
ENERGY


GOT
Winter is Coming.
HBO

2020 COVID

grist.com

2003 BLACKOUT

history.com

AUGUST 2003

#1 Song: Beyoncé's "Crazy in Love"

On TV, "CSI" and "Arrested Development" debuted, "Colombo" ended, "Girlfriends" was midway through its run.

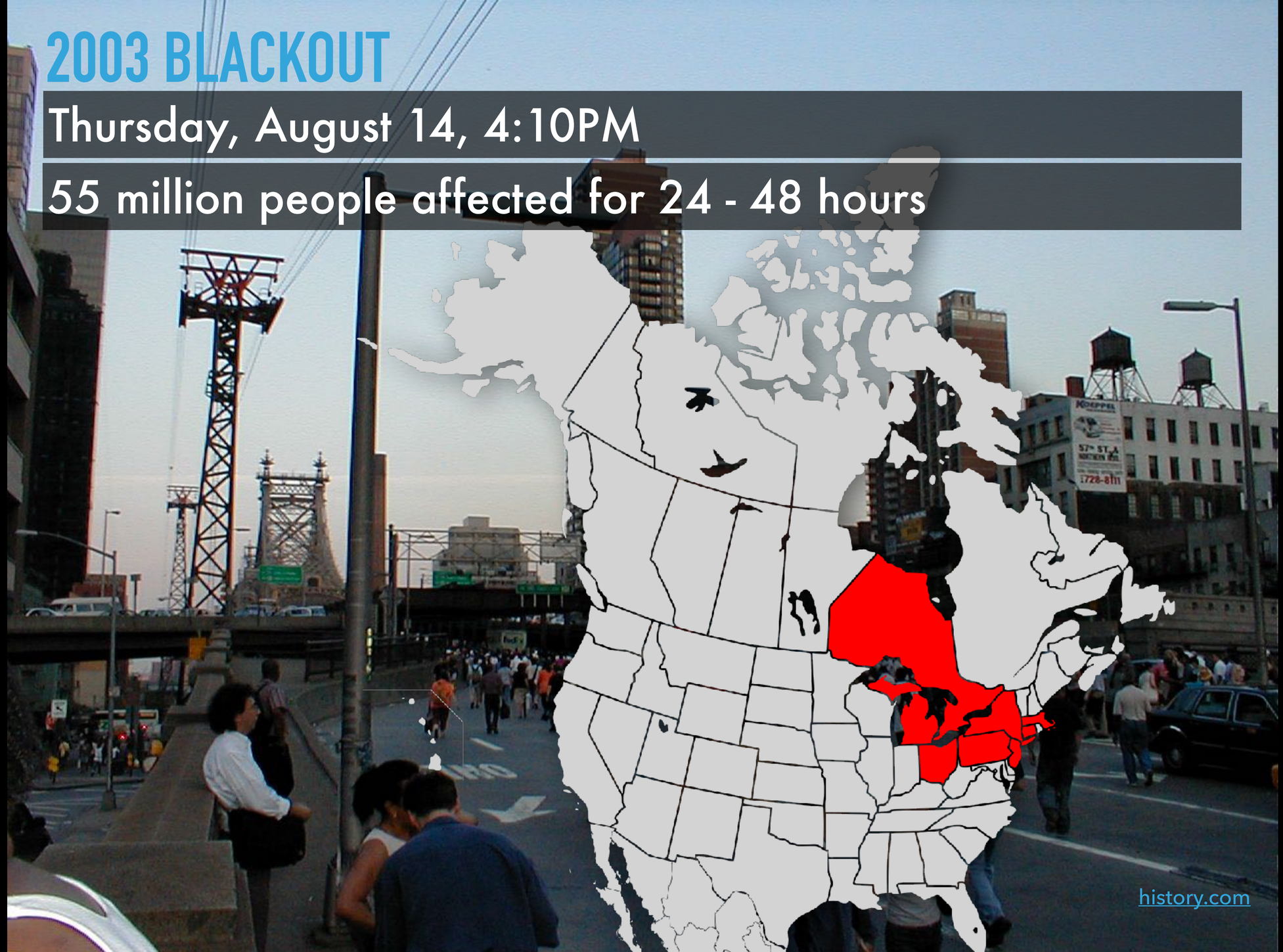
Top movies included the first Pirates of the Caribbean, the second Matrix, and the third Lord of the Rings.

September 11th 2001 was a close memory.

2003 BLACKOUT

Thursday, August 14, 4:10PM

55 million people affected for 24 - 48 hours



history.com

2003 BLACKOUT

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history.com

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history.com

2003 BLACKOUT

history.com

2003 BLACKOUT

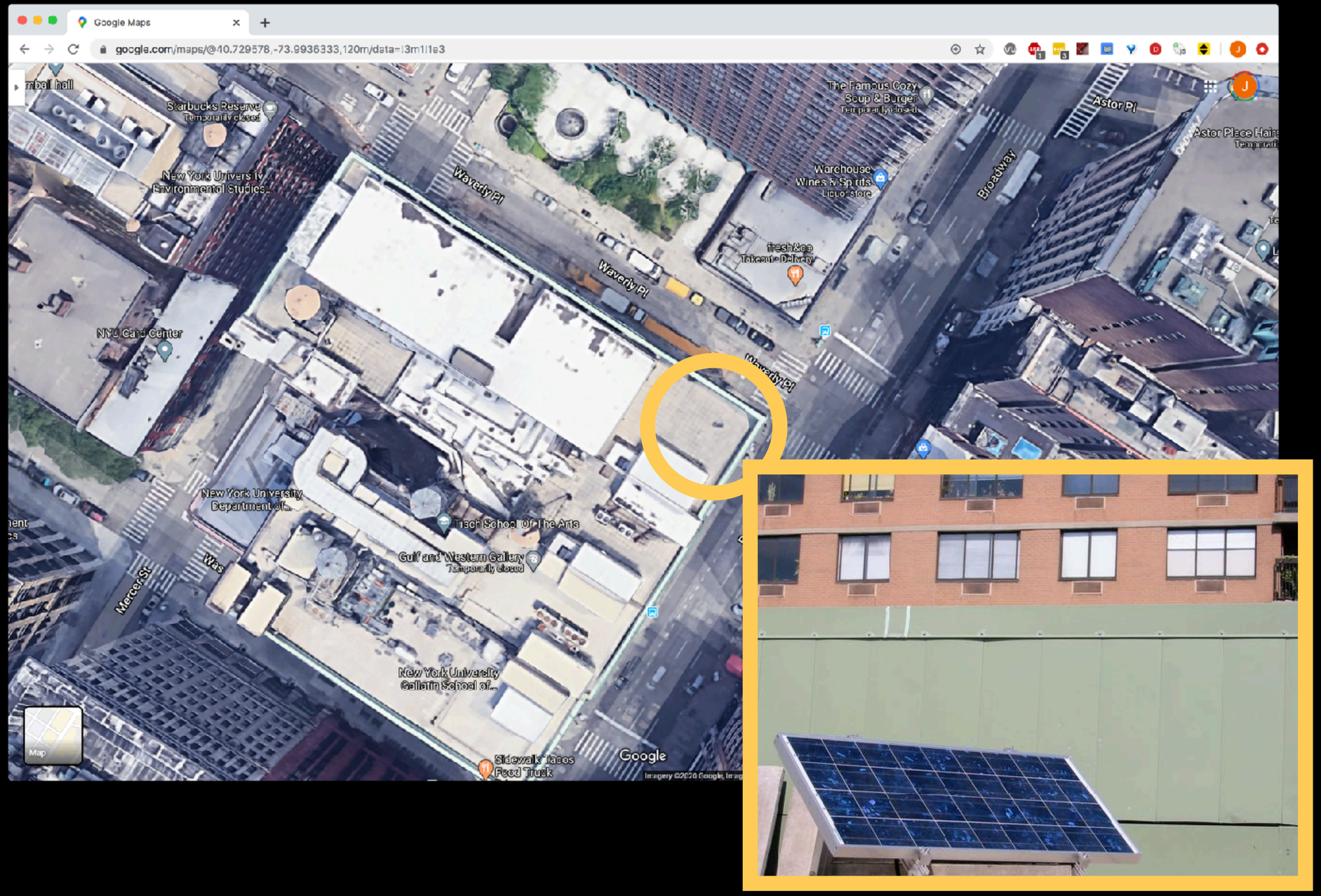
Third-largest power outage when it happened.

Largest [edit]

Article	People affected (millions)	Location	Date	References
2012 India blackouts	620	India	July 30–31, 2012	[1][2][3]
2023 Pakistan blackout	230(99% of population)	Pakistan	January 23, 2023	[4]
2001 India blackout	230	India	January 2, 2001	[5]
2022 Pakistan blackout	200	Pakistan	October 13, 2022	[6]
2021 Pakistan blackout	200 (90% population)	Pakistan	January 9, 2021	[7]
2014 Bangladesh blackout	150	Bangladesh	November 1, 2014	[8]
2015 Pakistan blackout	140	Pakistan	January 26, 2015	[9]
2019 Java blackout	120	Indonesia	August 4–5, 2019	[10][11][12][13]
2005 Java–Bali blackout	100	Indonesia	August 18, 2005	[14]
1999 Southern Brazil blackout	97	Brazil	March 11–June 22, 1999	[15]
2015 Turkey blackout	70	Turkey	March 31, 2015	[16]
2009 Brazil and Paraguay blackout	60	Brazil, Paraguay	November 10–20, 2009	[17]
2003 Italy blackout	56	Italy, Switzerland	September 28, 2003	[18]
Northeast blackout of 2003	55	Canada, United States	August 14–28, 2003	[19]
2019 Argentina, Paraguay and Uruguay blackout	48	Argentina, Paraguay, Uruguay	June 16, 2019	[20]
2002 Luzon blackout	40	Philippines	May 21, 2002	[21]
2001 Luzon blackout	35	Philippines	April 7, 2001	[22]
Northeast blackout of 1965	30	Canada, United States	November 9, 1965	[23]
2019 Venezuelan blackouts	30	Venezuela	March 7, 2019–July 23, 2019	[24][25][26][27]
2020 Sri Lankan blackouts	21	Sri Lanka	August 17, 2020	[28]
2016 Sri Lanka blackout	21	Sri Lanka	March 13, 2016	[29]

