Simple Math
Complicated Politics

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Where do emissions come from?

People	Population	P
Engage in economic activity that	GDP per capita	GDP/P
Uses energy from	Energy intensity of the economy	TE/GDP
Carbon emitting generation	Carbon intensity of energy	C/TE

$$\text{Carbon emissions} = C = P * \frac{GDP}{P} * \frac{TE}{GDP} * \frac{C}{TE}$$

The "Kaya Identity"

THB

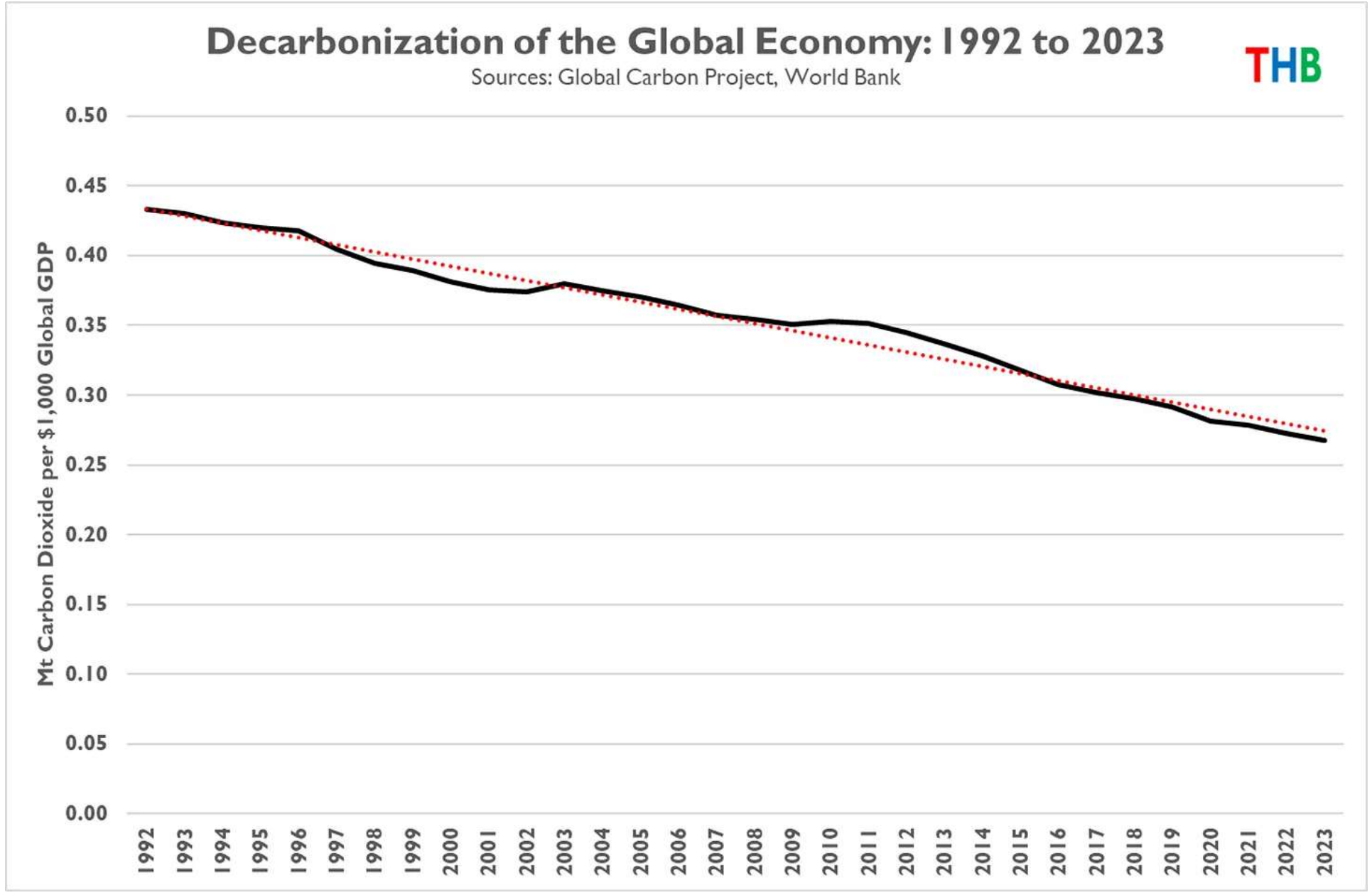
Decarbonization defined

(1) Carbon emissions = C = $\frac{P \times GDP}{P} * \frac{TE \times C}{GDP}$

