

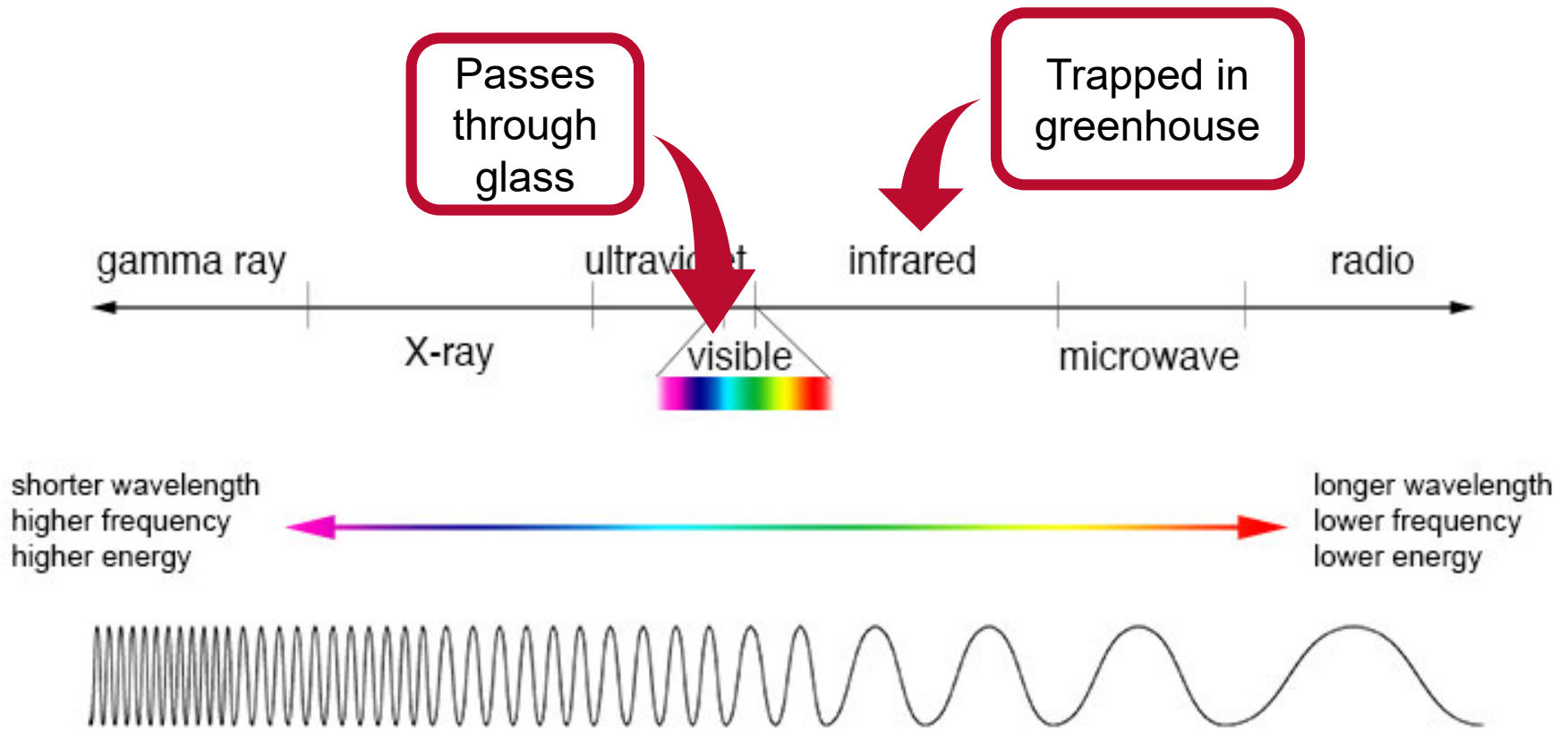
Connecting the Dots on Climate Change

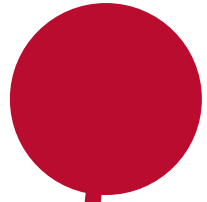


Kerry Howe ~ Club 21 ~ February 17, 2020

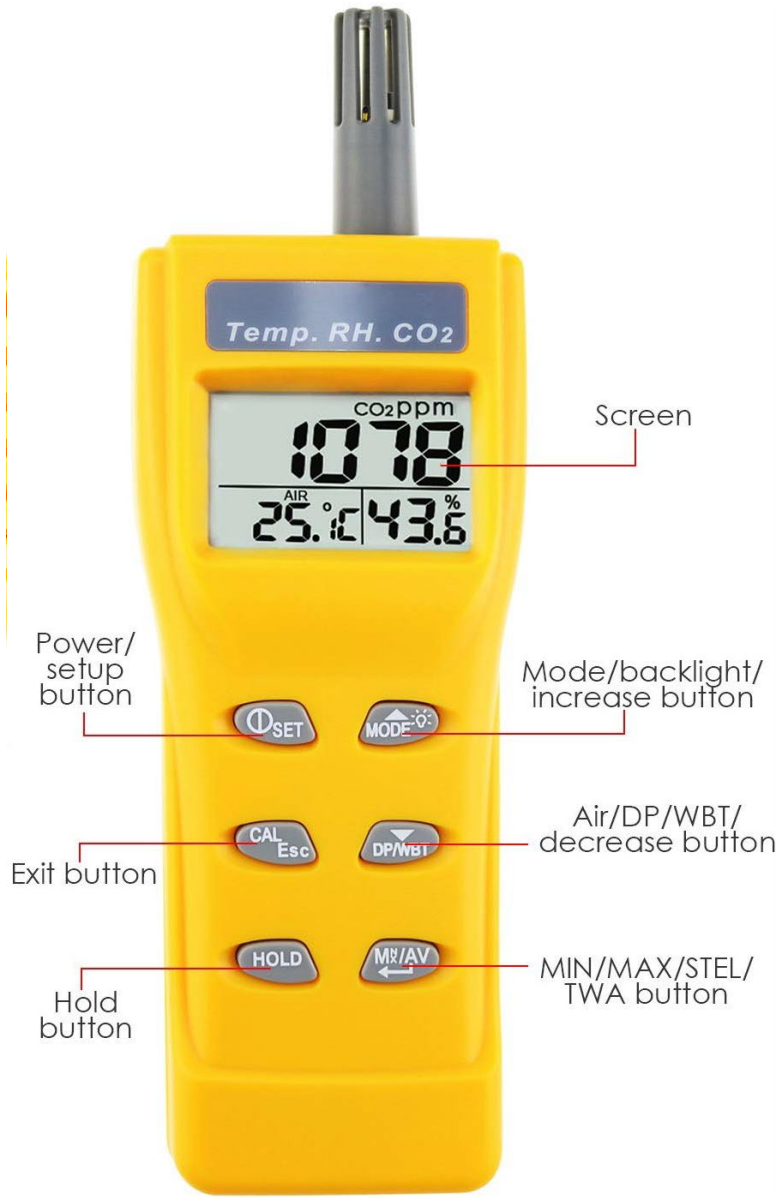


Electromagnetic spectrum





Infrared
energy
causes
warming



Portable Digital Carbon Dioxide Temperature Humidity Indoor 9999ppm NDIR Sensor IAQ CO2 Detector Monitor Meter Wet Bulb Temperature (WB) (Without CD Software & Adaptor)

