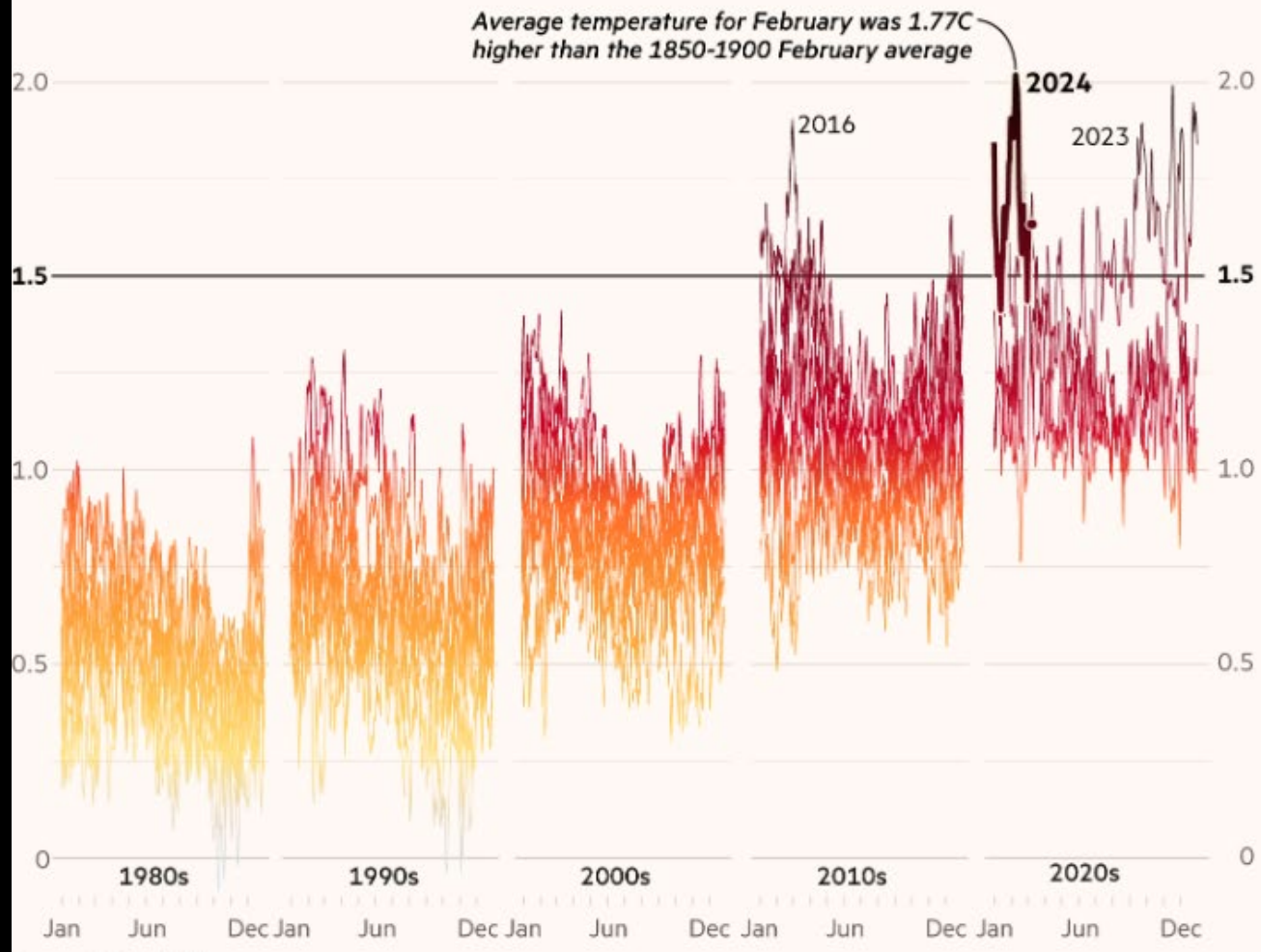
FIG. 4.—Temperature variations of the zones and of the earth. Ten-year moving departures from the mean, 1901-1930, °C.

Source: G. S. Callendar. "The artificial production of carbon dioxide and its influence on temperature" (April 1938).

Climate graphic of the week

Global temperatures continue run of record highs in February

Difference between global 2-metre temperatures from 1980 to 2024 and pre-industrial average (C)