(2) Emissions = GDP x Technology

(3) $\frac{\text{Emissions}}{\text{GDP}}$ = Technology

A reduction in this ratio is called "decarbonization" and means that technologies are improving


Decarbonization of the Global Economy: 1992 to 2023
Sources: Global Carbon Project, World Bank
THB
Mt Carbon Dioxide per $1,000 Global GDP
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1992
1993
1994
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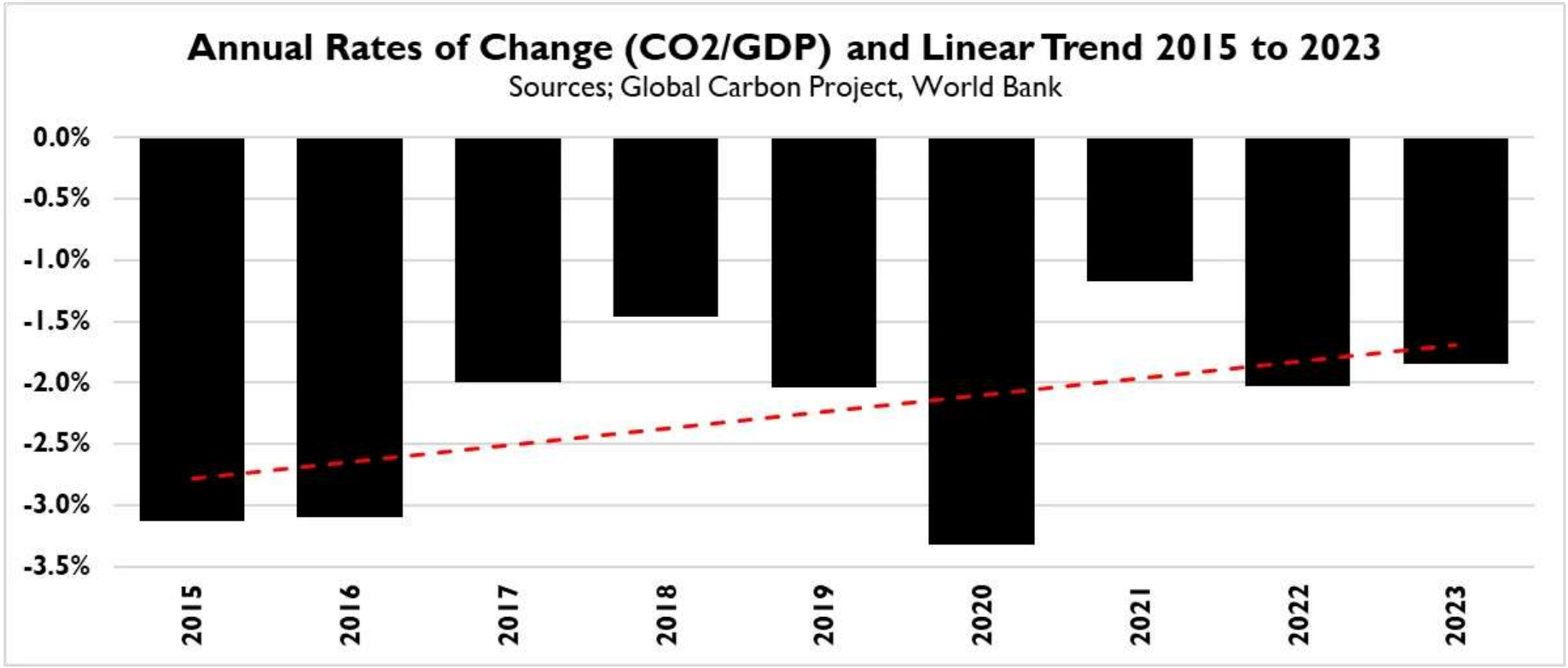
2020
2021
2022
2023