by **TEKCOPLUS**

★★★★★ ▾ 37 ratings | 10 answered questions

Price: **\$138.90** ✓prime & FREE Returns

Coupon Save an extra \$7.00 when you apply this coupon. [Details](#)

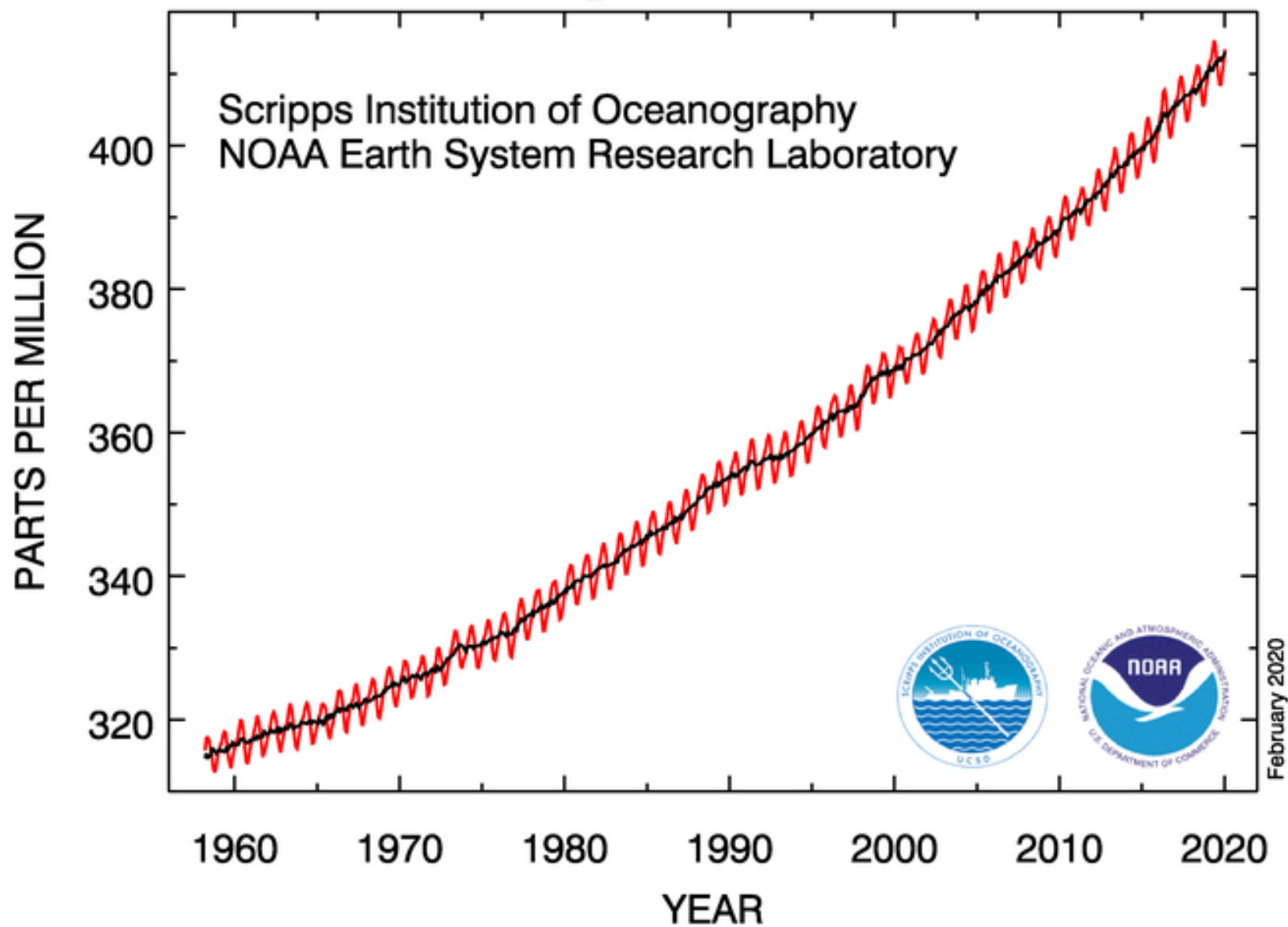
• **NDIR SENSOR for CO2 DETECTION-** Non-dispersive infrared technology is used to ensure the reliability and long-term stability. Measures 0~9999ppm while 0~2000ppm can maintain a high accuracy at +/- 50ppm