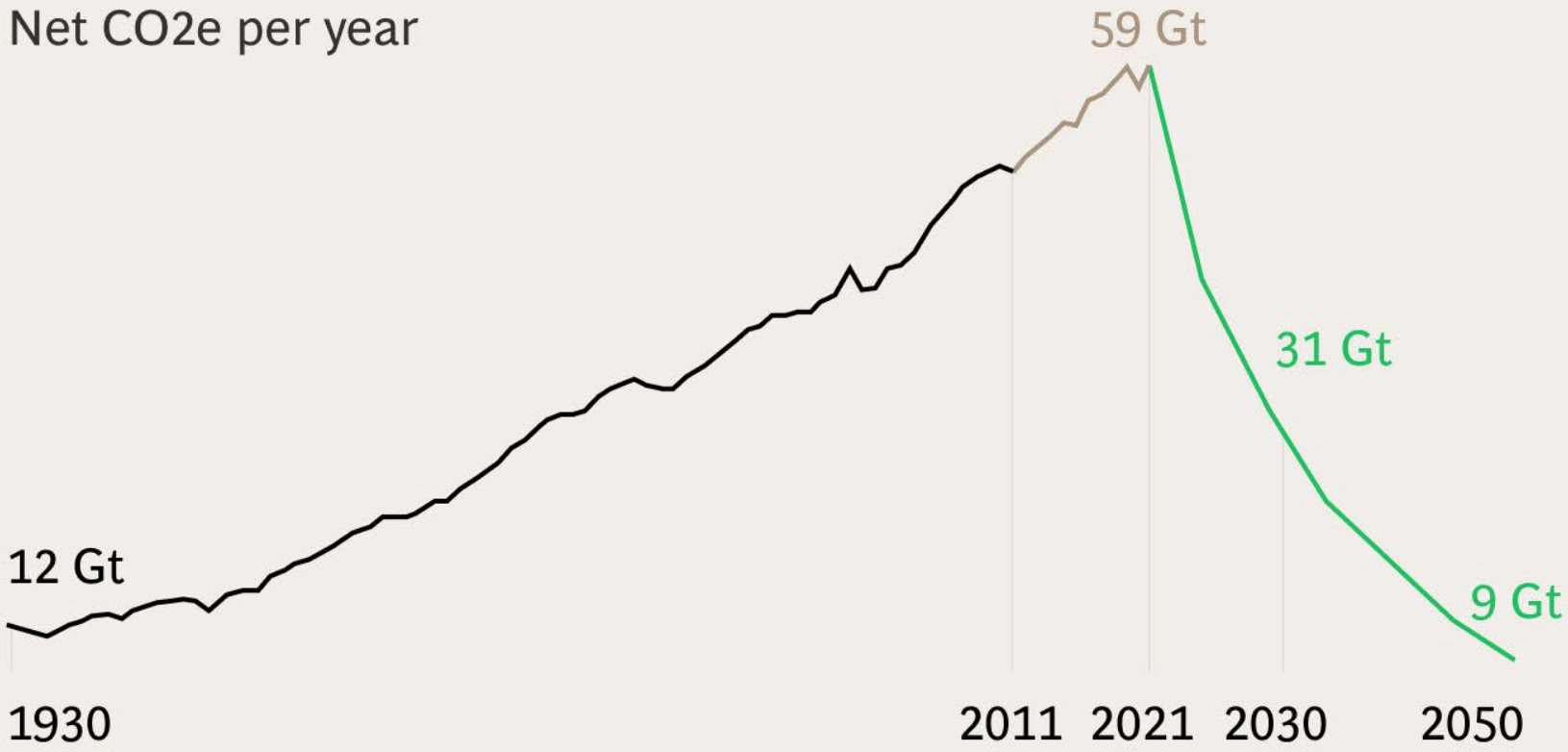
Source: C3S/ECMWF
© FT

Warmer, wetter, hotter, drier — February caps unending stretch of record temperatures

Global average temperature rise in February reaches 1.77C above pre-industrial levels

Source: *Financial Times* (10 March 2023)

Major course correction needed to achieve the 1.5°C ambition



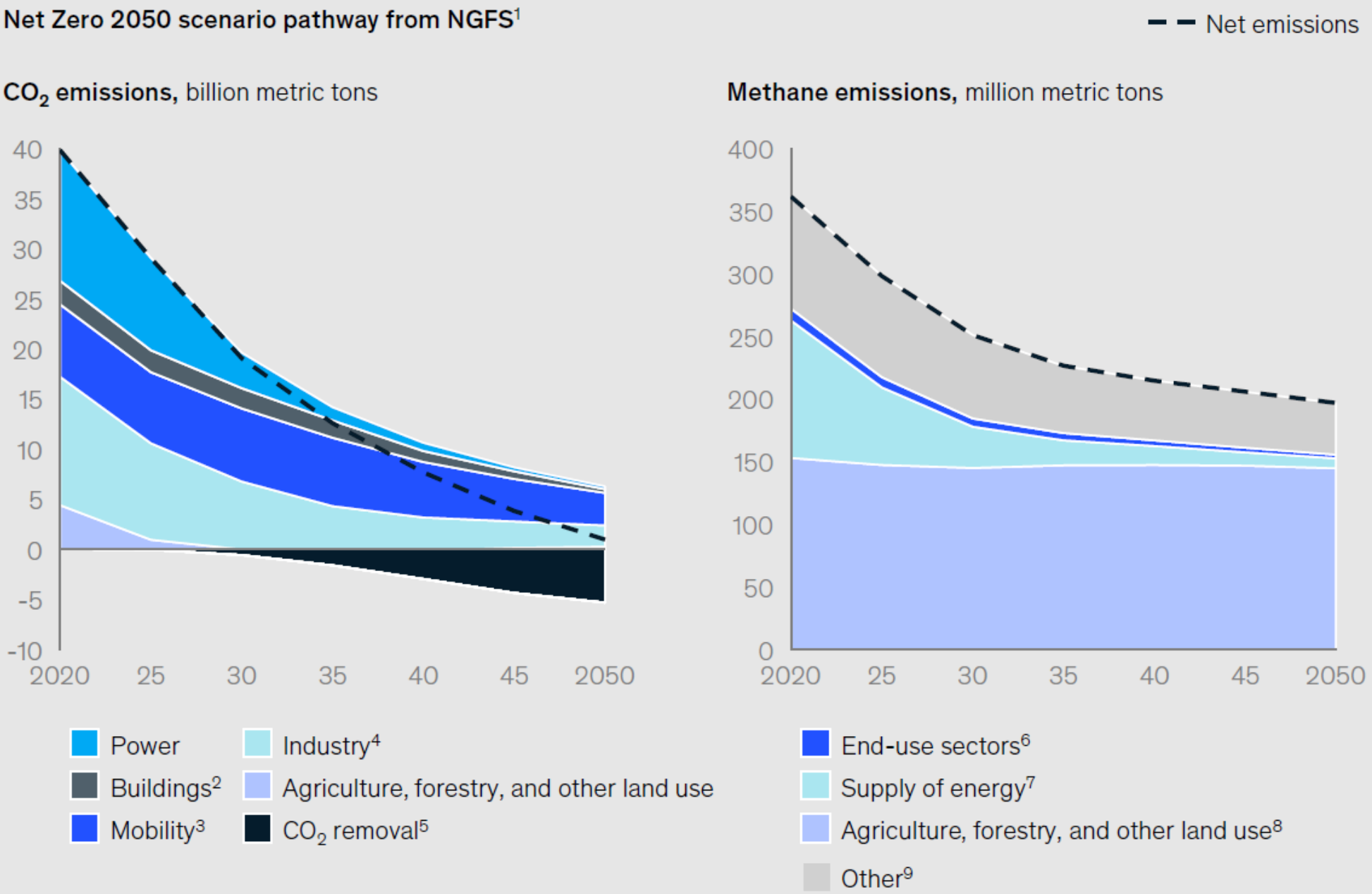
-7%
annual reduction in emissions needed by 2030 to meet the 1.5°C pathway