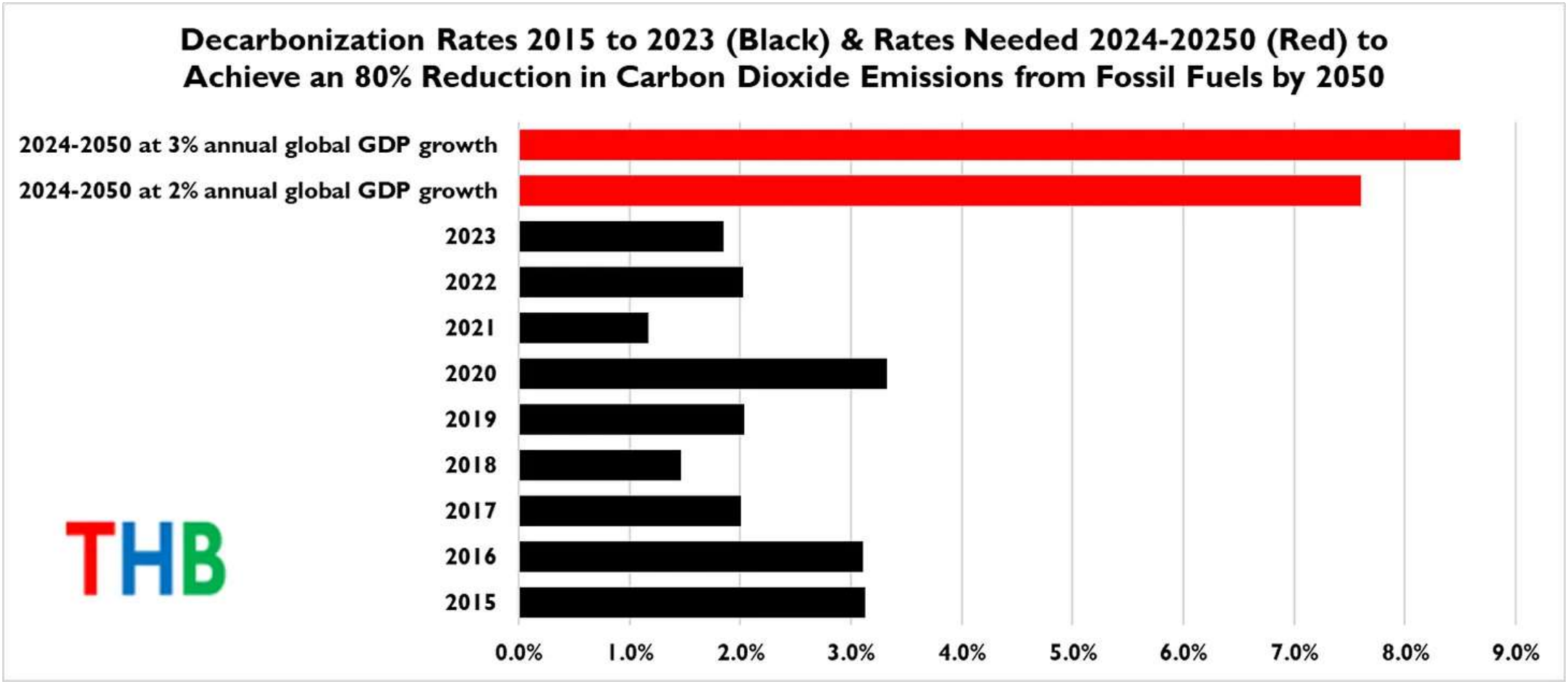
THB	Pre-Paris 2006-2014	Post-Paris 2015-2023	Pre- to Post-Paris Change in Annual Decarbonization Rate	Proportion of 2023 Global CO2 Emissions from Energy
UAE	-1.66%	1.32%	2.98%	0.8%
Brazil	-0.76%	2.15%	2.91%	1.3%
Saudi Arabia	-1.19%	1.46%	2.65%	1.8%
Japan	0.76%	2.80%	2.04%	2.9%
South Korea	1.79%	3.34%	1.55%	1.6%
Iran	-1.34%	0.04%	1.38%	1.9%
Germany	3.15%	4.34%	1.19%	1.6%
Turkey	1.09%	2.24%	1.15%	1.2%
India	0.57%	1.65%	1.08%	8.0%
Mexico	0.36%	0.88%	0.52%	1.4%
United Kingdom	4.32%	4.77%	0.45%	0.9%
Canada	2.13%	2.57%	0.44%	1.5%
Australia	2.99%	3.31%	0.32%	1.1%
United States	3.36%	3.39%	0.03%	13.2%
World	**1.98%**	**1.99%**	**0.01%**	**100%**
Poland	5.00%	4.33%	-0.67%	0.8%
South Africa	2.90%	1.42%	-1.48%	1.2%
Italy	4.12%	2.25%	-1.87%	0.9%
China	4.94%	2.94%	-2.00%	31.9%
Russia	3.70%	0.64%	-3.06%	4.6%
Indonesia	2.81%	-1.22%	-4.03%	2.0%