14TH

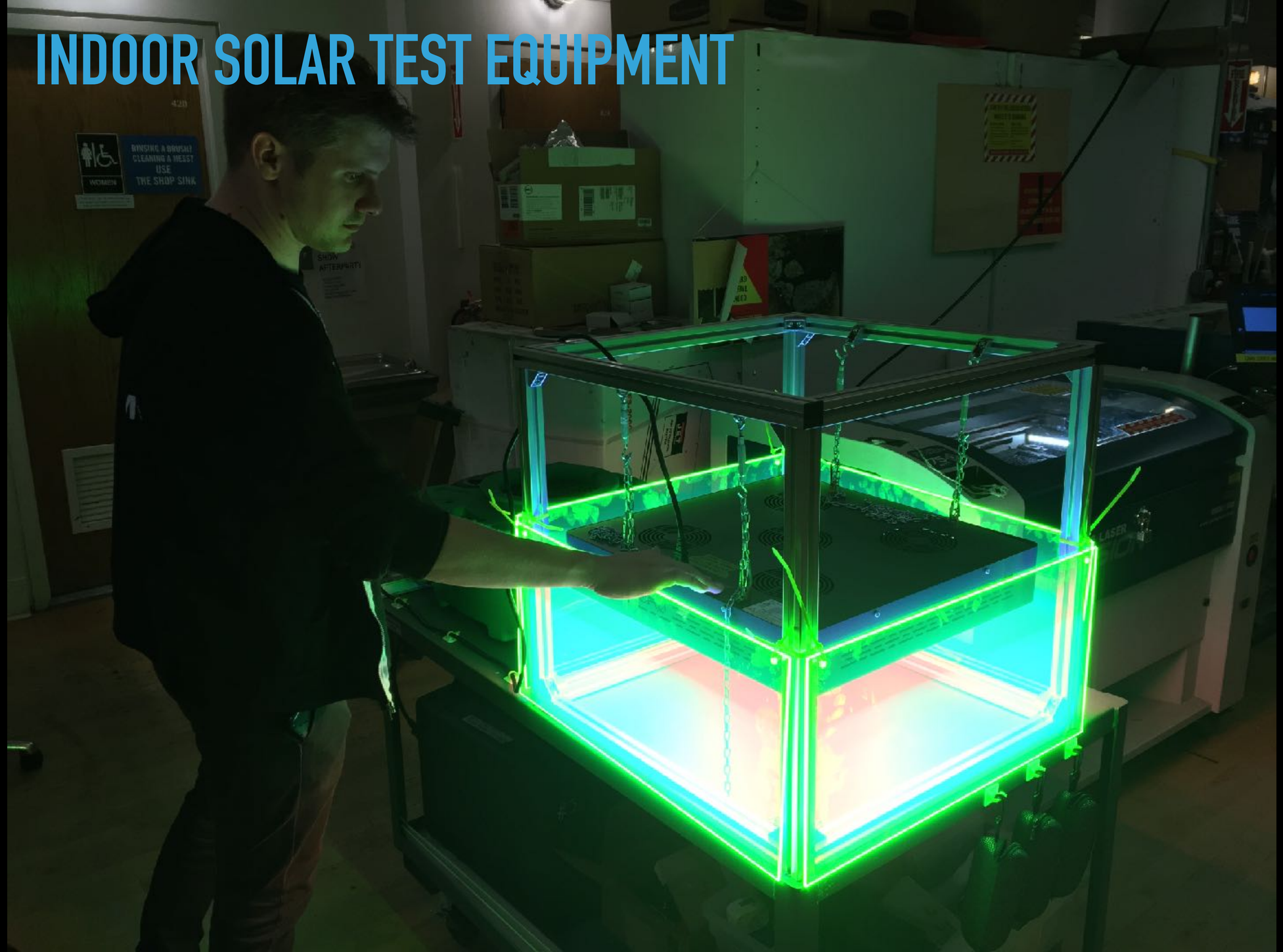
NYU's FIRST (?) SOLAR – 2004



PNC BEACON

2004–2019

INDOOR SOLAR TEST EQUIPMENT



NASHVILLE TODAY

NEW JERSEY YESTERDAY

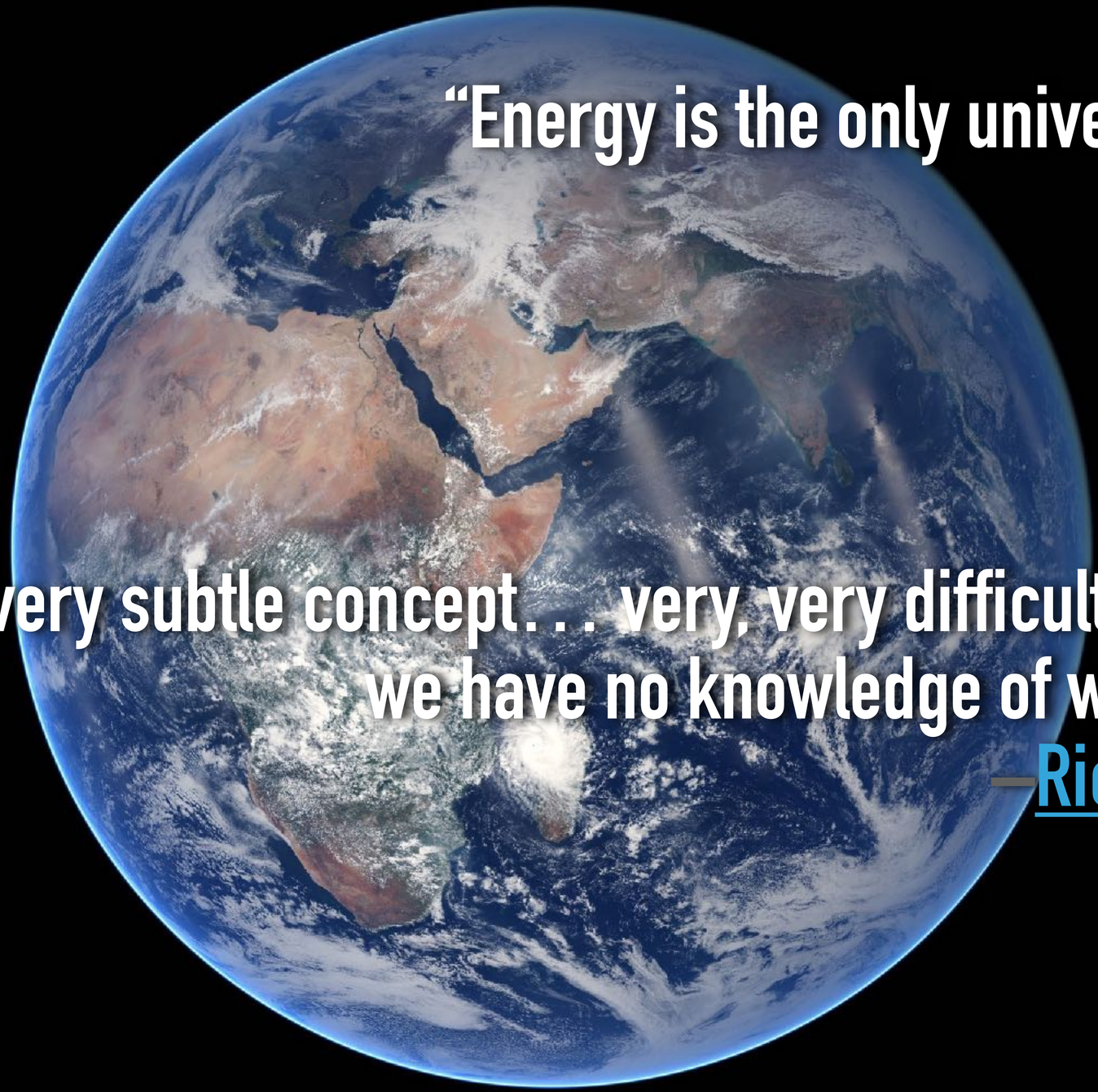
Intros:

Hi! Who are you?

Why Energy at ITP?

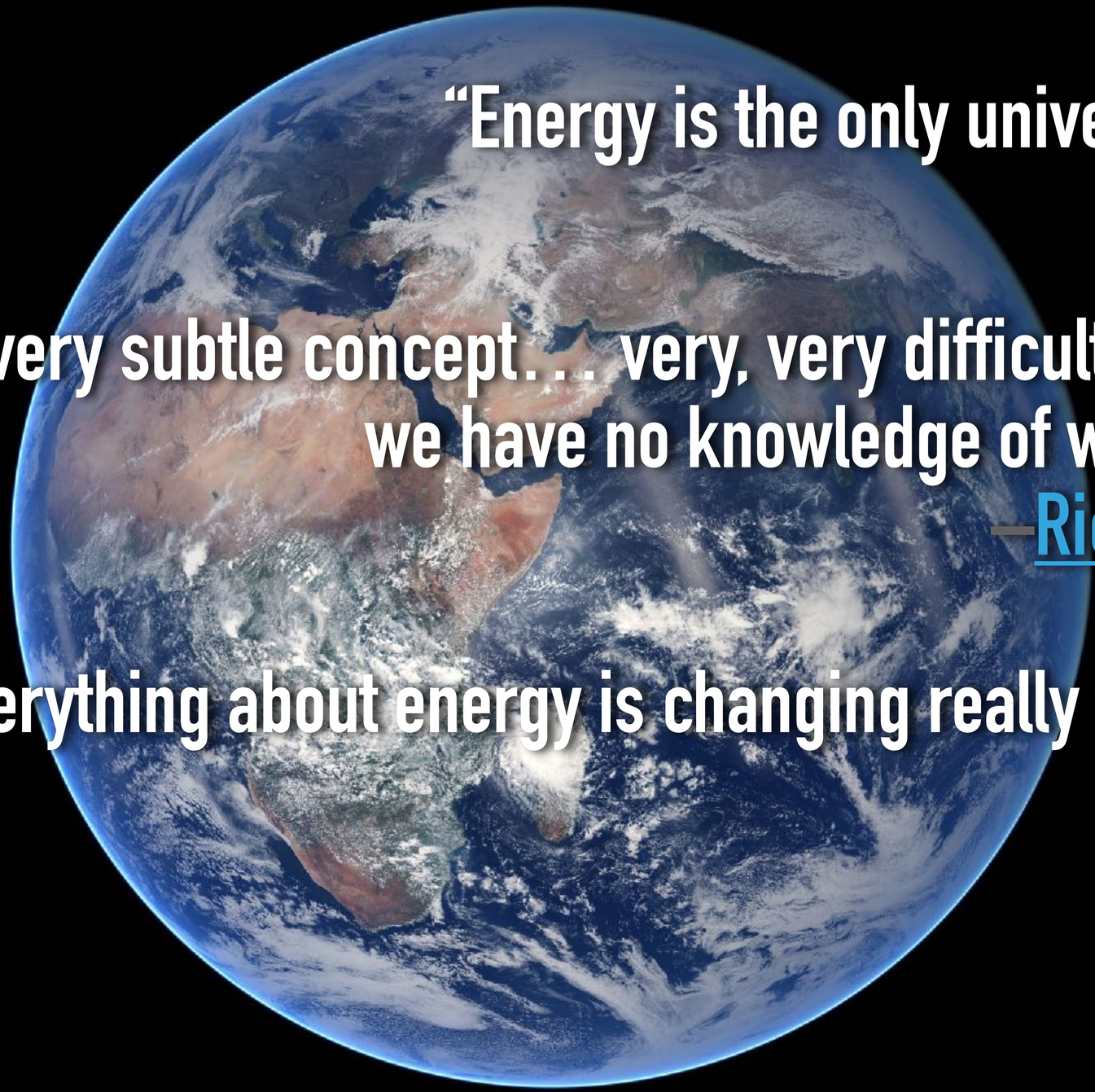
Ever experience time w/o access to power?

If we'd lost power in this storm, what was your plan?



"Energy is the only universal currency."
—Vaclav Smil

"Energy is a very subtle concept… very, very difficult to get right…
we have no knowledge of what energy is."
—Richard Feynman



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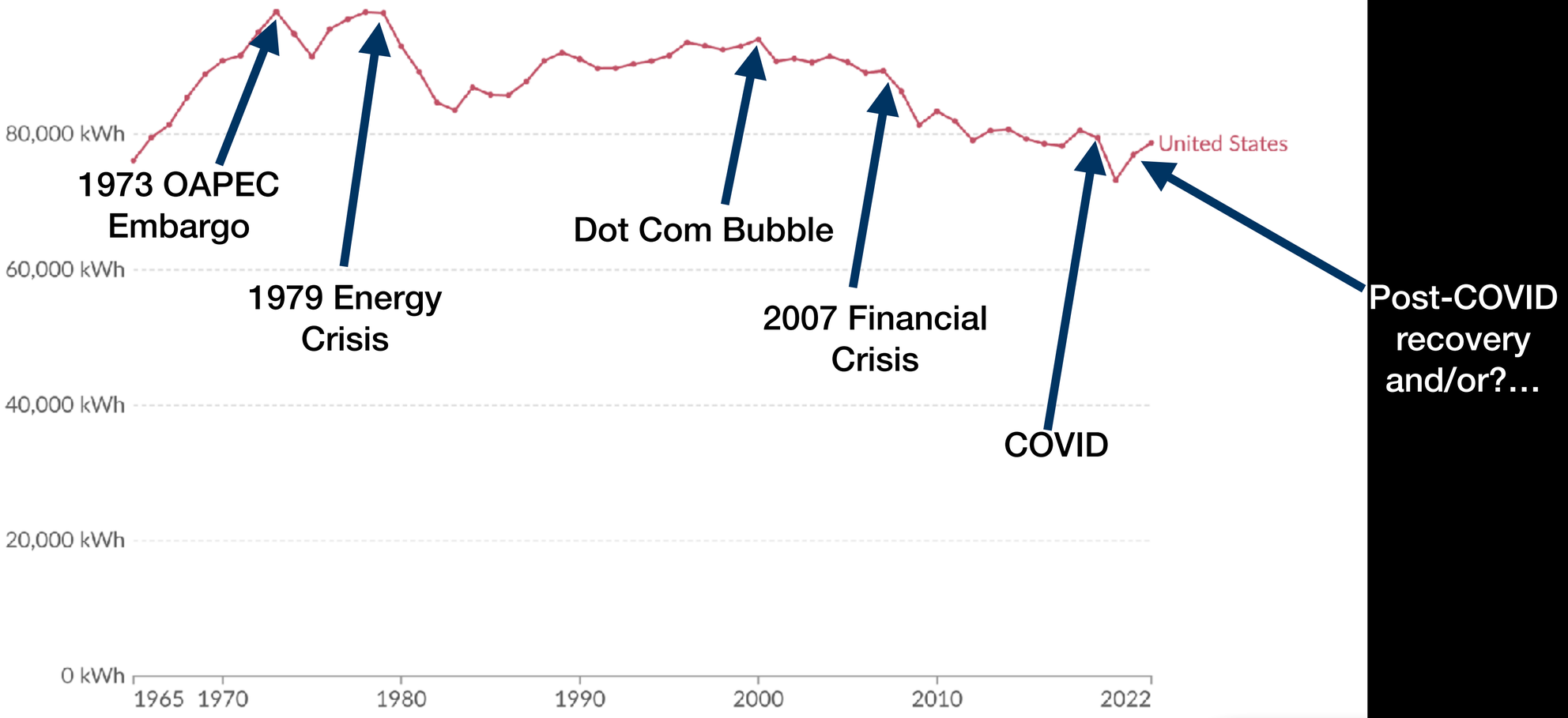
Everything about energy is changing really fast, right now!
—Me!