Infrared energy causes warming

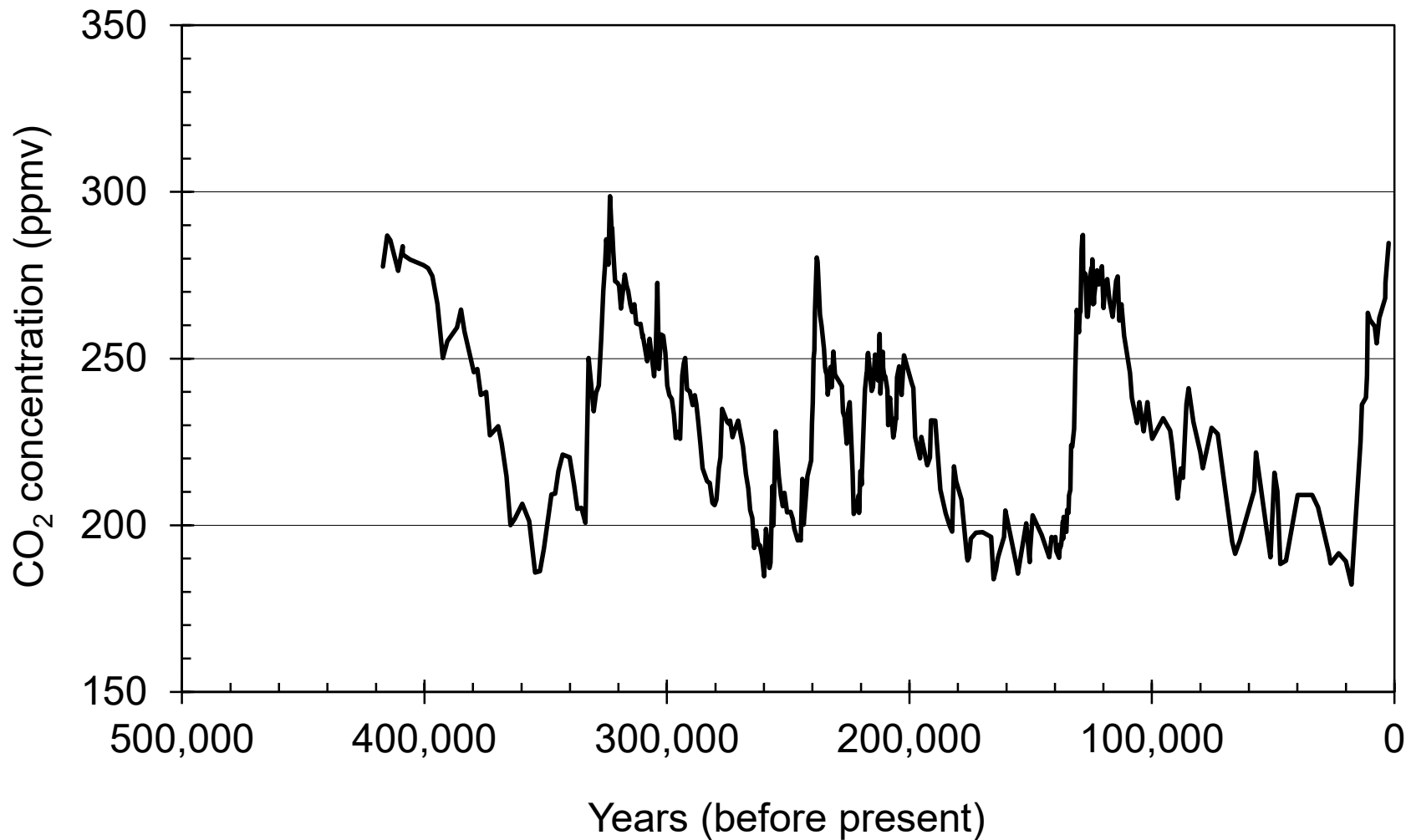
The diagram consists of two red circles at the top. A red line connects them, sloping downwards from right to left. From the left circle, a red line extends downwards to a rounded rectangular box containing the text 'Infrared energy causes warming'. From the right circle, a red line extends downwards to another rounded rectangular box containing the text 'CO2 absorbs infrared energy'.

CO₂ absorbs infrared energy

Atmospheric CO₂ at Mauna Loa Observatory



Vostok Ice Core Data for CO₂ Concentrations

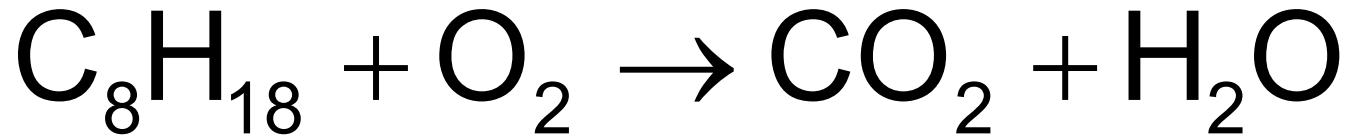


Infrared energy causes warming

CO₂ absorbs infrared energy

CO₂ is increasing in the atmosphere

Burning Fossil Fuels



1 gallon gasoline

sp. grav. = 0.74
gasoline = 6.2 lbs
87% carbon
carbon = 5.4 lbs

×

$$\frac{44 \text{ g/mol CO}_2}{12 \text{ g/mol C}}$$

=

20 lbs
CO₂!