+1.5%
recent annual increase in emissions from 2011-2021

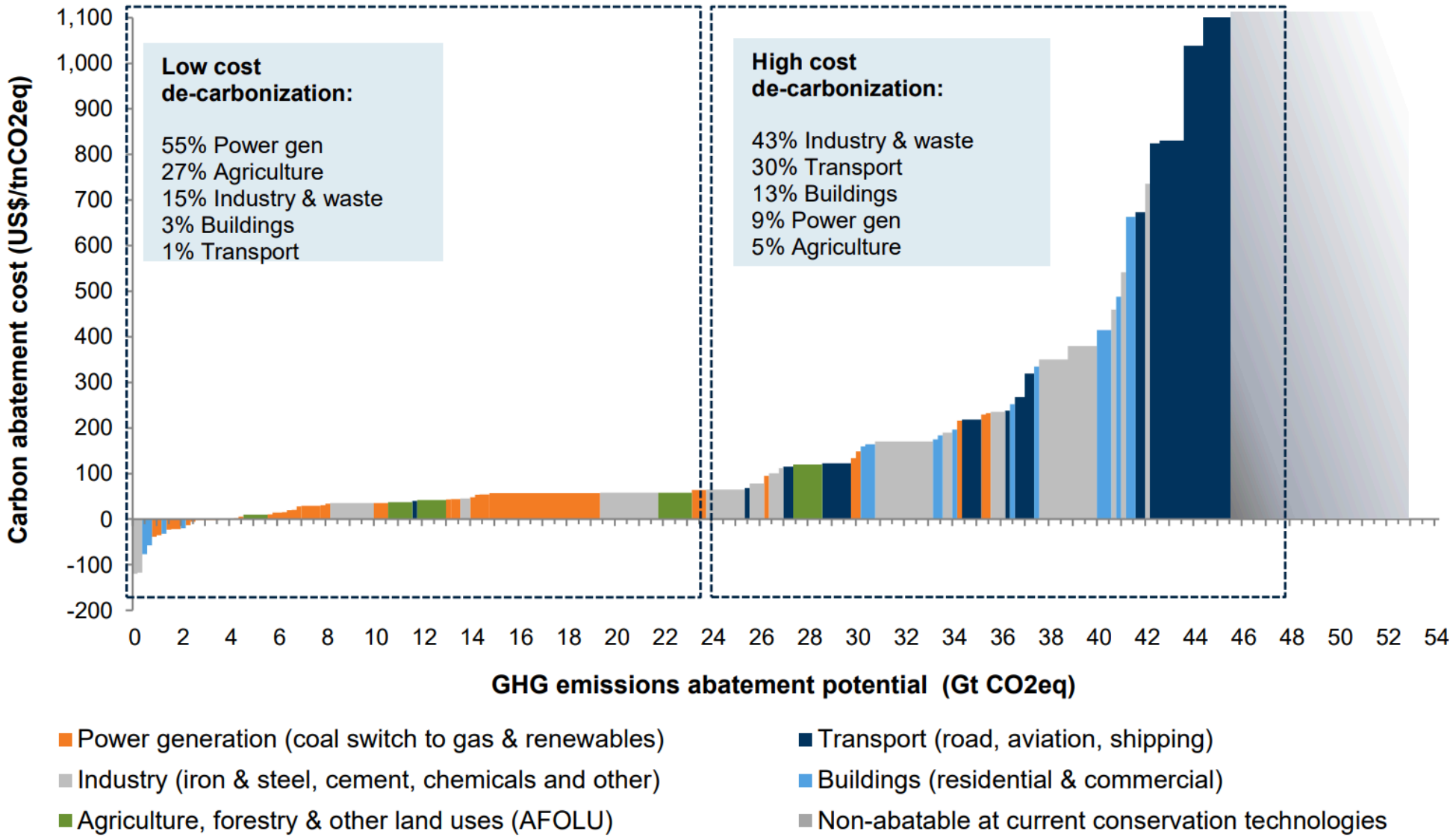
Sources: IPCC, PIK, BCG analysis

Our analysis uses the Net Zero 2050 scenario from the Network for Greening the Financial System (NGFS).

Net Zero 2050 scenario pathway from NGFS[1]