Faster Decarbonization Post-Paris

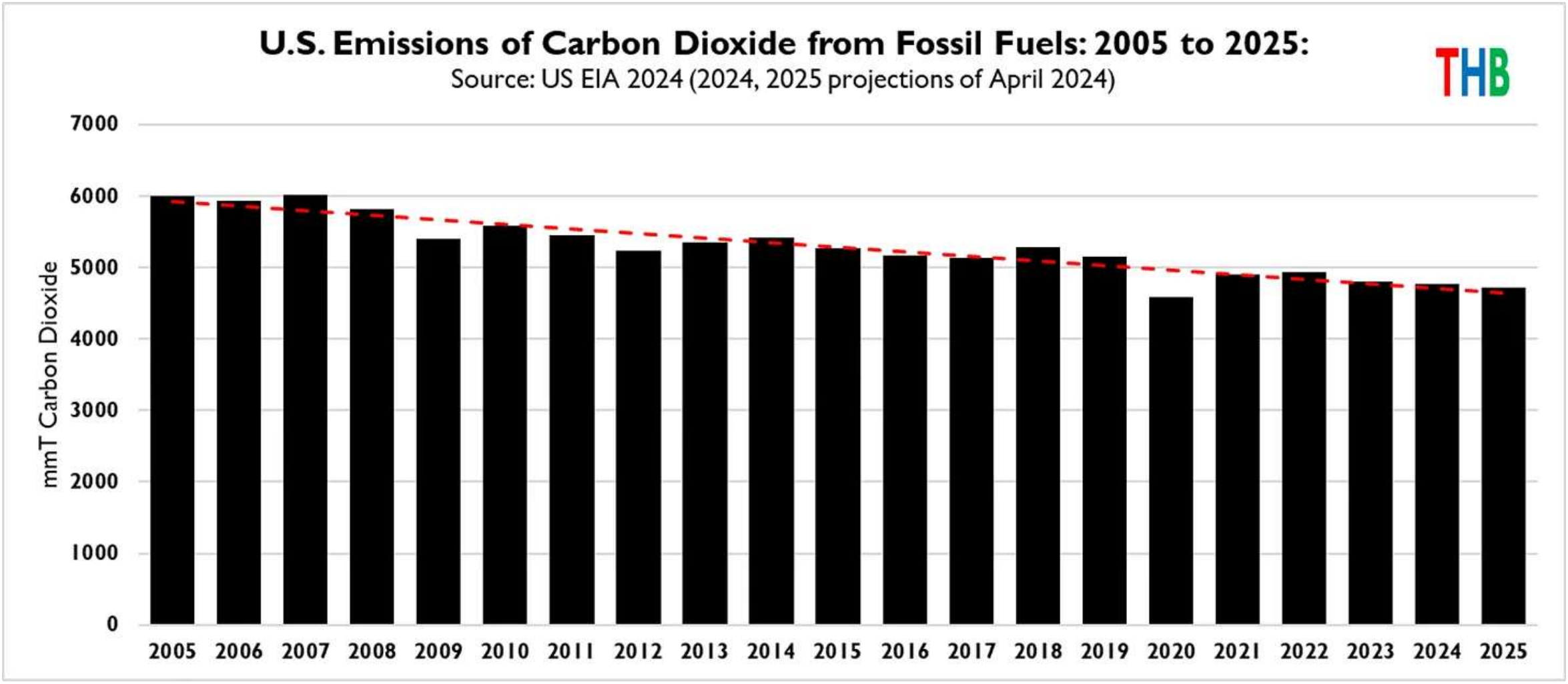
Since Paris 2015 Slowing Global Decarbonization