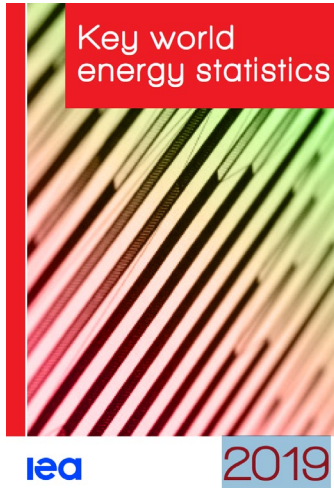
Key world energy statistics



Available at:

<https://webstore.iea.org/key-world-energy-statistics-2019>

Region / Country / Economy	Population (million)	GDP (billion 2010 USD)	GDP (PPP) (billion 2010 USD)	Energy prod. (Mtoe)	Net imports (Mtoe)	TPES (Mtoe)	Elec. cons. ¹ (TWh)	CO ₂ emissions ² (Mt of CO ₂)
World	7 519	80 079	113 555	14 035	-	13 972 ⁽³⁾	23 696	32 840 ⁽⁴⁾
OECD	1 295	51 133	50 410	4 181	1 275	5 309	10 352	11 579
Middle East	237	2 368	5 344	2 032	-1 243	750	979	1 785
Non-OECD Europe and Eurasia	340	2 759	5 641	1 924	-757	1 122	1 559	2 464
China	1 394	10 441	21 201	2 450	663	3 077	6 349	9 302
Non-OECD Asia	2 501	6 619	18 743	1 521	440	1 877	2 712	4 179
Non-OECD Americas	497	4 329	6 509	792	-177	612	1 024	1 064
Africa	1 255	2 430	5 708	1 135	-309	812	721	1 185
Albania	2.9	14.0	32.9	1.6	0.9	2.4	6.2	4.3
Algeria	41.3	199.2	562.7	152.9	-96.5	55.5	64.8	130.5
Angola	29.8	101.7	176.6	91.9	-76.3	14.7	9.5	18.0
Argentina	44.3	460.3	821.2	74.3	12.6	85.3	133.1	183.4
Armenia	2.9	12.4	25.2	1.0	2.3	3.2	6.0	5.2
Australia	24.6	1574.1	1142.6	405.2	-268.8	127.0	244.1	384.6
Austria	8.8	432.8	387.9	12.1	22.2	33.5	74.5	64.9
Azerbaijan	9.9	57.3	153.1	54.4	-39.4	14.3	20.9	30.8
Bahrain	1.5	33.0	63.3	22.4	8.3	14.0	27.8	29.8

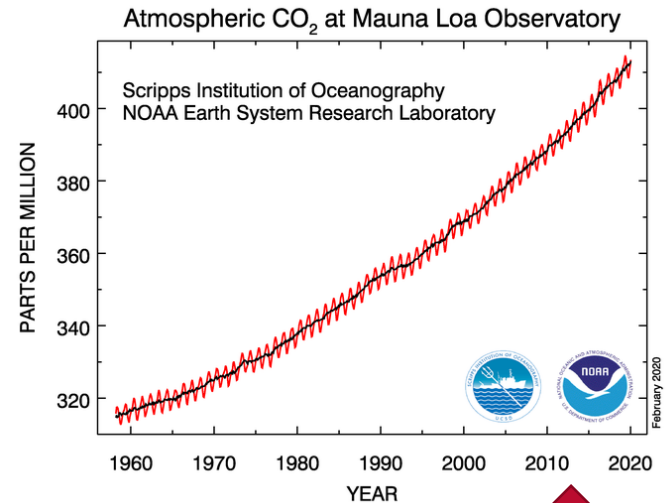


← Mass of CO₂

$$\frac{\text{Mass of CO}_2 \text{ from combustion}}{\text{Volume of earth's atmosphere}} = 4.2 \text{ ppm}$$