GS Carbon Abatement Cost Curve

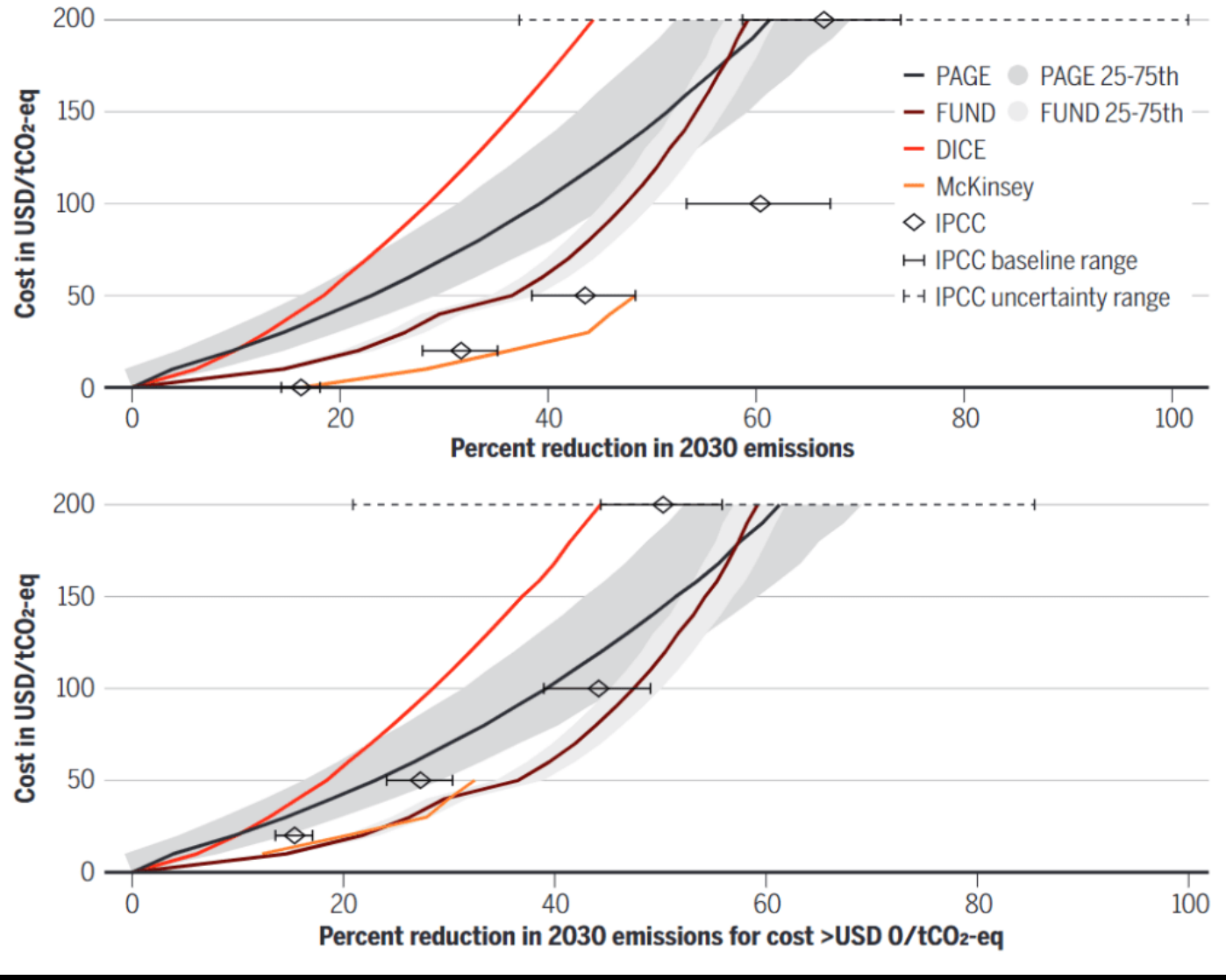


Source: Goldman Sachs Global Investment Research

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

Comparison of global mitigation potentials at different costs

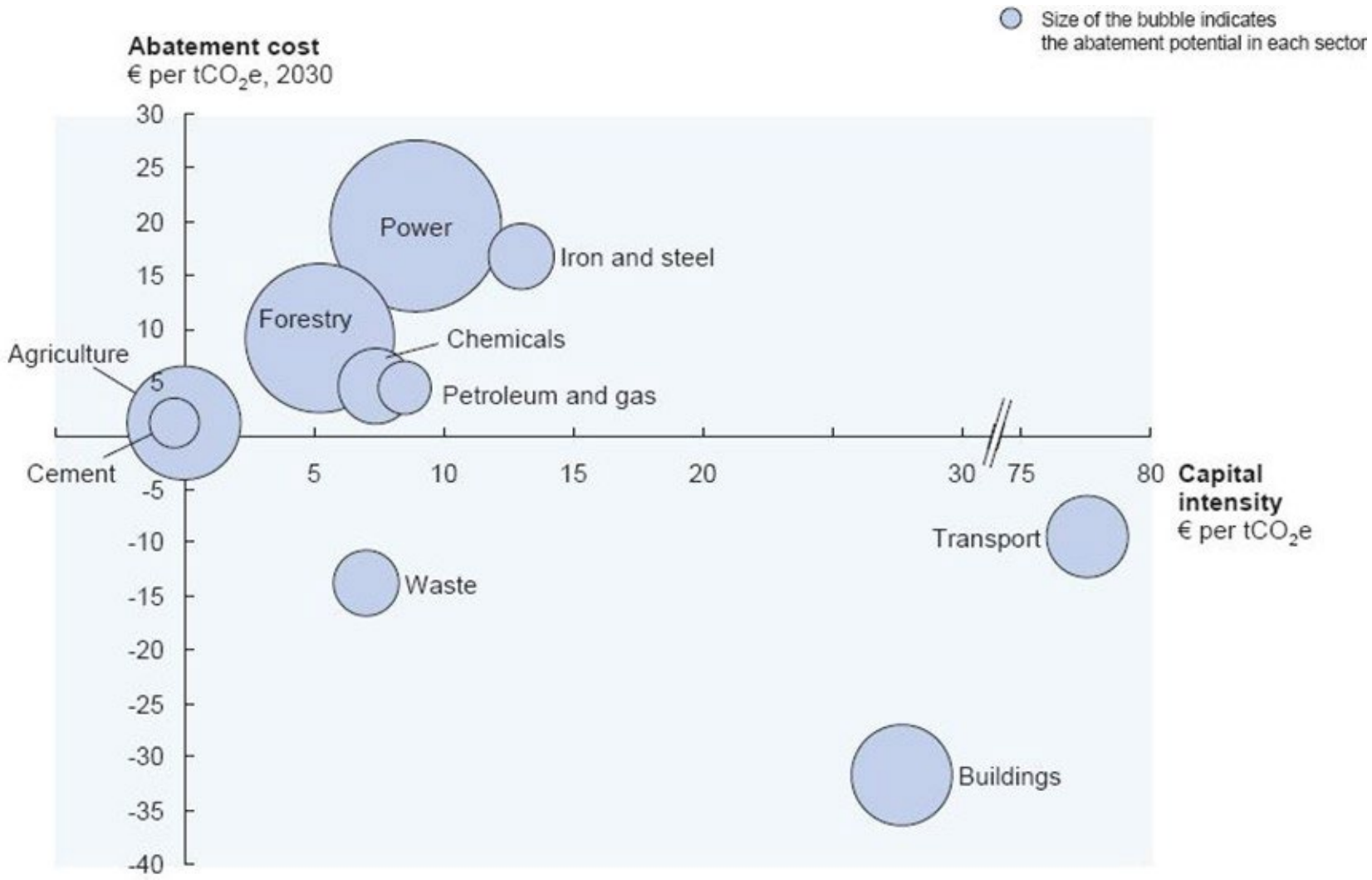
The IPCC results use different baseline emissions to calculate the range of mitigation potentials. The top panel reports the full set of results, and the bottom panel reports only the mitigation potentials with costs >$0 per tonne of CO_2 equivalent (tCO_2-eq). USD reported in 2020 dollars. See supplementary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



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

Capital intensity varies widely across sectors

Transport and buildings with largest up-front capital expenditure requirements



Source: Global GHG Abatement Cost Curve v2.0

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

- The challenge: Addressing ‘fossilflation’ while keeping ‘greenflation’ in check
- Direct effects are important
  - e.g. get $8k rebate for your heat pump, $2.5k to improve electric wiring, … $250b in DOE loans
  - adding up to $1.2 trillion in federal spending over first decade, spurring $2.9 trillion in total spending over first decade, >$10 trillion by 2050, per Goldman Sachs Research,

  But:
- It’s the external effects, norm changes, positive socio-economic tipping points that will truly make the difference