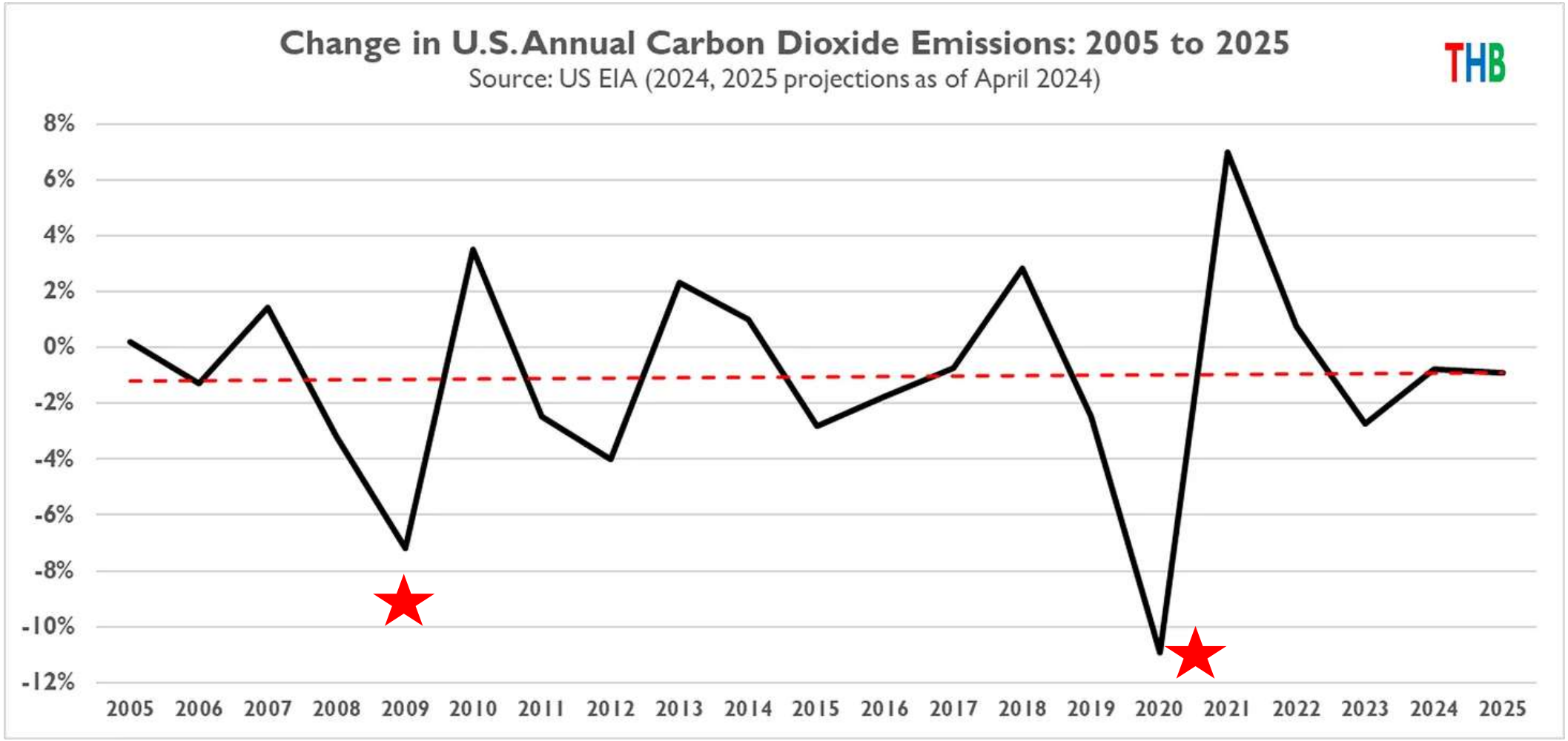
Since Paris 2015 Well Below Target
Global Decarbonization