← Volume of atmosphere



↑ Annual CO₂ increase at Mauna Loa ~ 2.1 ppm

Infrared energy causes warming

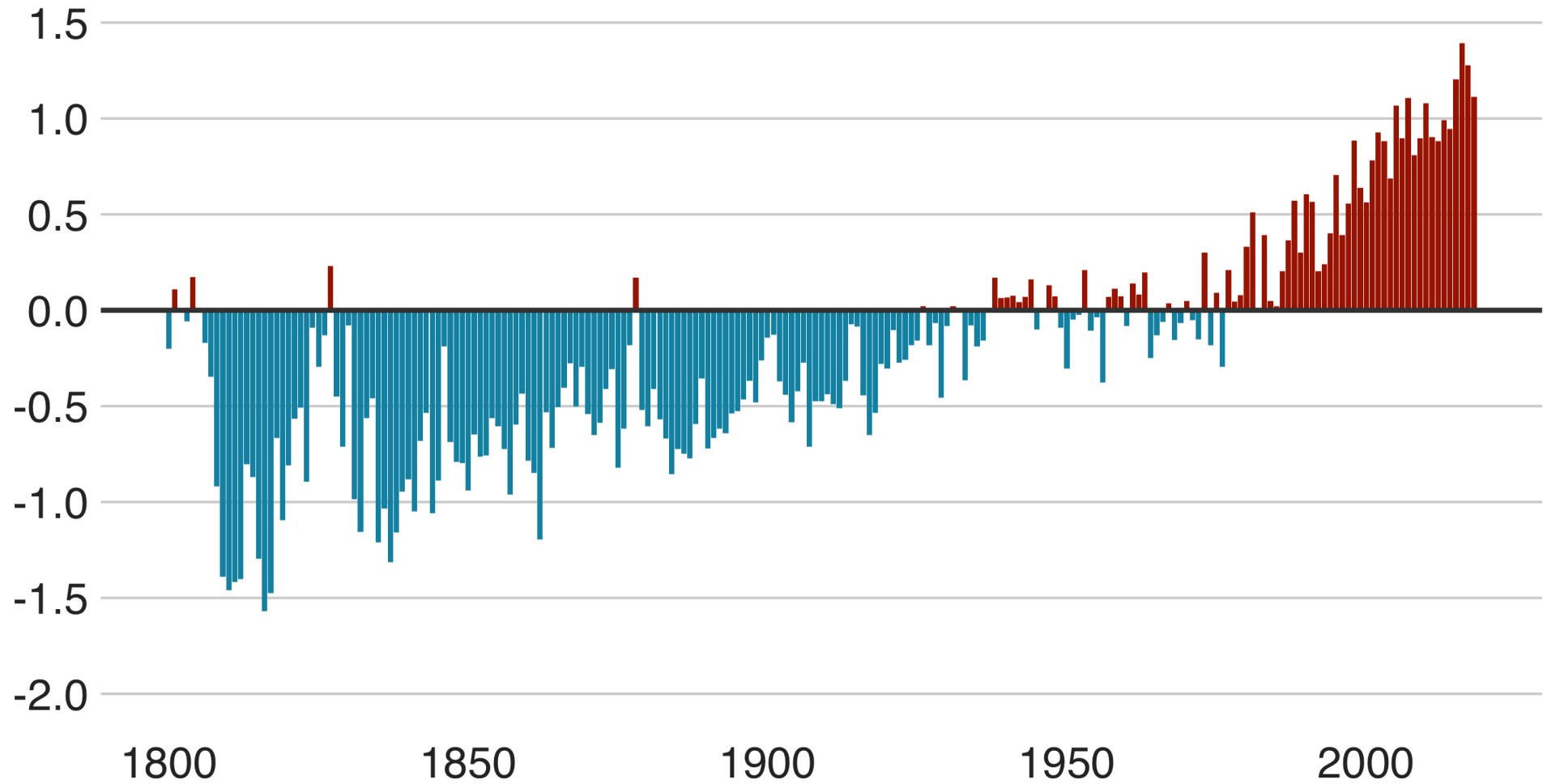
CO₂ absorbs infrared energy

CO₂ is increasing in the atmosphere

We burn enough to cause the increase

The world has been getting warmer

Annual mean land temperature above or below average (°C)



Note: Average is calculated from 1951-1980 land surface temperature data

Source: University of California Berkeley

Infrared energy causes warming

CO₂ is increasing in the atmosphere

The world is getting warmer

Humans are causing climate change

Who cares?

Current state
of evolution
is based on
current
environmental
conditions

Modern
infrastructure
is based on
current
environmental
conditions



Houston, 2016



Venice, 2019



California, 2019

Why don't we do something
about it?

It's the economy, stupid.

The US withdraws from the Paris Climate Agreement



<https://www.youtube.com/watch?v=5uPoZhFrJ7Y&t=362s>

(362,513,606,784,1007)

(6:02; 8:33; 10:06; 13:04; 16:47)

Paris Climate Agreement

- Every country except the Holy See has signed the agreement
 - The Holy See intends to join the UNFCCC so it can sign
 - The United States intends to withdraw
- Each country determines, plans, and regularly reports on its own contribution
 - Intended Nationally Determined Contribution (INDC)
- Has no mechanism to force a country to set a specific target by a specific date.