Energy use per person

Measured in kilowatt-hours[1] per person. Here, energy refers to primary energy[2] using the substitution method[3].

Our World in Data



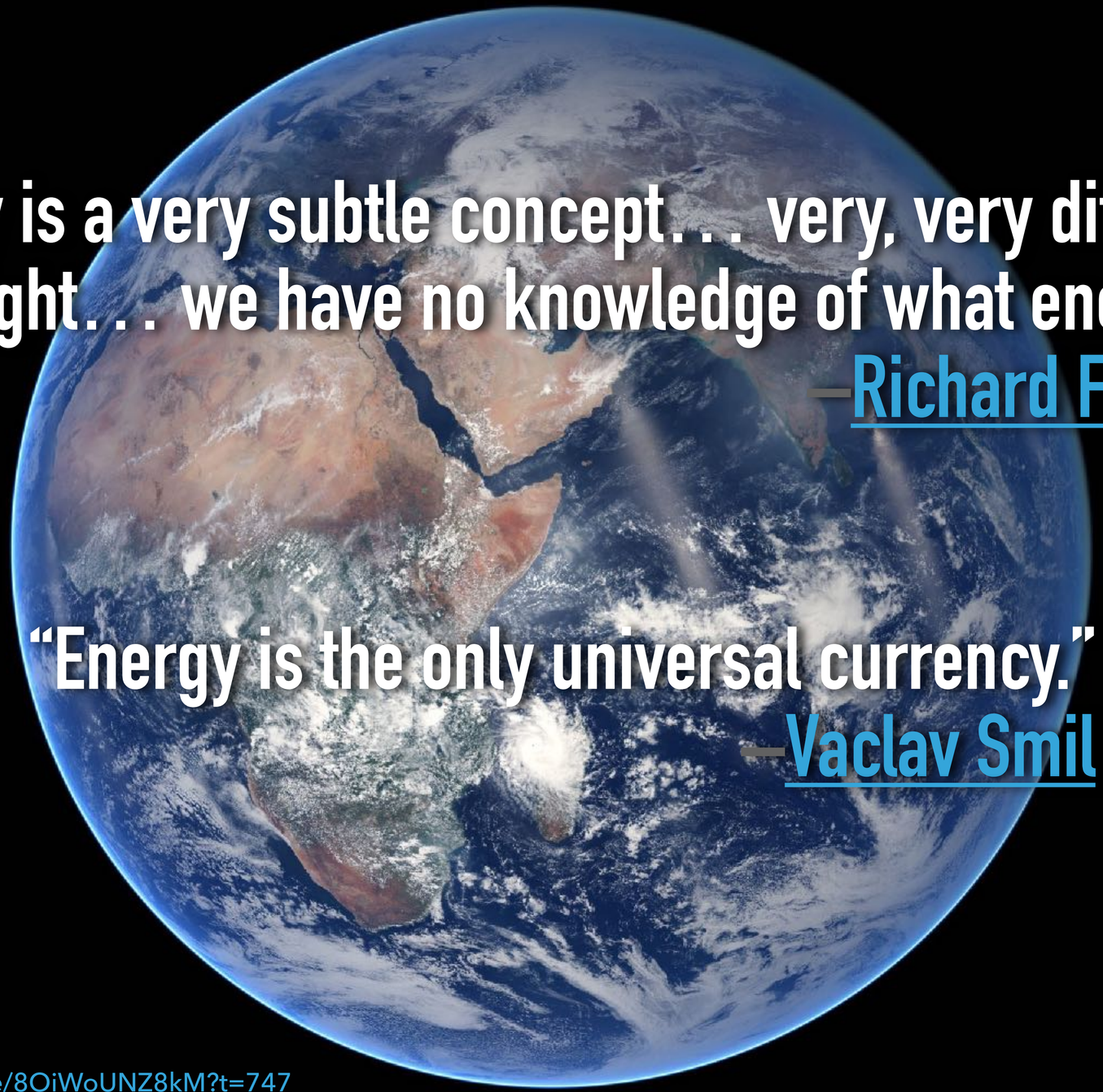
Data source: U.S. Energy Information Administration (2023); Energy Institute - Statistical Review of World Energy (2023); Popu
based on various sources (2023)

OurWorldInData.org/energy | CC BY

1. Watt-hour: A watt-hour is the energy delivered by one watt of power for one hour. Since one watt is equivalent to one joule per second, a watt-hour is equivalent to 3600 joules of energy. Metric prefixes are used for multiples of the unit, usually: - kilowatt-hours (kWh), or a thousand watt-hours. - Megawatt-hours (MWh), or a million watt-hours. - Gigawatt-hours (GWh), or a billion watt-hours. - Terawatt-hours (TWh), or a trillion watt-hours.

2. Primary energy: Primary energy is the energy available as resources – such as the fuels burnt in power plants – before it has been transformed. This relates to the coal before it has been burned, the uranium, or the barrels of oil. Primary energy includes energy that the end user needs, in the form of electricity, transport and heating, plus inefficiencies and energy that is lost when raw resources are transformed into a usable form. You can read more on the different ways of measuring energy in our article.

3. Substitution method: The 'substitution method' is used by researchers to correct primary energy consumption for efficiency losses experienced by fossil fuels. It tries to adjust non-fossil energy sources to the inputs that would be needed if it was generated from fossil fuels. It assumes that wind and solar electricity is as inefficient as coal or gas. To do this, energy generation from non-fossil sources are divided by a standard 'thermal efficiency factor' – typically around 0.4 Nuclear power is also adjusted despite it also experiencing thermal losses in a power plant. Since it's reported in terms of electricity output, we need to do this adjustment to calculate its equivalent input value. You can read more about this adjustment in our article.



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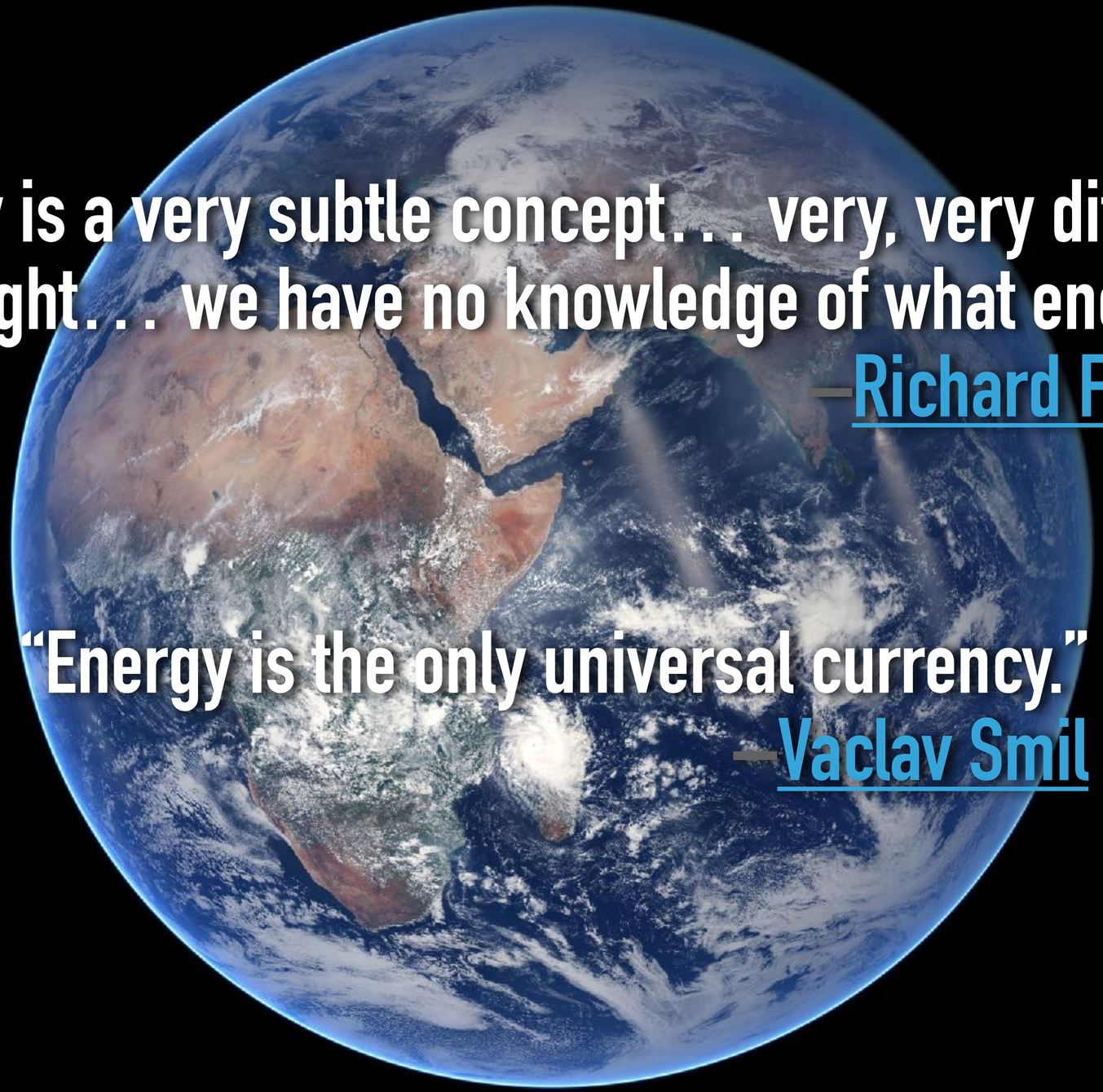
https://youtu.be/8OiWoUNZ8kM?t=747



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Feddersen
Energy NYU/ITP

TW GW MW kW W

18,000,000,000,000

18TW

Feddersen
Energy NYU/ITP

TW GW MW kW W

18,000,000,000,000

(1 : 21 GW)