Clean Growth*

Costas Arkolakis
Yale University

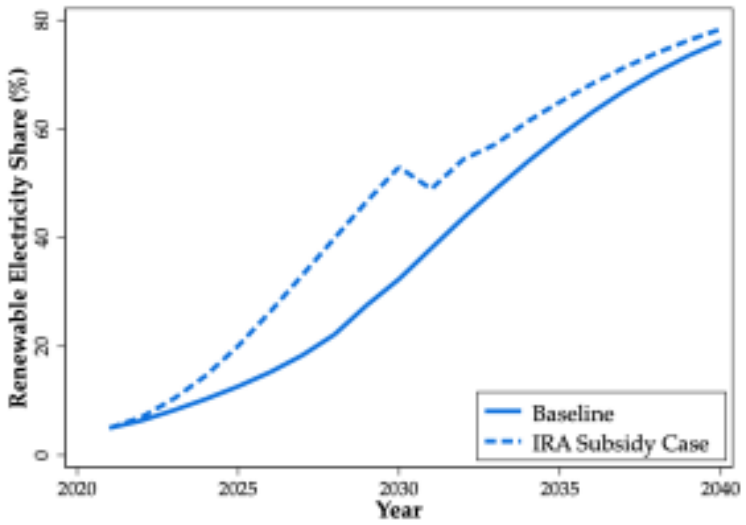
Conor Walsh
Columbia University

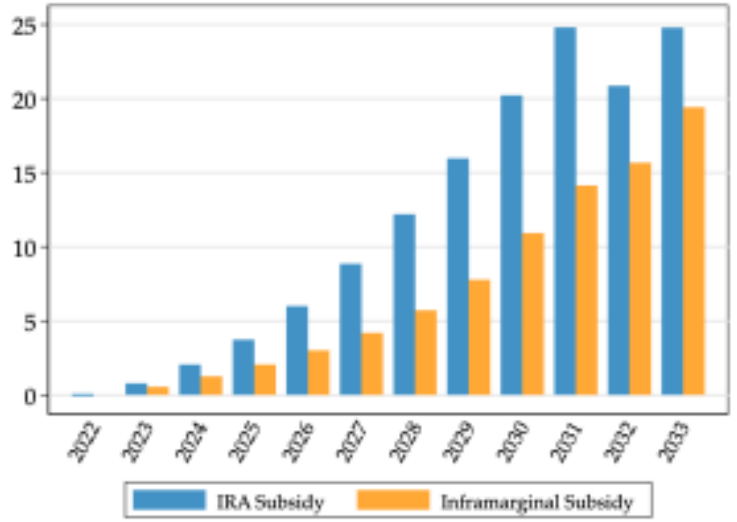
February 2023

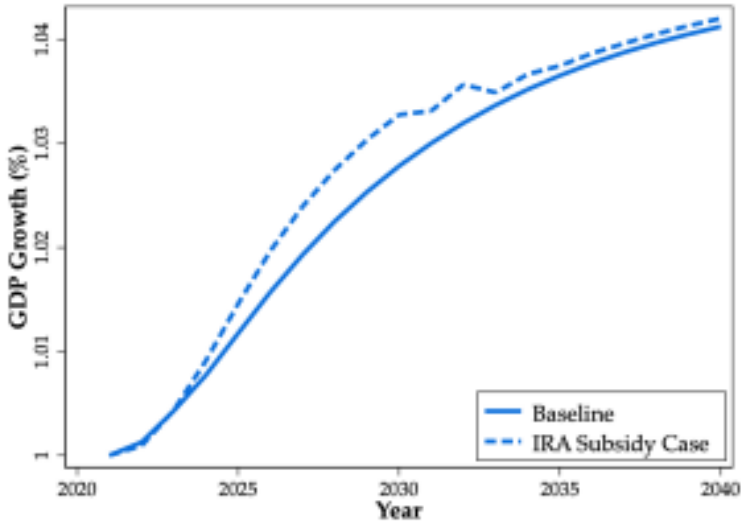
Abstract

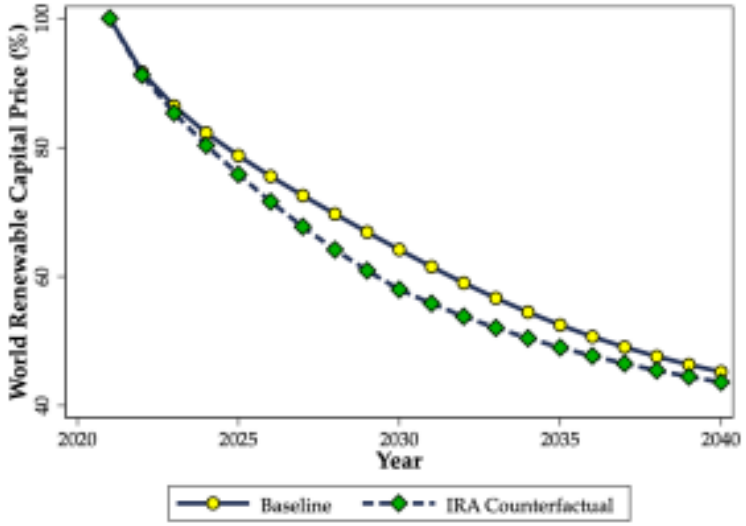
We provide a spatial theory of clean growth to assess the global impact of the rise of renewable energy. We model the details of the combined production and transmission network of electricity ("the grid") that determine the supply and losses of energy in space. The local rate of clean energy adoption depends on learning-by-doing, the global electricity and trade network, and regional comparative advantage in renewable resources. To quantify the contribution of renewable adoption to global growth, we collect and harmonize global data on transmission lines, power stations, trade, and regional output. We use the model to measure the aggregate and spatial implications of clean growth, as well as the role of the Inflation Reduction Act affecting the transition.

Figure 7: The Impact of the Inflation Reduction Act









Notes: The top left panel shows the model's projection for renewable power share under the IRA production tax credit, and without. The top right panel shows the total cost of the bill (in blue), and subsidies going to capital that would be installed in the absence of the subsidy. The bottom left shows GDP growth in both scenarios, and the bottom right shows the renewable capital price.

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Bob Litterman, Ph.D.

Risk Committee Chair & Founding Partner, Kepos Capital

1980	Ph.D. Economics, U. of Minnesota
1990	Black-Litterman Global Asset Allocation Model
2009	Retired as Goldman Sachs' top risk manager
2020	Chair, CFTC's Climate-Related Market Risk Subcommittee
	Niskanen, RFF, WWF, Climate Central… Boards

Photo: 2017 *Bloomberg* profile

Carbon Barometer

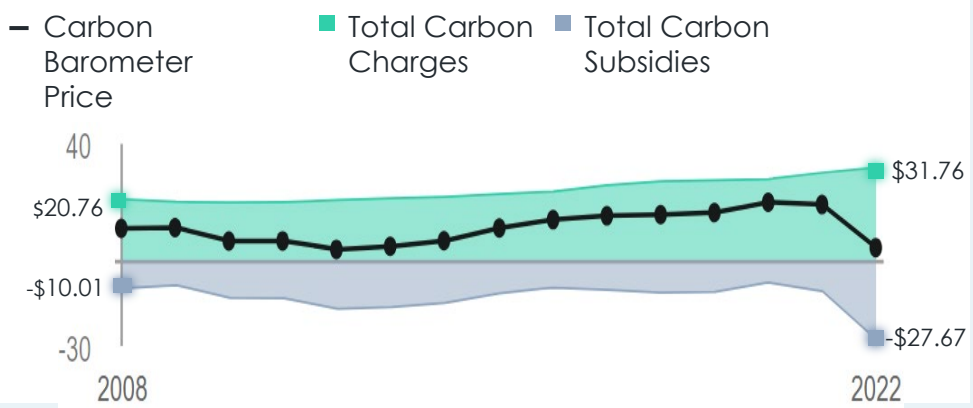
Evolution of Global Carbon Price

The Global Carbon Barometer price has increased steadily over the past decade, until 2022.