Paris Climate Agreement

Intended Nationally Determined Contributions

United
States

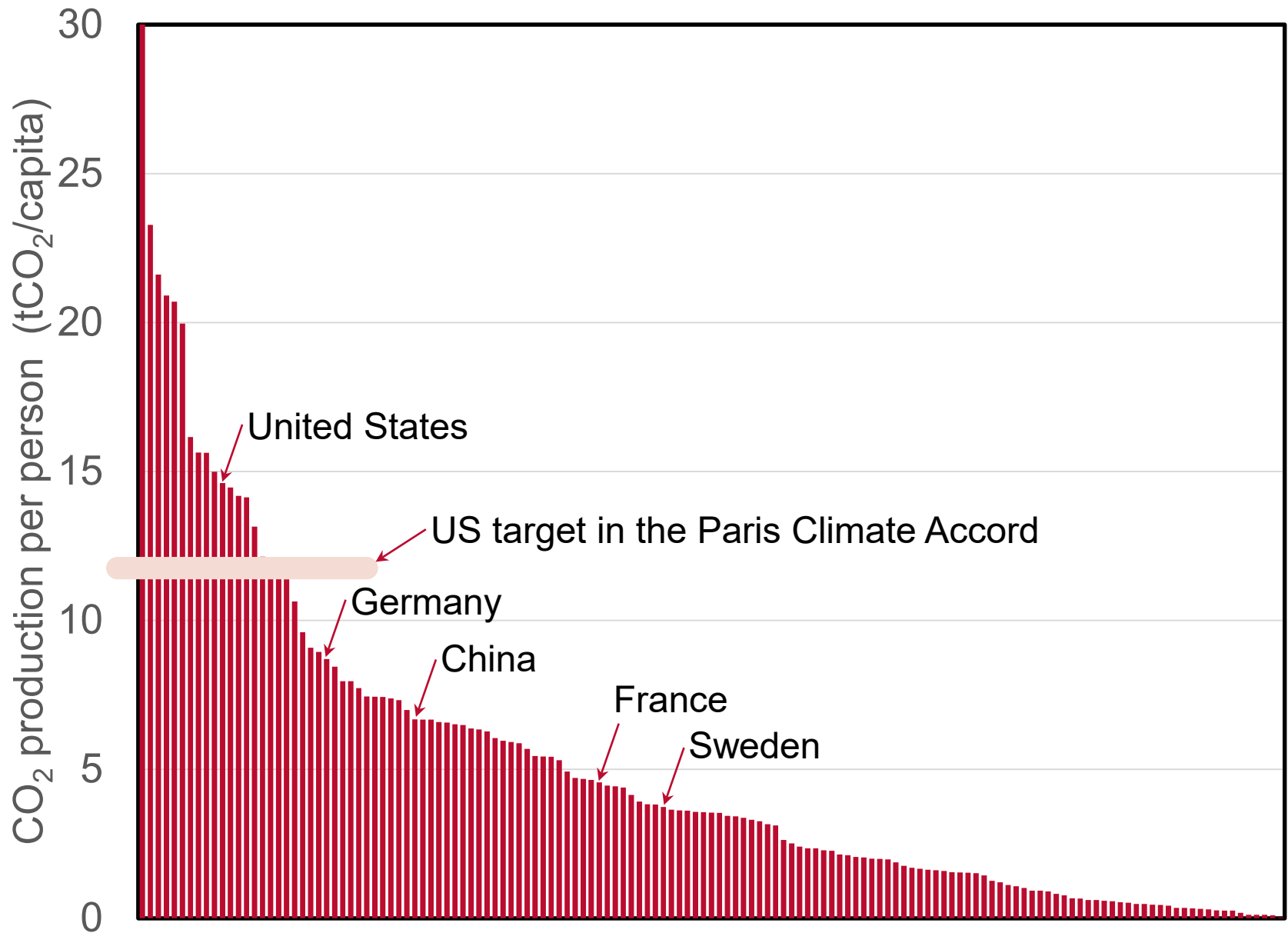
Intends to achieve an economy-wide target of reducing its greenhouse gas emissions by 26-28 percent below its 2005 level in 2025.

European
Union

The UE and its Member States are committed to a binding target of an at least 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990.

Comparison of INDC's

	United States	European Union
Base Year	2005	1990
CO ₂ per capita in base year (tonnes CO ₂ -eq)	24	12
CO ₂ per capita in 2012 (tonnes CO ₂ -eq)	20	9.2
Target year	2025	2030
CO ₂ per capita in target year (tonnes CO ₂ -eq)	15	6