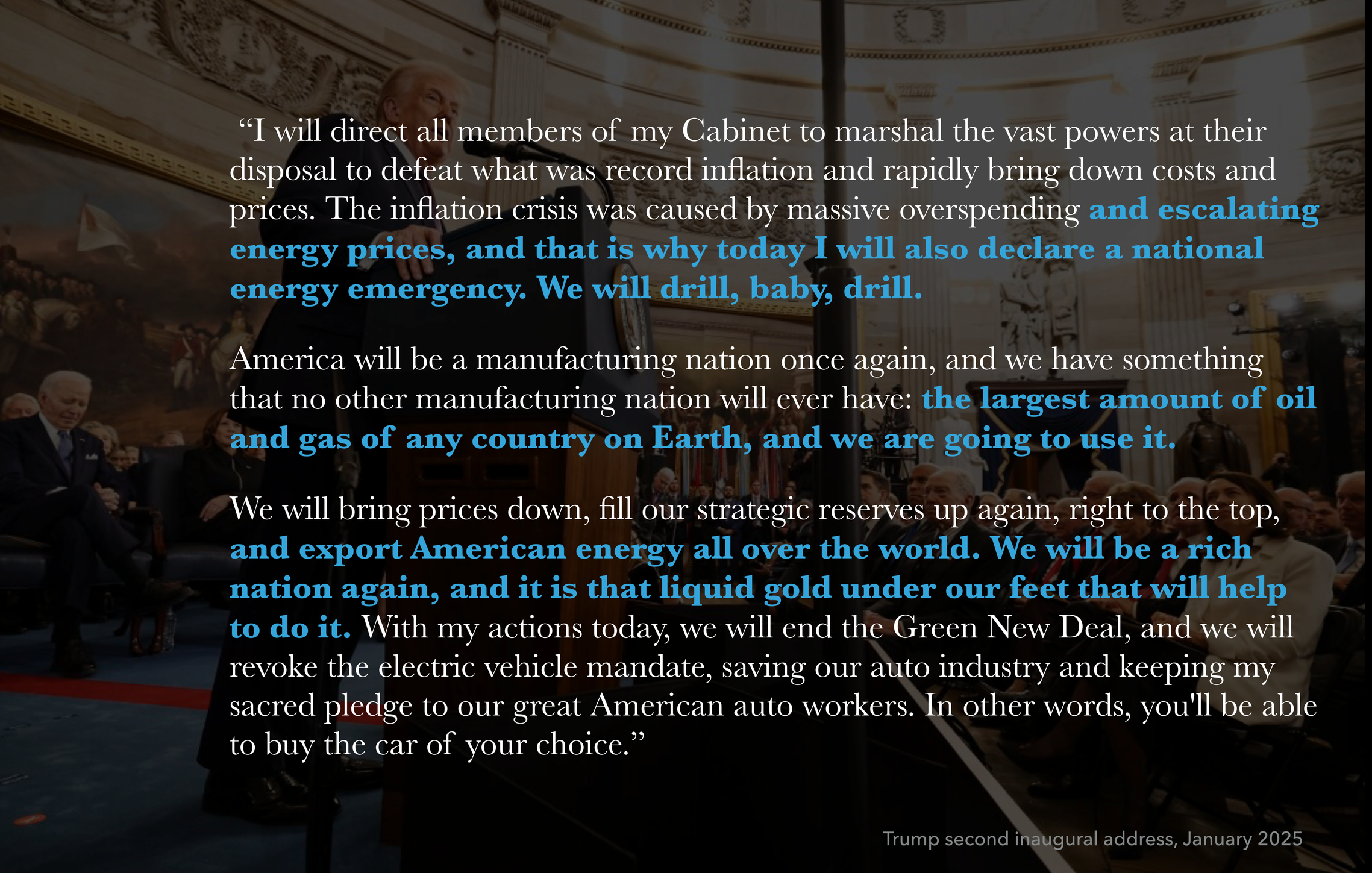
18TW

Feddersen
Energy NYU/ITP

ELECTRIFY EVERYTHIN

DECARBONI

ELECTRICIT



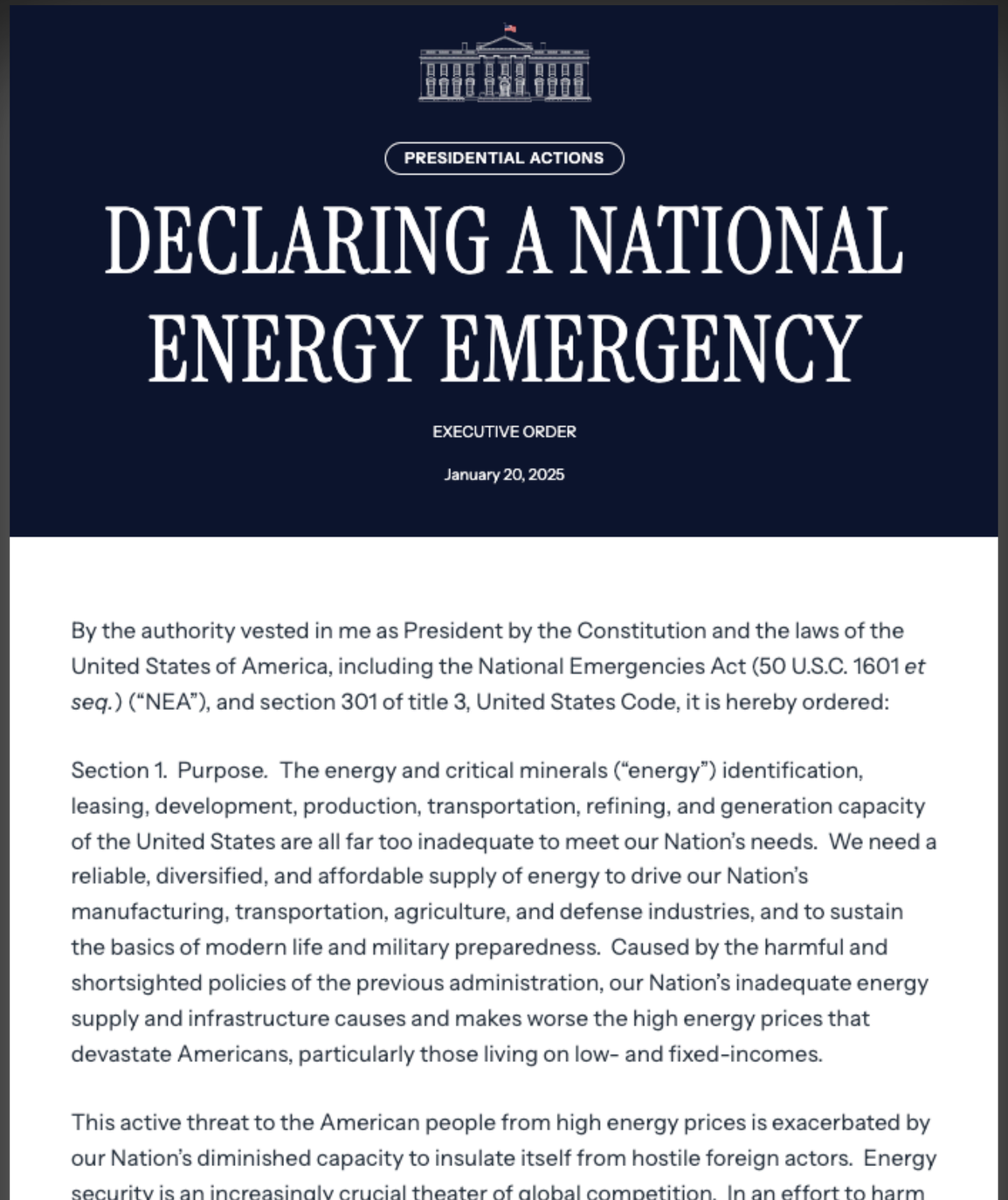
“I will direct all members of my Cabinet to marshal the vast powers at their disposal to defeat what was record inflation and rapidly bring down costs and prices. The inflation crisis was caused by massive overspending **and escalating energy prices, and that is why today I will also declare a national energy emergency. We will drill, baby, drill.**

America will be a manufacturing nation once again, and we have something that no other manufacturing nation will ever have: **the largest amount of oil and gas of any country on Earth, and we are going to use it.**

We will bring prices down, fill our strategic reserves up again, right to the top, **and export American energy all over the world. We will be a rich nation again, and it is that liquid gold under our feet that will help to do it.** With my actions today, we will end the Green New Deal, and we will revoke the electric vehicle mandate, saving our auto industry and keeping my sacred pledge to our great American auto workers. In other words, you'll be able to buy the car of your choice.”

Trump second inaugural address, January 2025

“The energy and critical minerals (“energy”) identification, leasing, development, production, transportation, refining, and generation capacity of the United States **are all far too inadequate to meet our Nation’s needs**. We need a reliable, diversified, and affordable supply of energy to drive our Nation’s manufacturing, transportation, agriculture, and defense industries, and to sustain the basics of modern life and military preparedness. Caused by the harmful and shortsighted policies of the previous administration, our Nation’s inadequate energy supply and infrastructure causes and makes worse the high energy prices that devastate Americans, particularly those living on low- and fixed-incomes.”



PRESIDENTIAL ACTIONS

DECLARING A NATIONAL ENERGY EMERGENCY

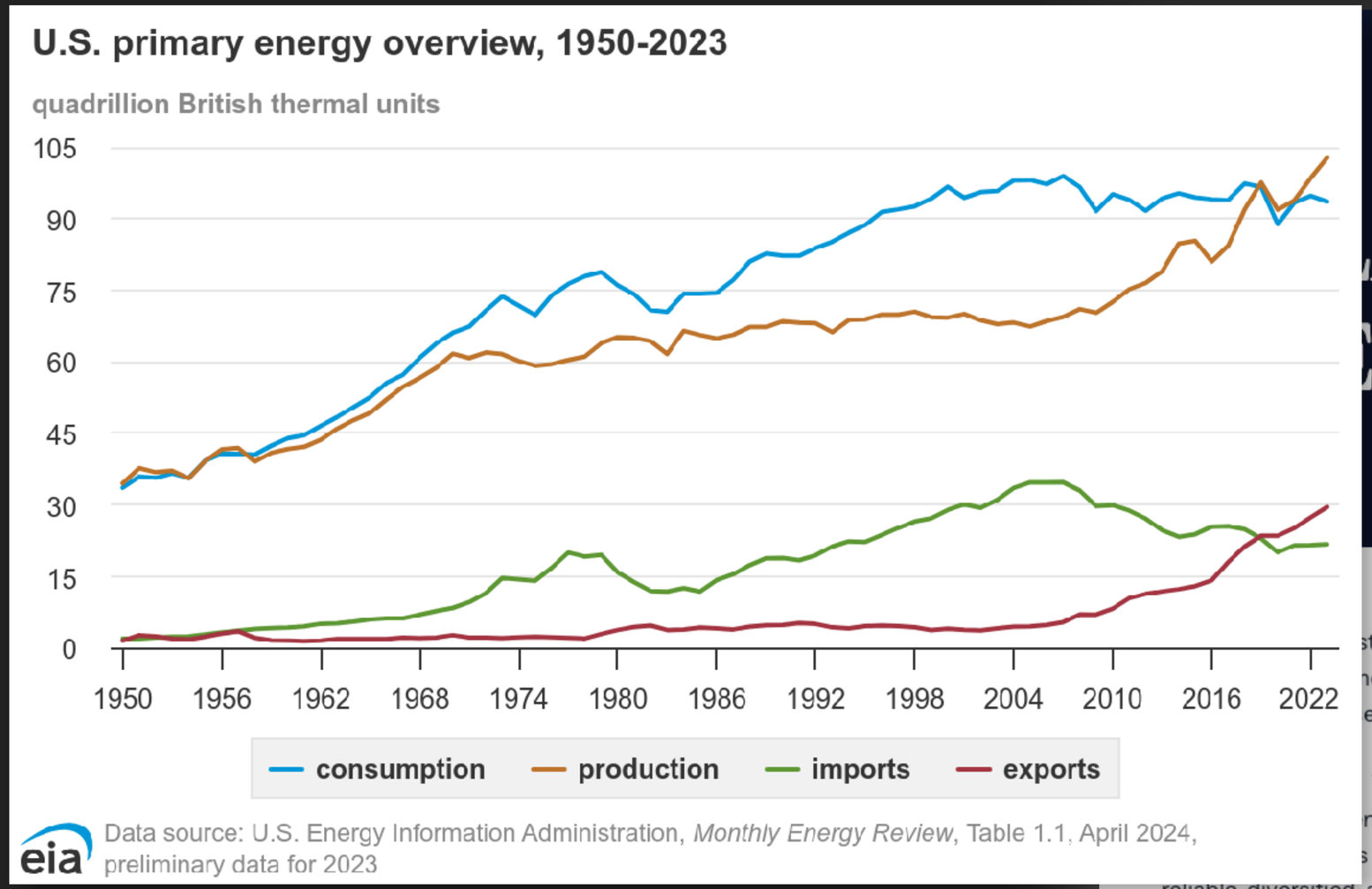
EXECUTIVE ORDER

January 20, 2025

By the authority vested in me as President by the Constitution and the laws of the United States of America, including the National Emergencies Act (50 U.S.C. 1601 *et seq.*) (“NEA”), and section 301 of title 3, United States Code, it is hereby ordered:

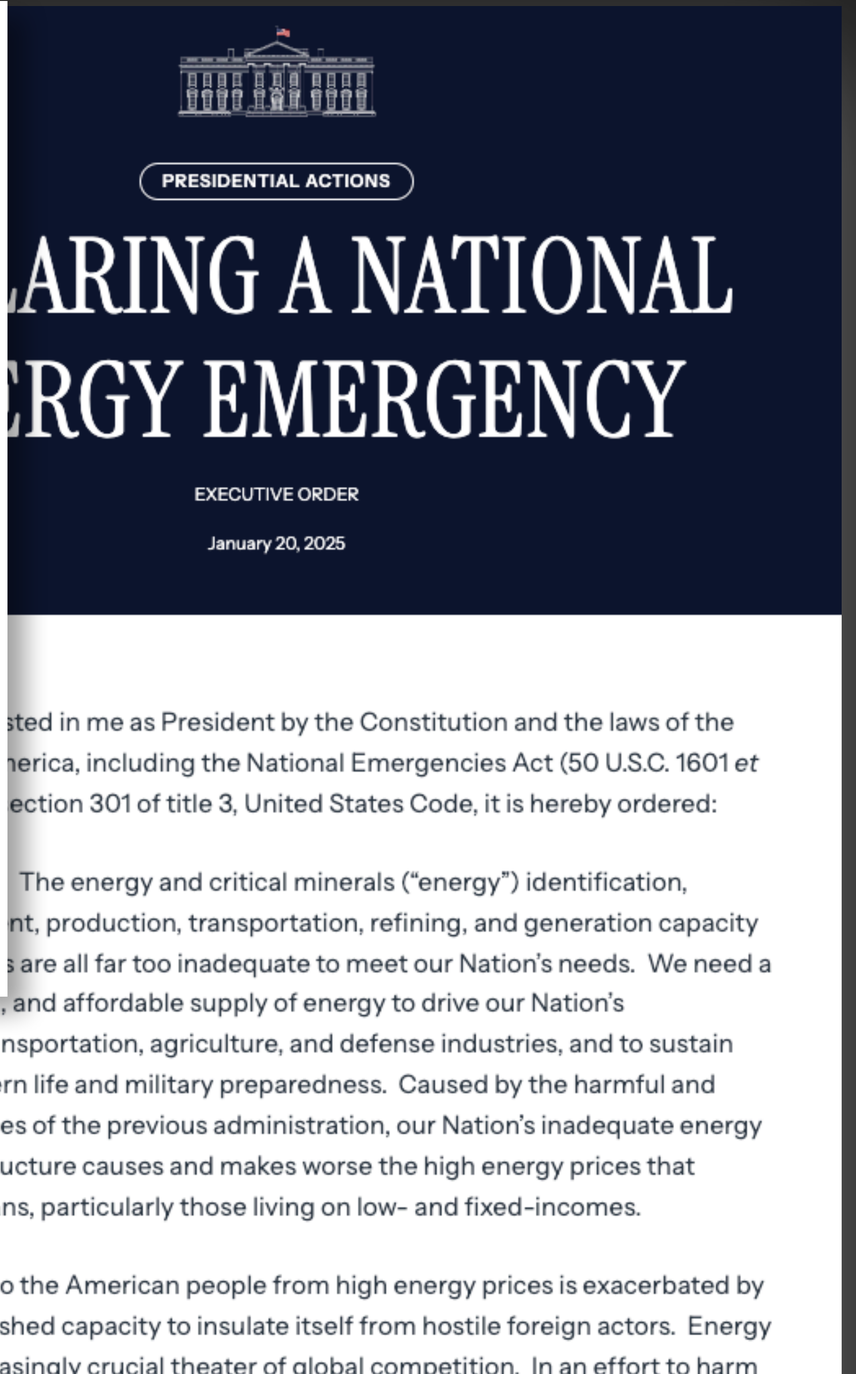
Section 1. Purpose. The energy and critical minerals (“energy”) identification, leasing, development, production, transportation, refining, and generation capacity of the United States are all far too inadequate to meet our Nation’s needs. We need a reliable, diversified, and affordable supply of energy to drive our Nation’s manufacturing, transportation, agriculture, and defense industries, and to sustain the basics of modern life and military preparedness. Caused by the harmful and shortsighted policies of the previous administration, our Nation’s inadequate energy supply and infrastructure causes and makes worse the high energy prices that devastate Americans, particularly those living on low- and fixed-incomes.

This active threat to the American people from high energy prices is exacerbated by our Nation’s diminished capacity to insulate itself from hostile foreign actors. Energy security is an increasingly crucial theater of global competition. In an effort to harm



US has run an energy surplus since 2021

US has been the world's largest producer of oil since 2018



PRESIDENTIAL ACTIONS

LARING A NATIONAL ERGY EMERGENCY

EXECUTIVE ORDER

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“I actually think before we hit [compute limits for AI] **you're going to run into energy constraints.** I don't think [in 2024] anyone's built a gigawatt single training cluster yet - just to put this in perspective a gigawatt is around the size of a meaningful nuclear power plant, only going towards training a model.

And then you run into these things that just end up being slower in the world, like **getting energy permitted is a very heavily regulated government function, and if you're talking about building large new power plants… and transmission lines that cross other private or public land that is a heavily regulated thing.** So you're talking about many years of lead time so if we wanted to stand up just some like massive facility um to power that I I think that that is that's that's a very long-term project .”

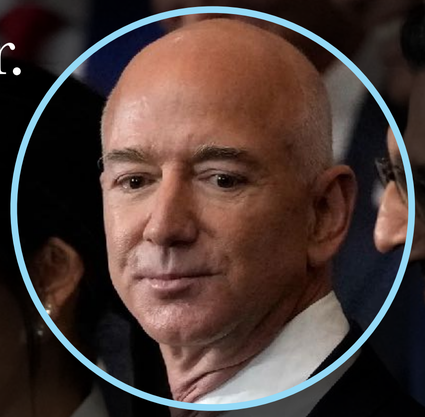
Dwarkesh Patel podcast, 2024: https://www.youtube.com/watch?v=i-o5YbNfmh0

“Elon Musk's massive AI data center gets unlocked — xAI gets approved for 150MW of power, enabling all 100,000 GPUs to run concurrently.

Elon Musk’s ‘Gigafactory of Compute,’ the xAI Colossus, received approval from the Tennessee Valley Authority in early November to receive 150MW from the state’s power grid. This increases the site’s initial supply of 8MW by almost twenty times, triggering concerns from local stakeholders about how this much power demand from xAI would impact supply reliability and power prices across the Tennessee Valley. Furthermore, Power Grid International reports that Elon plans to double the site’s computing capacity, doubling the facility’s energy requirements.”

November 2024, https://www.tomshardware.com/tech-industry/artificial-intelligence/elon-musks-massive-ai-data-center-gets-unlocked-xai-gets-approved-for-150mw-of-power-enabling-all-100-000-gpus-to-run-concurrently

“Amazon just bought a 100% nuclear-powered data center.



One of the US’s largest nuclear power plants will directly power cloud service provider Amazon Web Services’ new data center.

Power provider Talen Energy sold its data center campus, Cumulus Data Assets, to Amazon Web Services for $650 million. Amazon will develop an up to 960-megawatt (MW) data center at the Salem Township site in Luzerne County, Pennsylvania.

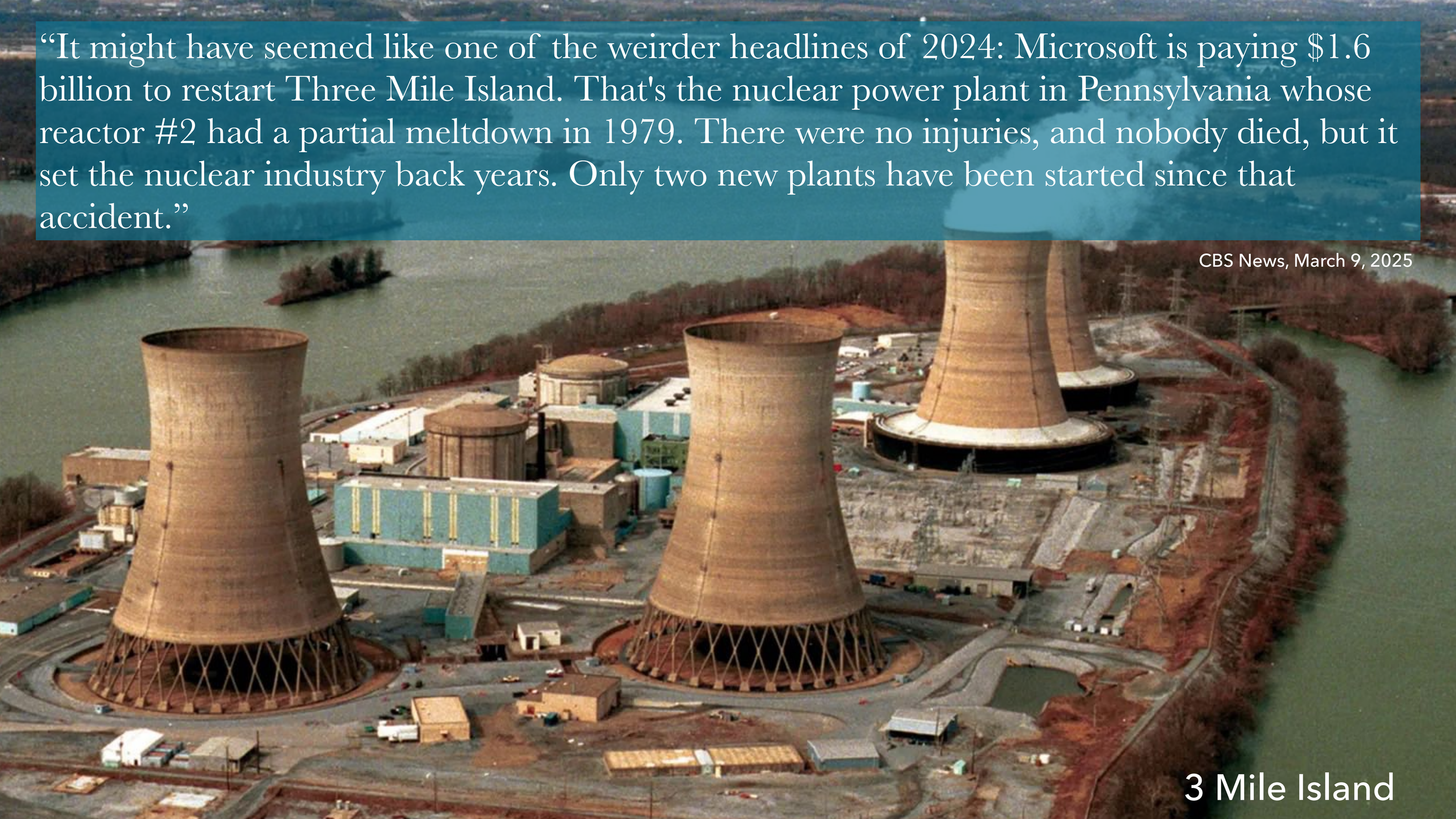
The 1,200-acre campus is directly powered by an adjacent 2.5 gigawatt (GW) nuclear power station also owned by Talen Energy.”

March 2024, https://electrek.co/2024/03/05/amazon-just-bought-a-100-nuclear-powered-data-center/

The 2GW Susquehanna nuclear power plant will provide a dedicated 960MW to a co-located data center developed by Amazon.
(March 2024).