Policy Overview, Global

Country	Carbon Barometer Price $USD/MTCO$_2$	Total Emissions M MTCO$_2$	Emissions Intensity of GDP kg CO$_2$/$USD	Net Carbon Charges as % of GDP
Global	$4.08	28713	0.34	0.14%

Policy Evolution



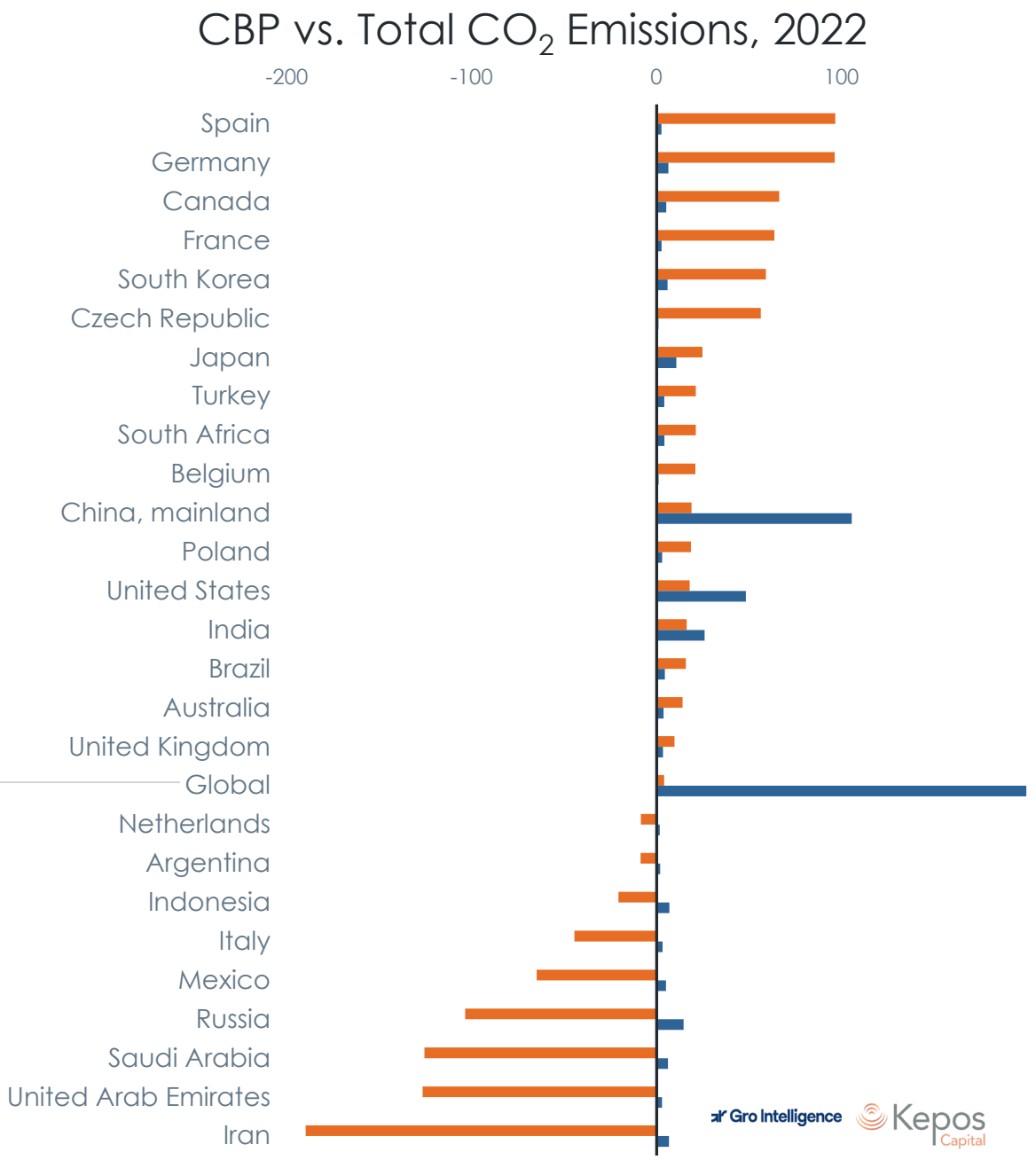
DATA AGGREGATION

Carbon Barometer Visualization

Carbon Barometer Price
Down 78% from 2021

$4.08

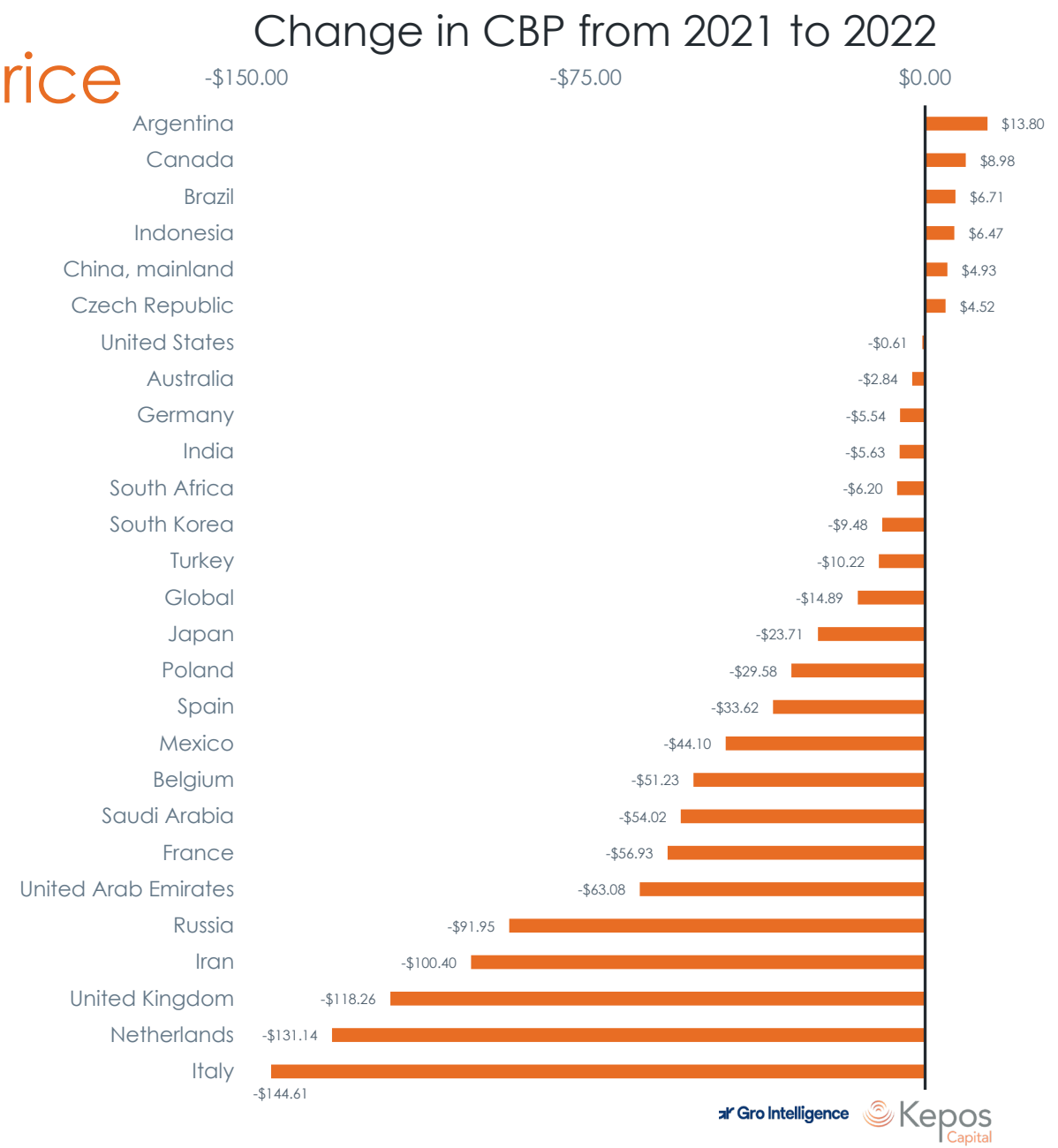
- Carbon Barometer Price $USD/MTCO$_2$
- Total Carbon Dioxide Emissions



DATA AGGREGATION

Change in Carbon Barometer Price

Country	2021 Price	2022 Price
Argentina	-$22.50	-$8.71
Canada	$57.33	$66.31
Brazil	$9.06	$15.77
Indonesia	-$27.13	-$20.66
China, mainland	$13.93	$18.87
Czech Republic	$51.80	$56.32
United States	$18.47	$17.85
Australia	$16.90	$14.06
Germany	$101.85	$96.31
India	$21.93	$16.29