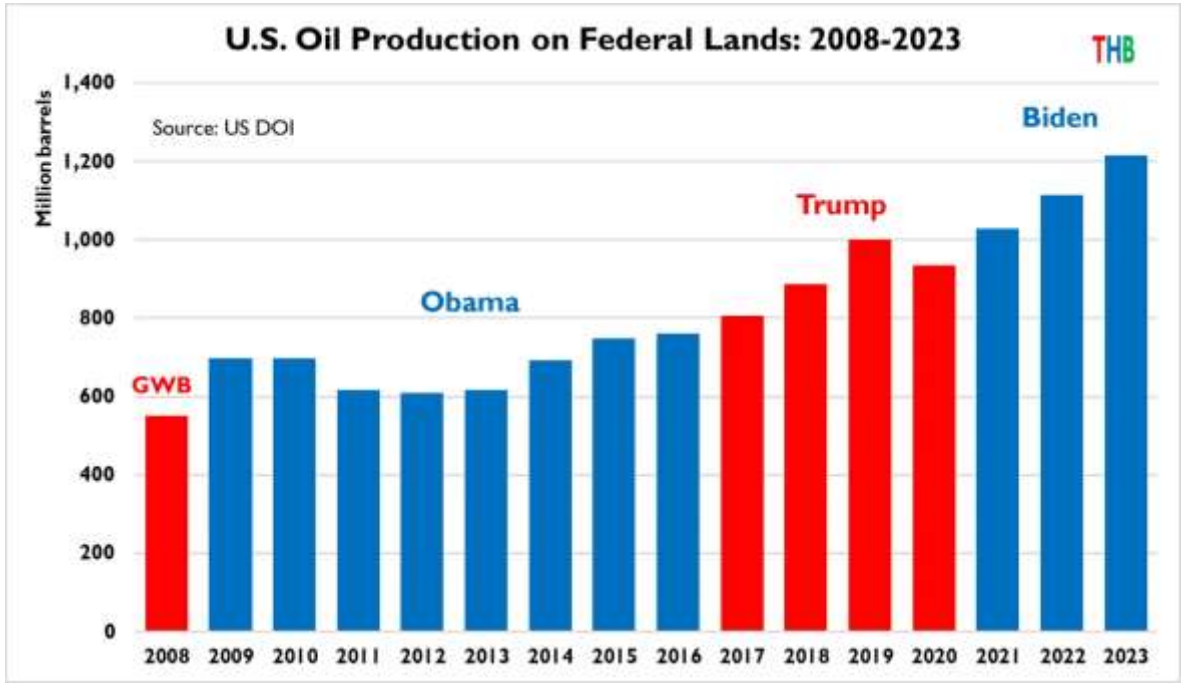
Do US Presidents Matter for US Emissions Reductions?