“It might have seemed like one of the weirder headlines of 2024: Microsoft is paying $1.6 billion to restart Three Mile Island. That's the nuclear power plant in Pennsylvania whose reactor #2 had a partial meltdown in 1979. There were no injuries, and nobody died, but it set the nuclear industry back years. Only two new plants have been started since that accident.”

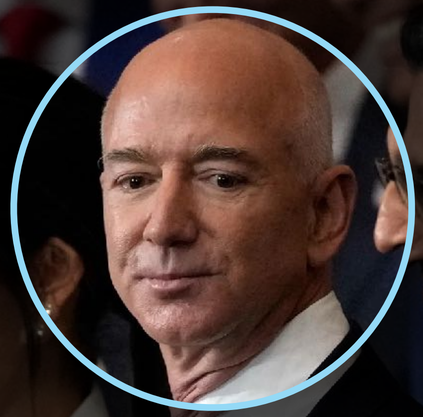
CBS News, March 9, 2025



3 Mile Island

2026

Plans 1GW Prometheus operational 2026, 5GW Hyperion after that. Total area ~ size of Manhattan



Claims 1GW cluster Colossus 2 for Grok 4 Heavy training (currently estimated to be at ~330MW based on satellite images)

SECTIONS NEW YORK POST

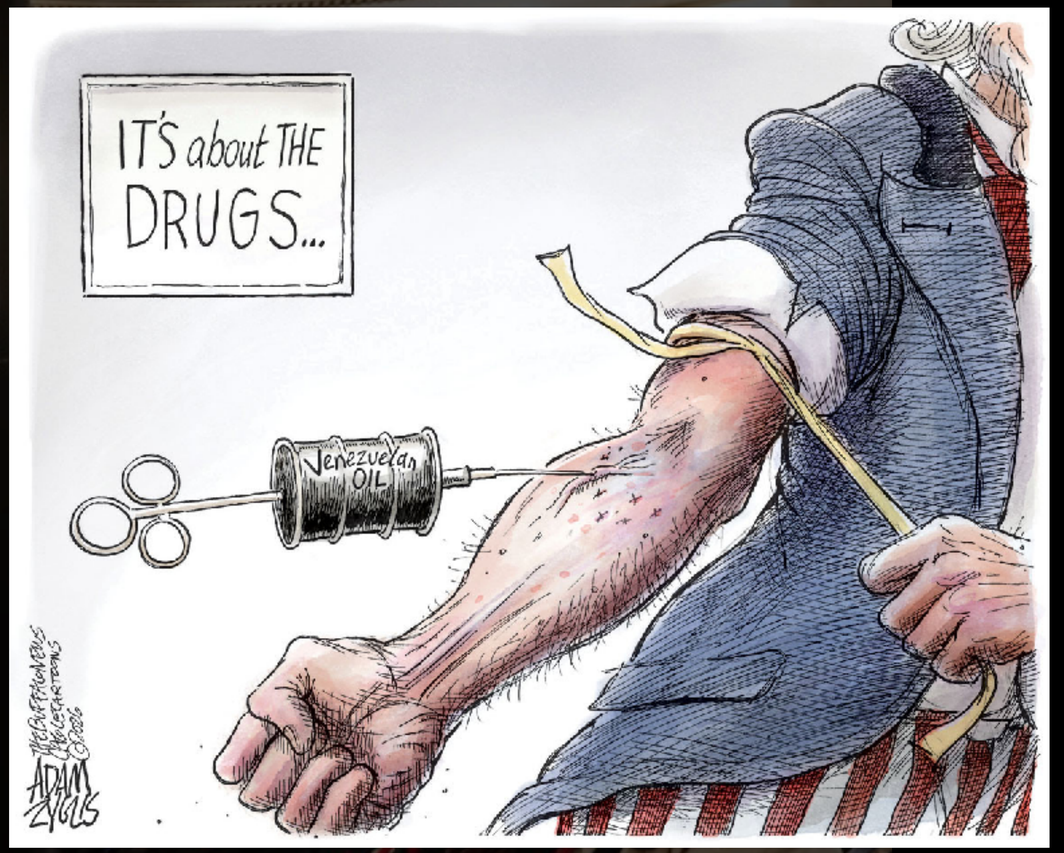
BUSINESS

Amazon planning thousands of job cuts next week after axing 14,000 due to AI: report

By Reuters

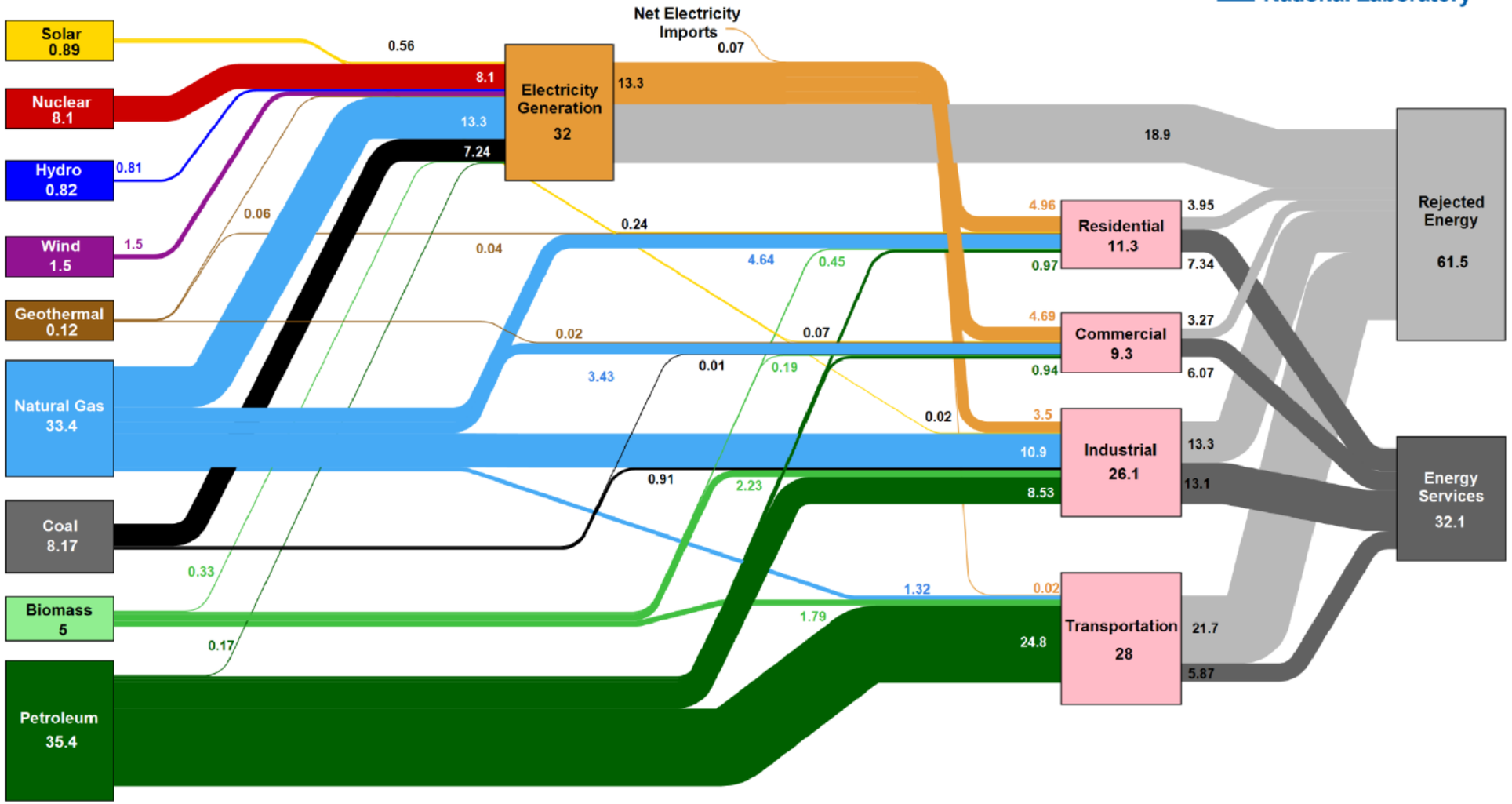
Published Jan. 22, 2026, 7:14 p.m. ET

Also - $38B deal with Open AI


IT'S about THE DRUGS...
Venezuelan OIL
ADAM ZYGLIS

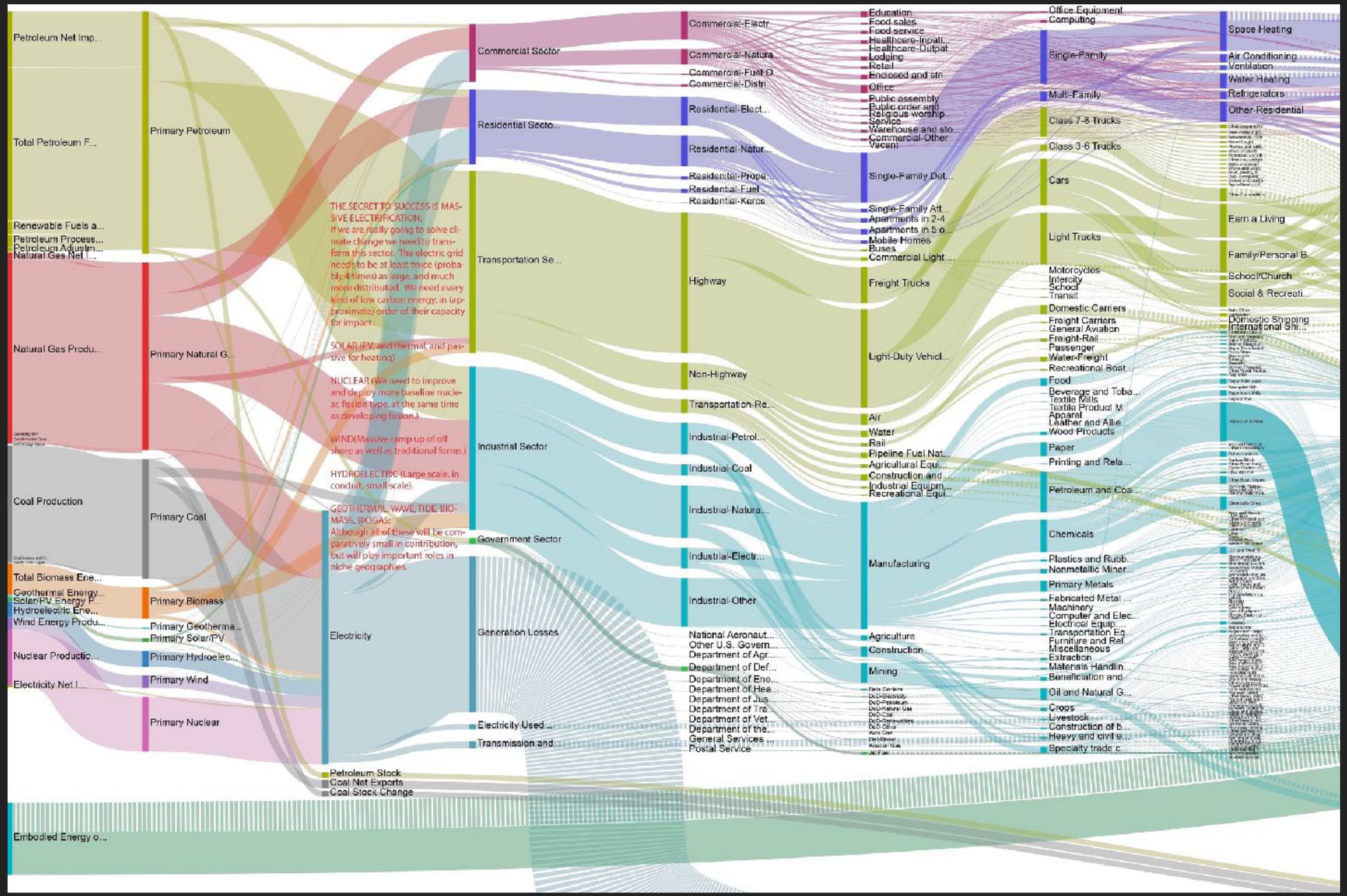
Estimated U.S. Energy Consumption in 2023: 93.6 Quads