South Africa	$27.39	$21.20
South Korea	$68.61	$59.13
Turkey	$31.42	$21.21
Global	$18.97	$4.08
Japan	$48.47	$24.76
Poland	$48.11	$18.53
Spain	$130.28	$96.67
Mexico	-$20.78	-$64.88
Belgium	$72.19	$20.96
Saudi Arabia	-$71.61	-$125.63
France	$120.64	$63.71
United Arab Emirates	-$63.51	-$126.59
Russia	-$11.62	-$103.57
Iran	-$89.47	-$189.87
United Kingdom	$127.94	$9.68
Netherlands	$122.58	-$8.56
Italy	$100.18	-$44.42



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Carbon Barometer

Policy Contributions

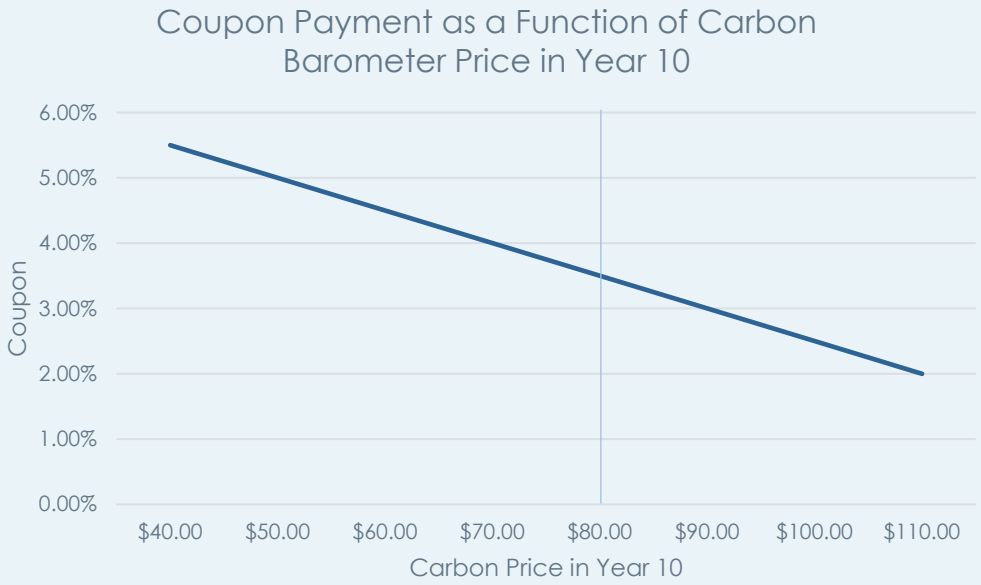
The Carbon Barometer framework allows users to clearly understand the relative contribution of various policies to a country-level Carbon Price

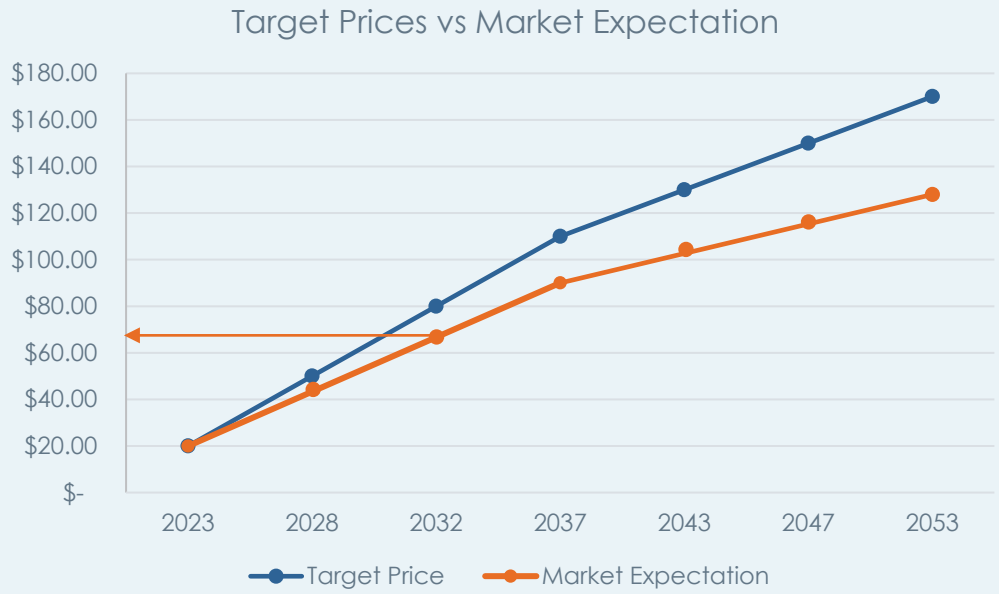
Individual Policy Contribution to Carbon Barometer Price