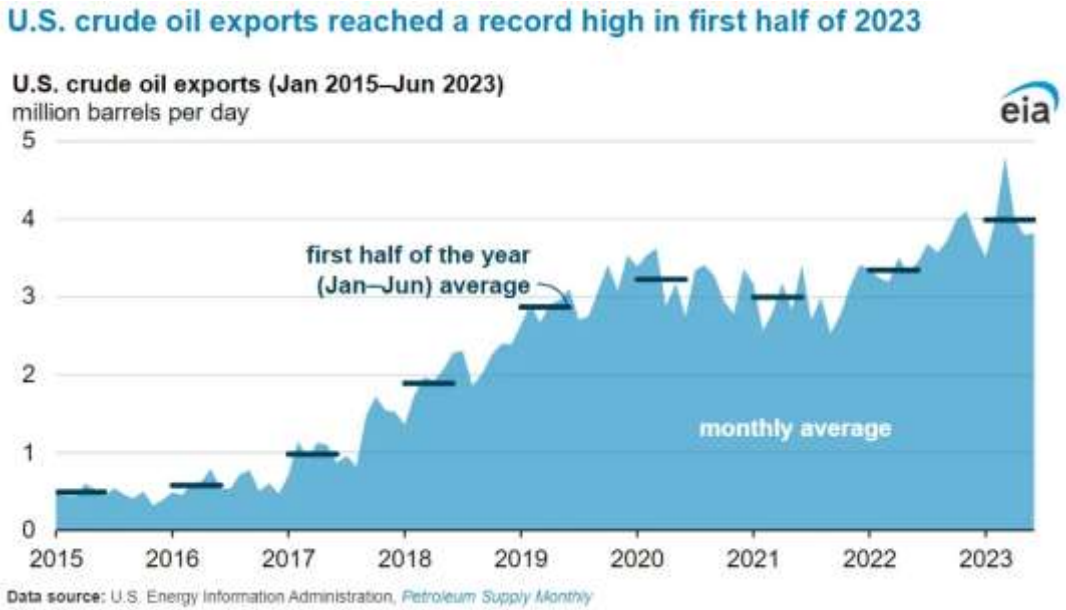


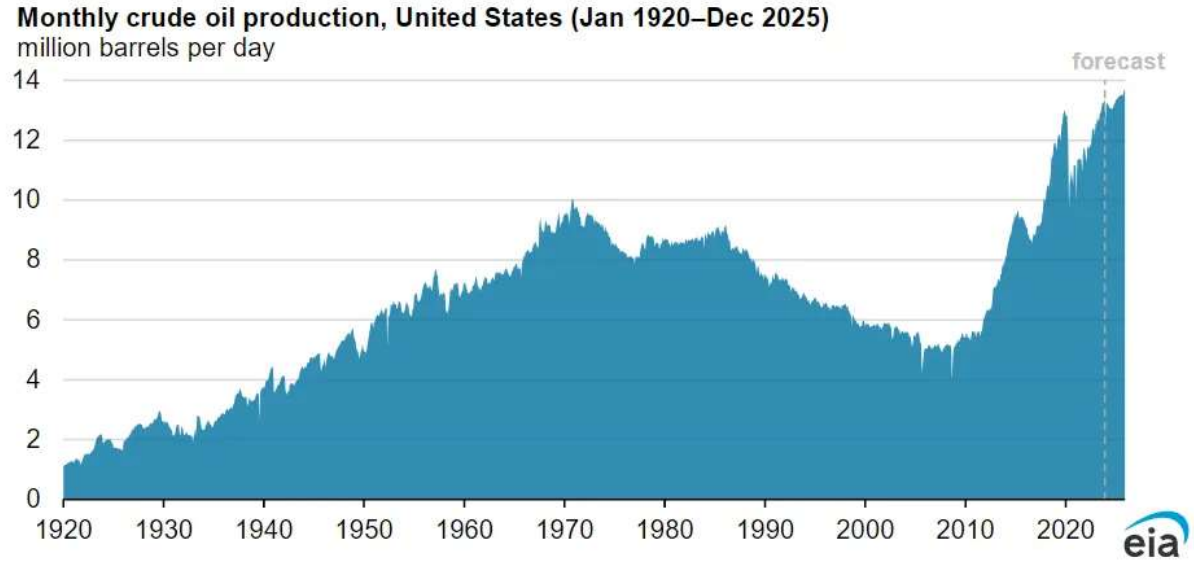
GFC and COVID-19 Matter Much More

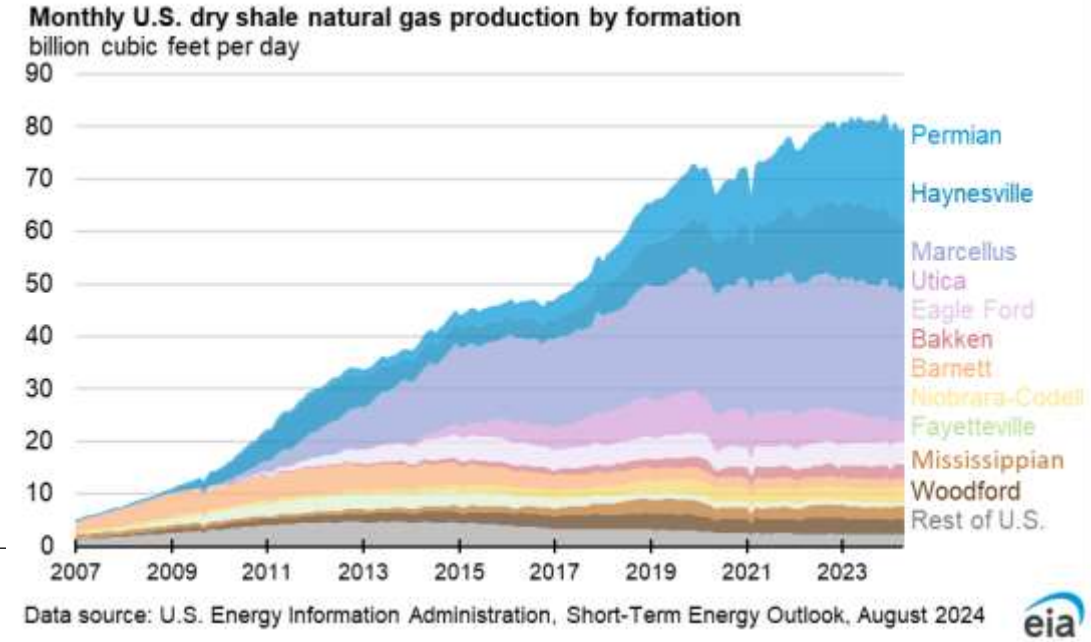


Change in U.S. Annual Carbon Dioxide Emissions from Fossil Fuels: By President Since 2005	
Bush (2005--2009)	-1.0%
Obama (2009-2017)	-1.5%
Trump (2017-2021)	-3.0%
Biden (2021-2025)	1.6%
Overall (2005-2025)	-1.2%









Data source: U.S. Energy Information Administration, *Short-Term Energy Outlook*, February 2024

The US is the world's energy superpower

2023	Oil Exports 1000s B/day
US	9108
Saudi Arabia	8282
Russian Federation	6736
Canada	4836
West Africa	3285
North Africa	2025
Mexico	1271
Other Middle East (ex SA)	15018

2023	LNG Exports BCM
US	114.4
Qatar	108.4
Australia	107.4
Russian Federation	42.7
Malaysia	36.3
Algeria	19.0
Nigeria	17.5
Indonesia	16.1
Oman	15.3
Papua New Guinea	11.5
Trinidad & Tobago	10.5

2023	Oil Production 1000s B/day
US	19358
Saudi Arabia	11389
Russian Federation	11075
Canada	5653
Iran	4662
Iraq	4355
China	4198
United Arab Emirates	3922
Brazil	3502
Kuwait	2908

Thank You!

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