Lawrence Livermore National Laboratory



Source: LLNL October, 2024. Data is based on DOE/EIA SEDS (2024). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant heat rate. The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential sector, 65% for the commercial sector, 49% for the industrial sector, and, 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

https://flowcharts.llnl.gov/

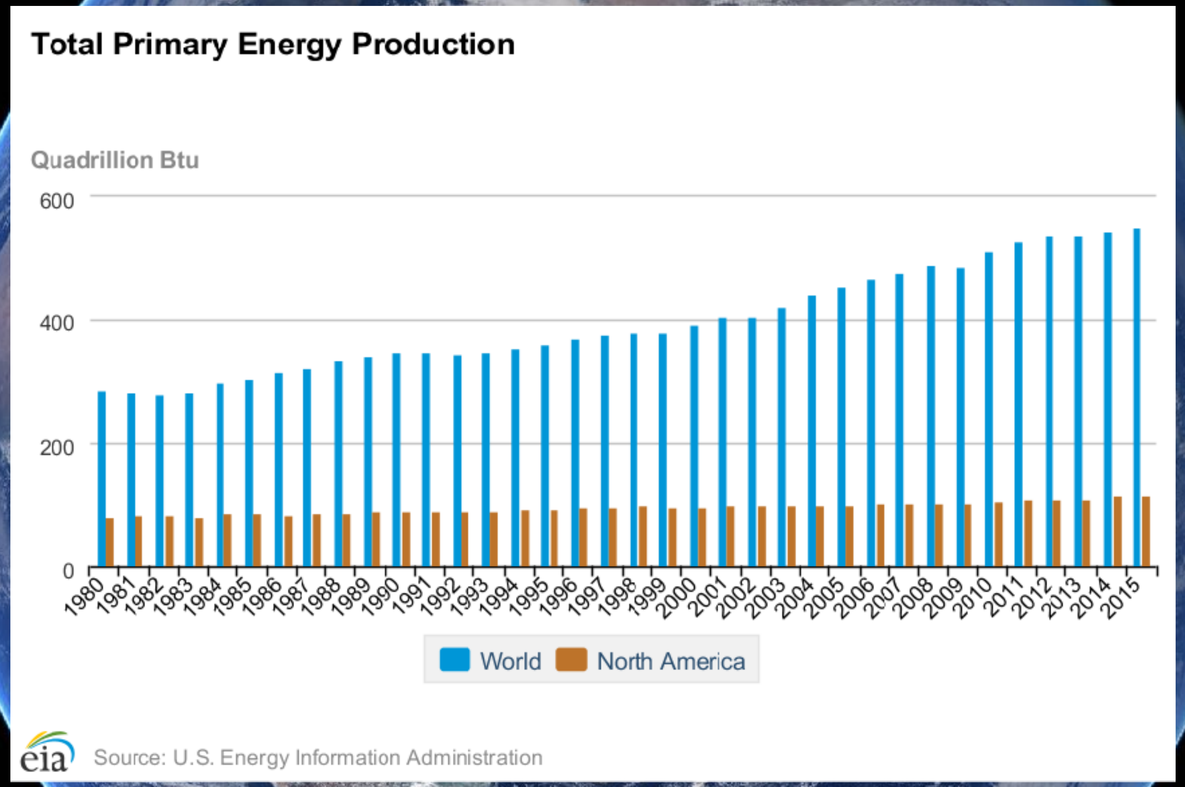


https://www.otherlab.com/blog-posts/us-energy-flow-super-sankey

http://energyliteracy.com/

TW GW MW kW W

18,000,000,000,000

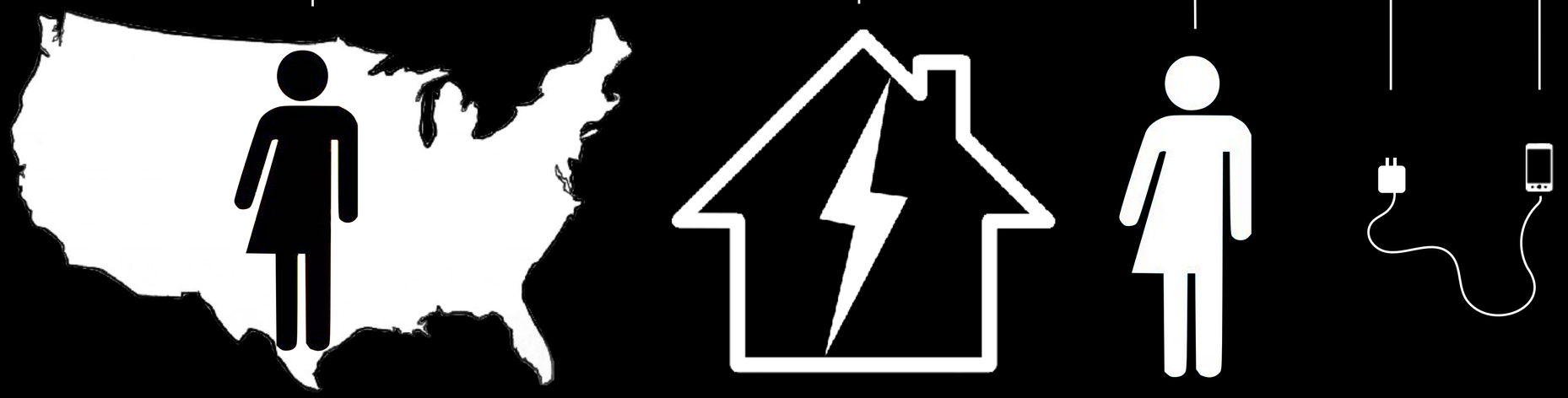


Source: EIA Total World Primary Energy Production
~550 Quadrillion BTUs / 1 year = 1.8×10^{13} Watts

See notes from MacKay and EIA on conversions when aggregating disparate energy sources.