Country	Carbon Barometer Price	Fossil Fuel Subsidies	Carbon Tax	Emissions Trading Systems	Carbon Barometer Price	Fossil Fuel Subsidies	Carbon Tax	Emissions Trading Systems
	$USD/MTCO$_2$	$USD/MTCO$_2$	$USD/MTCO$_2$	$USD/MTCO$_2$	$USD/MTCO$_2$	$USD/MTCO$_2$	$USD/MTCO$_2$	$USD/MTCO$_2$
	2021				2022			
Global	$18.97	-$11.07	$1.03	$3.09	$4.08	-$27.67	$1.12	$6.00
France	$120.64	-$34.85	$26.69	$19.91	$63.71	-$110.32	$25.55	$34.61
United States	$18.47	-$1.99	$0.00	$1.21	$17.85	-$2.91	$0.00	$2.03
China	$13.93	-$2.38	$0.00	$0.35	$18.87	-$2.37	$0.00	$4.55

Deriving a Product from the Carbon Barometer

Carbon-Linked Bonds Reveal Forward Expectations





Coupon and principal are tied to the Carbon Price

The forward curve for carbon prices

1. Forward dates have targeted carbon prices
2. A lower borrowing cost as a commitment device – missing target costs the issuer
3. Weak policy increases return to investors, and
4. Carbon forward curve allows hedging, reveals expectations, and accelerates investment in low-emissions capital

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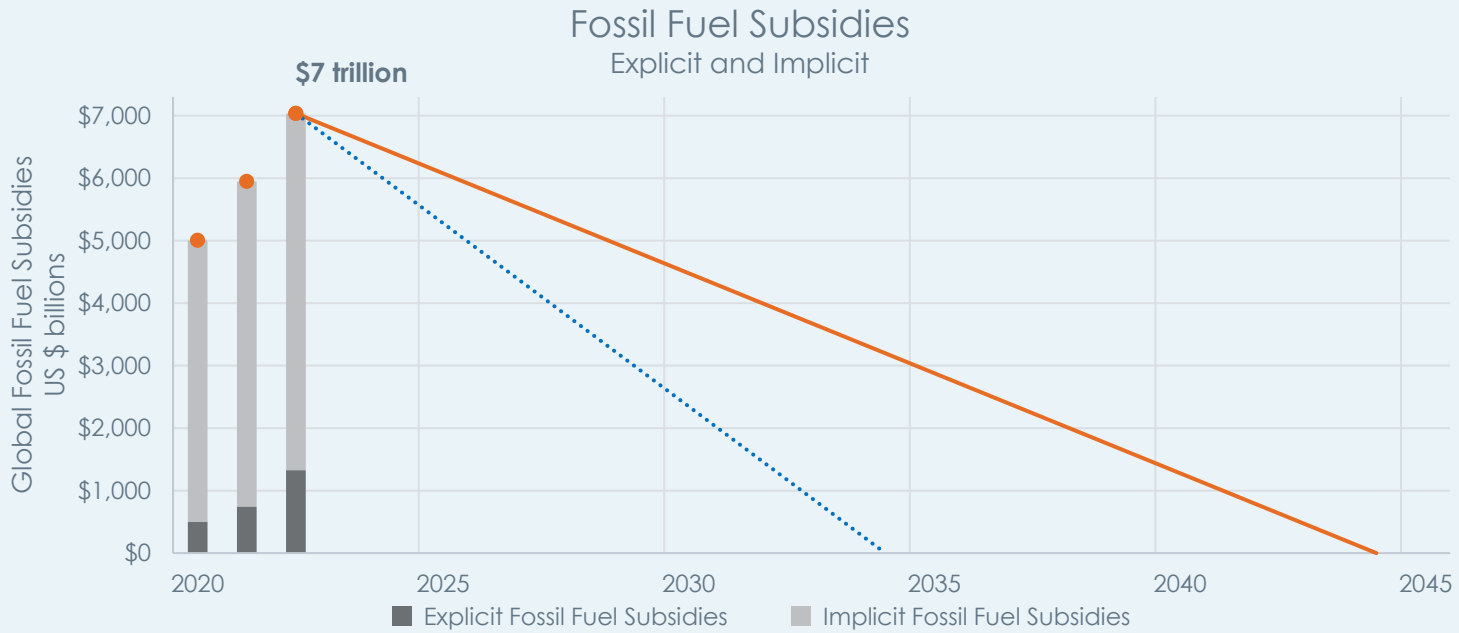
Global Harmonization of Incentives to Reduce Emissions

Highlight the Path to Elimination of Carbon Subsidies



Charting a Path to End Fossil Fuel Subsidies

1. Fossil fuel subsidies promote inefficient allocation of an economy's resources and encourage pollution
2. Raising fuel prices to their fully efficient levels reduces projected global fossil fuel CO_2 emissions by 36% below baseline levels[1]
3. Reducing subsidies saves money for taxpayers and redistributes investments towards sustainable and equitable outcomes

[1] Source: International Monetary Fund, Fossil Fuel Subsidies

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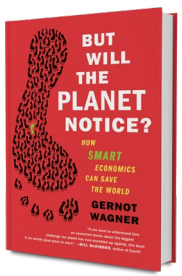
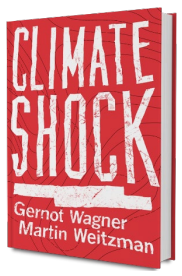
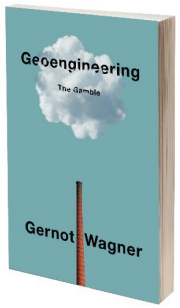
Henrik Henriksson

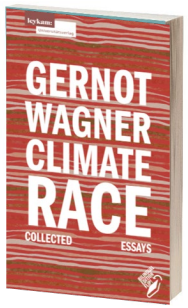
CEO, H2 Green Steel

1997	joined Scania Group
2015	President & CEO, Scania Group
2021	founded H2GS
2022	groundbreaking at Boden plant
2023	first binding customer contracts
2024	€6.5 billion funding secured









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