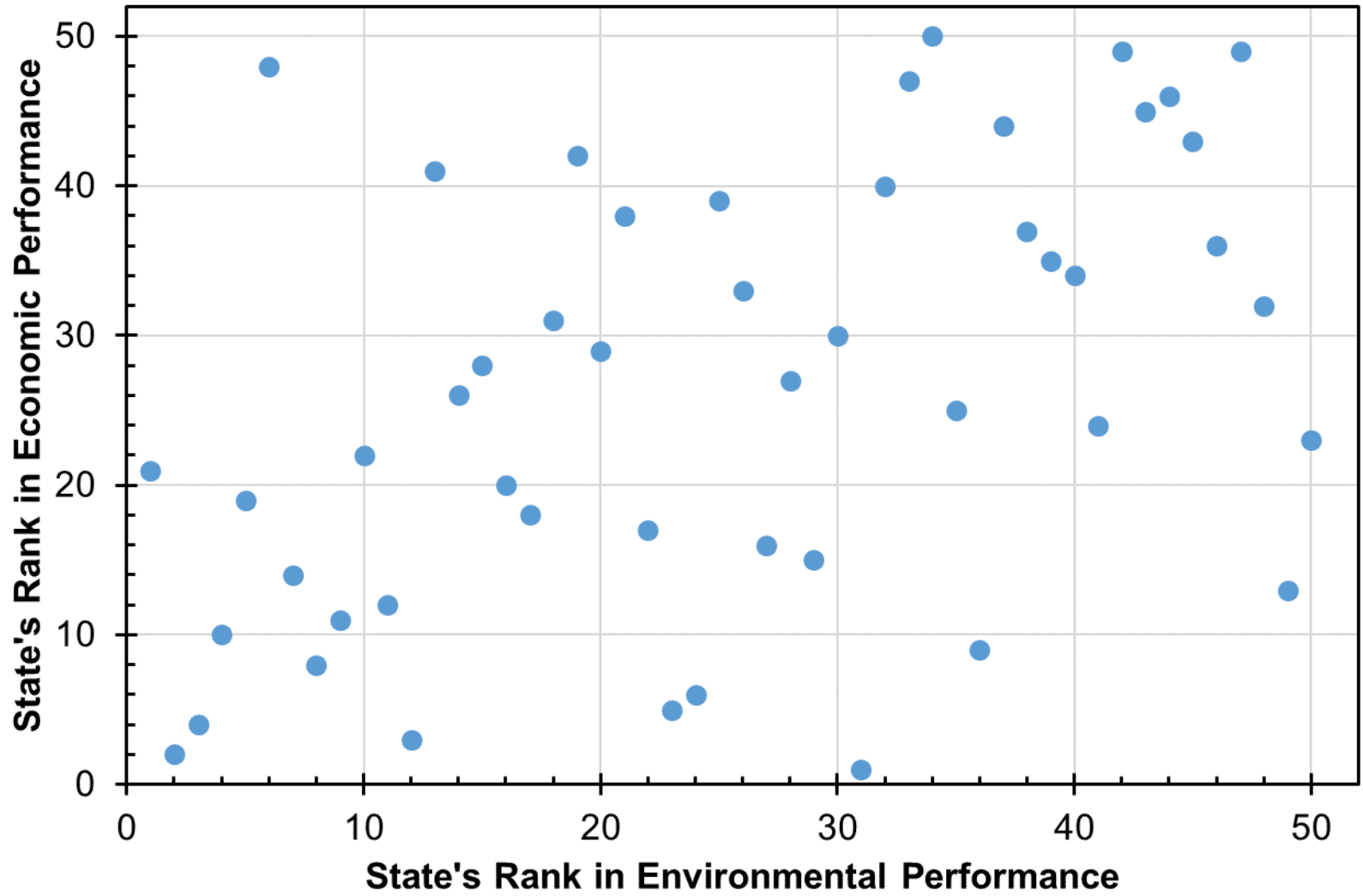


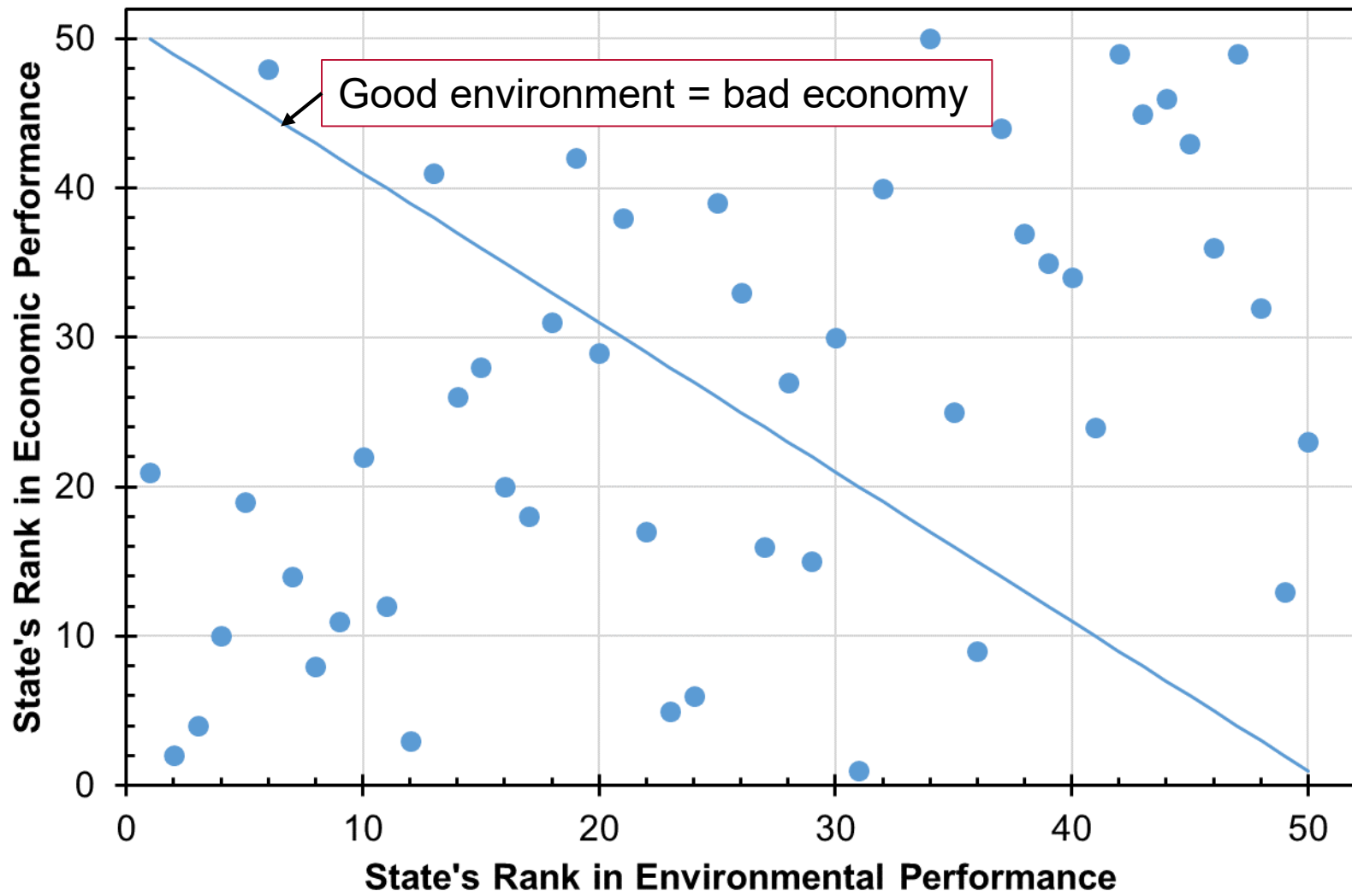
(from energy only, 2017 data)

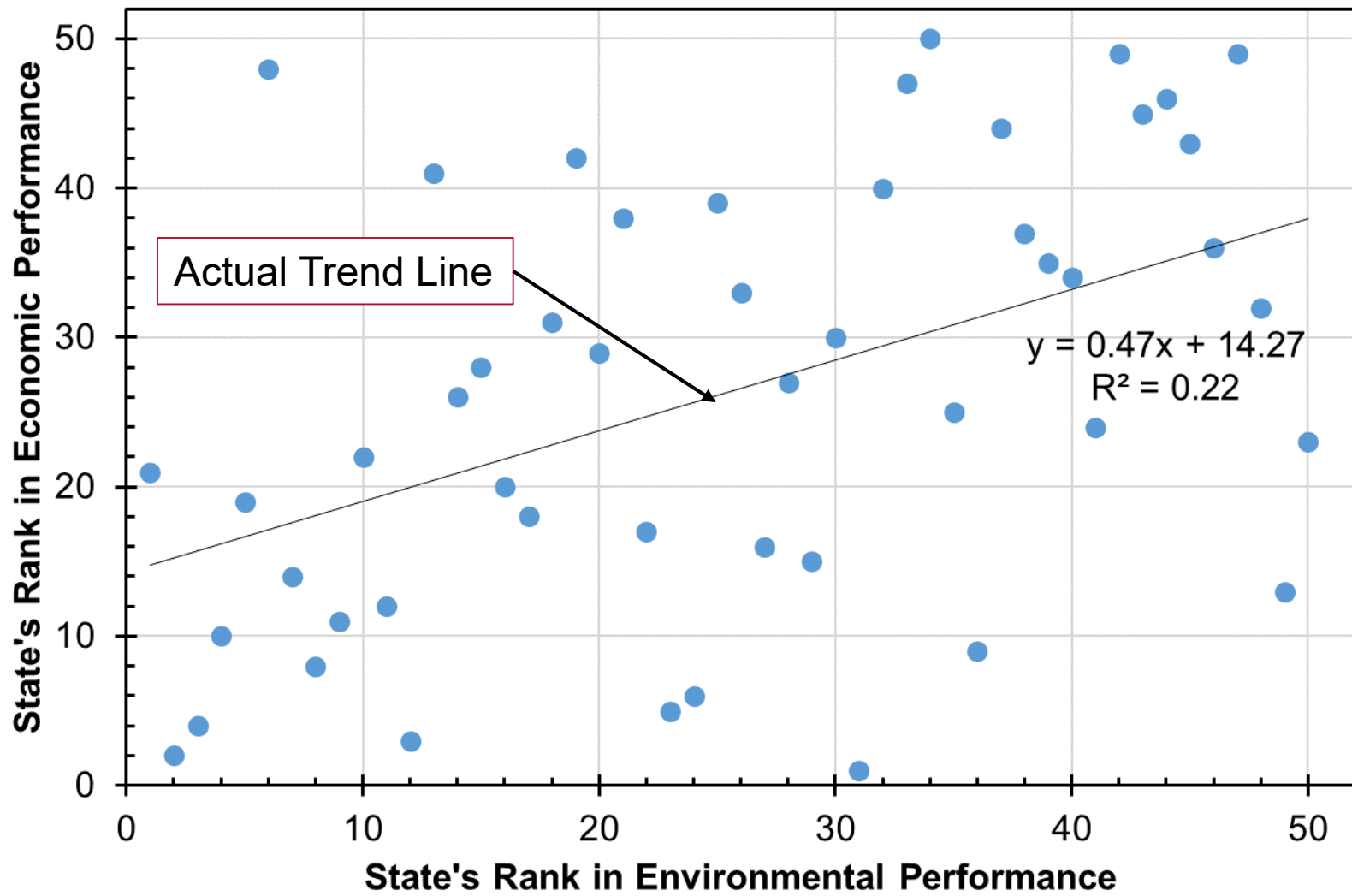
Which is better able to
predict the future?

Climate
Science

Economics







To summarize

The climate is warming, and humans are causing it.

The United States is the biggest obstacle to doing something about it.

The United States policy on climate change is based on:

- Flawed economic reasoning.
- A belief that US economic growth depends on waste and inefficiency.
- A disdain for American workers and their ability to innovate.

Photo Sources

Slide	Image	URL
1	Forest Fire	https://www.washingtonpost.com/technology/2019/11/06/california-has-million-acres-forest-this-company-is-training-artificial-intelligence-scour-it-all-wildfire/
2	Greenhouse	https://medium.com/@GreenhousesStores/halls-gube-greenhouse-review-d72ea7f4edf7
3	Electromagnetic Spectrum	https://imagine.gsfc.nasa.gov/science/toolbox/emspectrum1.html
5	CO2 Monitor	https://www.amazon.com/Portable-Digital-Temperature-Humidity-Diagnosis/dp/B01KTJL6OK/ref=sr_1_18?crd=2H7T8AH11HV9Q&keywords=carbon+dioxide+detector&qid=1581783006&srefix=carbon+dioxi%2Caps%2C204&sr=8-18
7	CO2 Mauna Loa	https://www.esrl.noaa.gov/gmd/webdata/ccgg/trends/co2_data_mlo.png
12	Earth	https://www.flickr.com/photos/donkeyhotey/5679642883
14	Temp Rise	https://www.bbc.com/news/science-environment-24021772
17	Houston	https://www.houstonchronicle.com/local/explainer/article/The-trouble-with-living-in-a-swamp-Houston-7954514.php
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19	Paradise, CA	https://www.npr.org/2019/05/15/723753237/pg-e-transmission-lines-caused-californias-deadliest-wildfire-state-officials-sa