TW GW MW kW W

18,000,000,0 10,000



Watts: 10,000 1,000 100 10 1

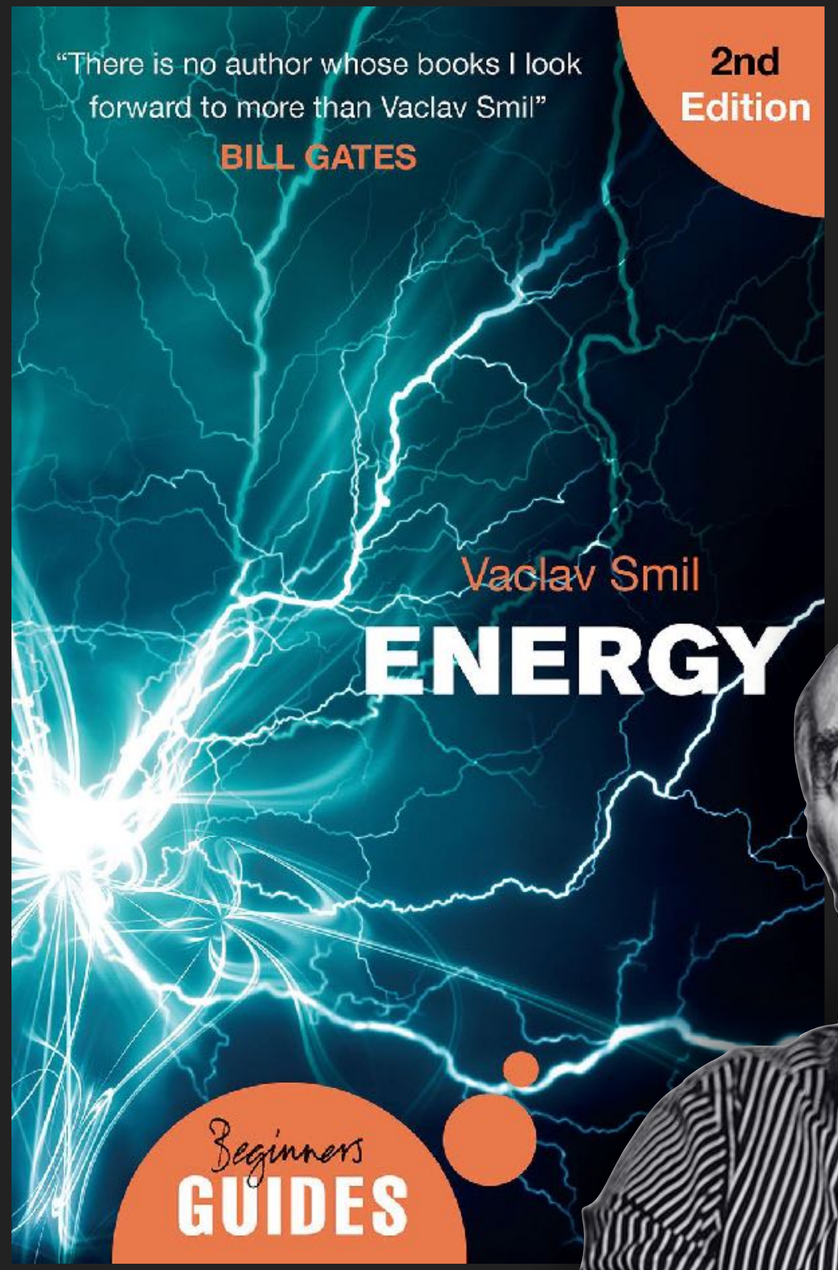
TW GW MW kW W

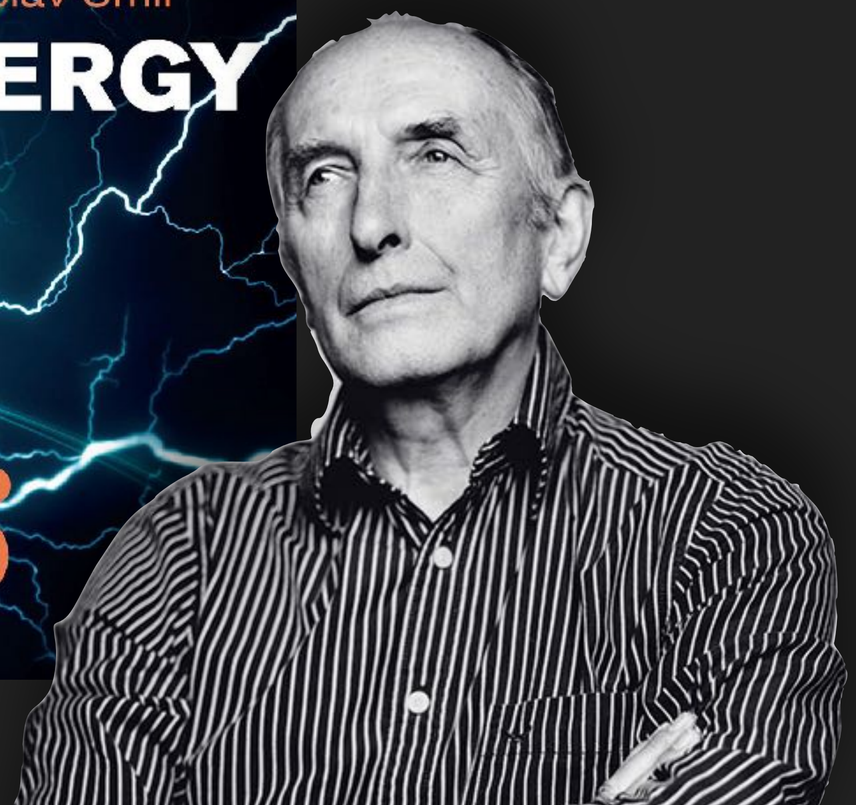
18,000,000,000,000

18TW

Feddersen
Energy NYU/ITP

COURSE TEXT

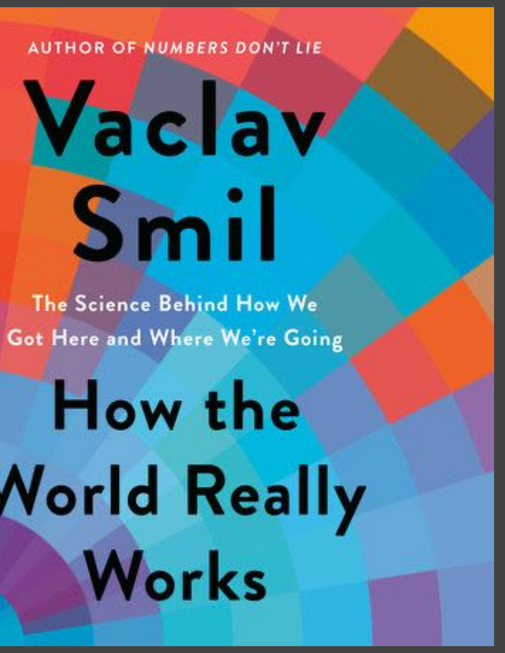


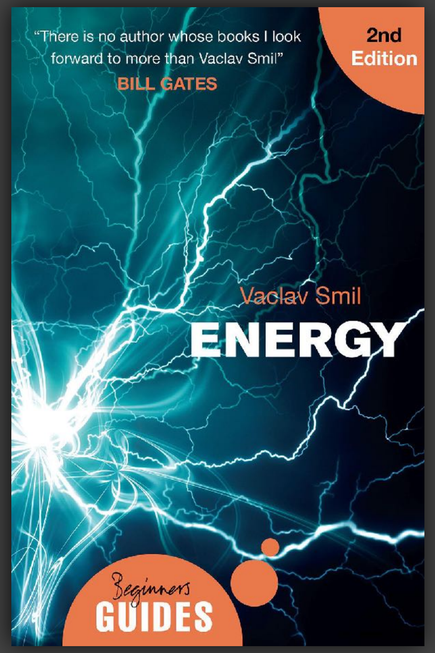


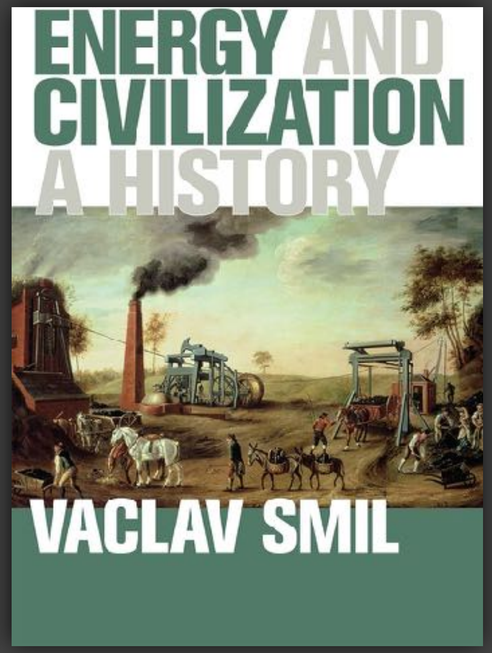
More here: https://www.fddrsn.net/teaching/energy/resources

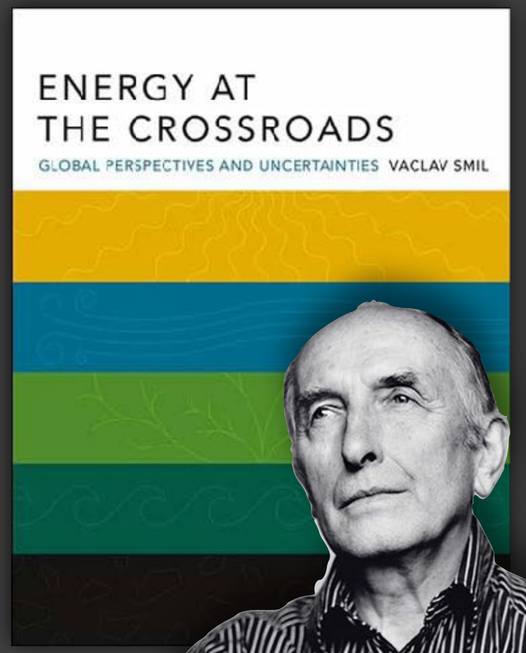
Further Resources

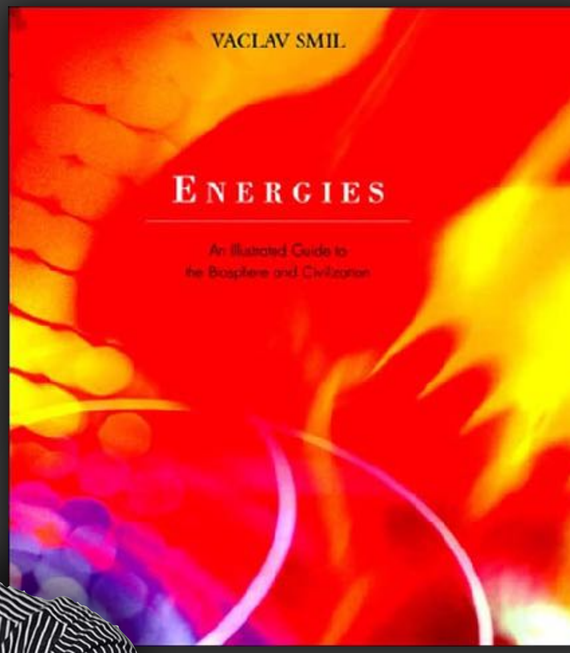
- Anything by Vaclav Smil

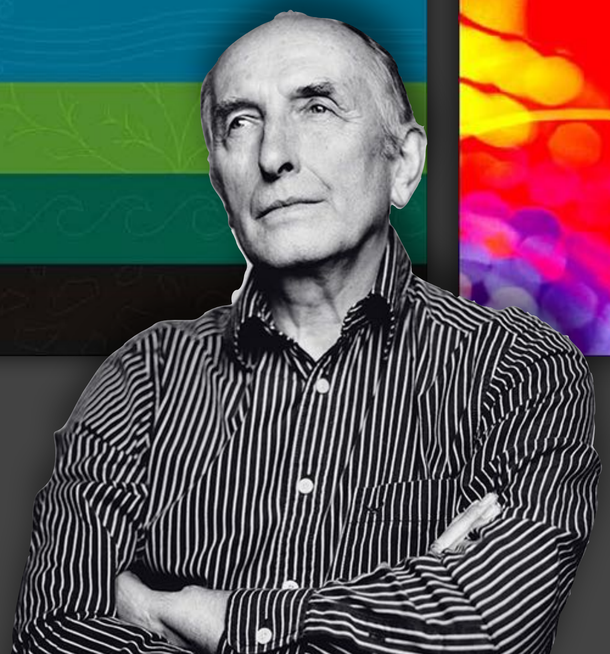






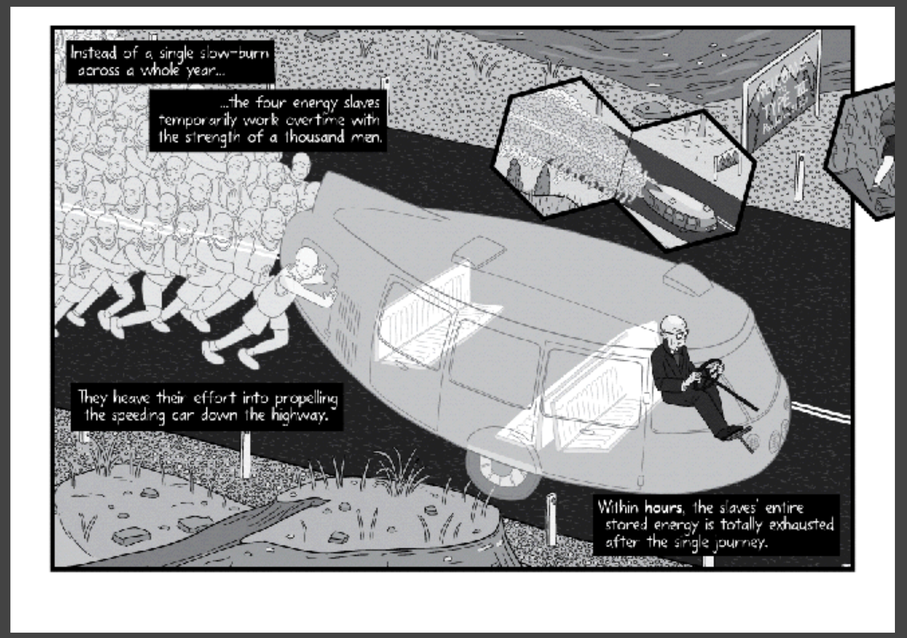


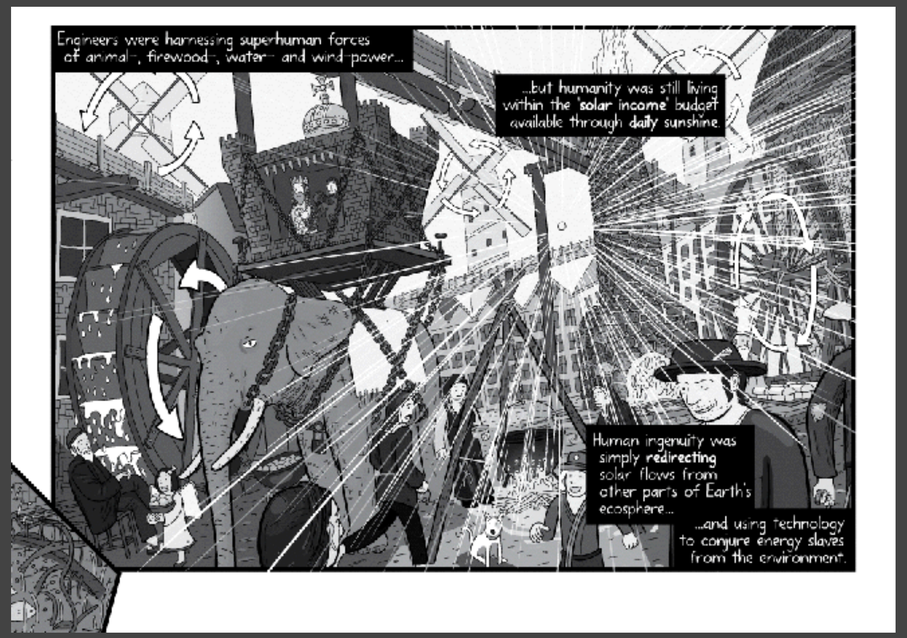




Further Resources

- Stuart McMillan on Buckminster Fuller





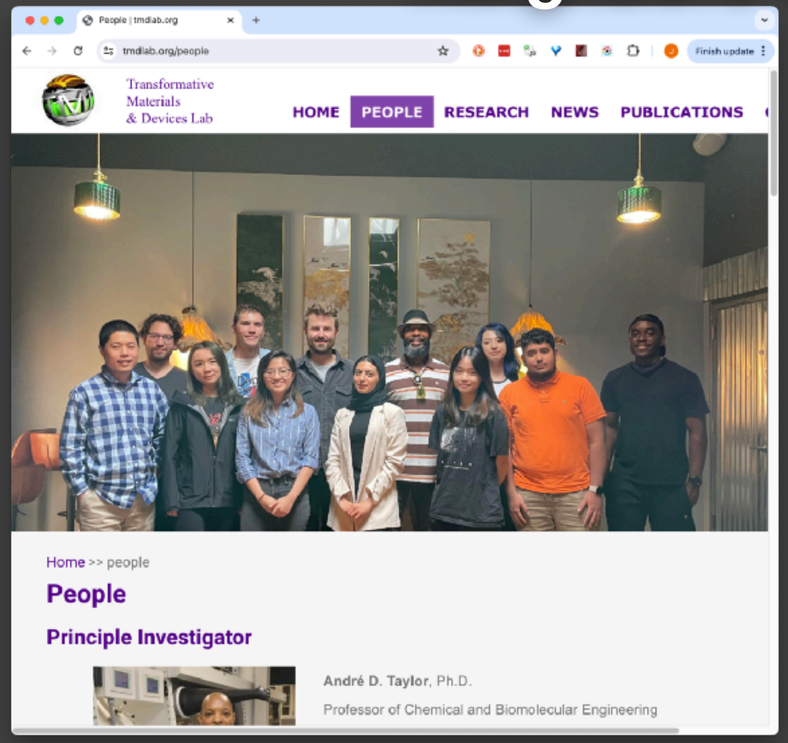
https://www.stuartmcmillen.com/comic/

Further Resources

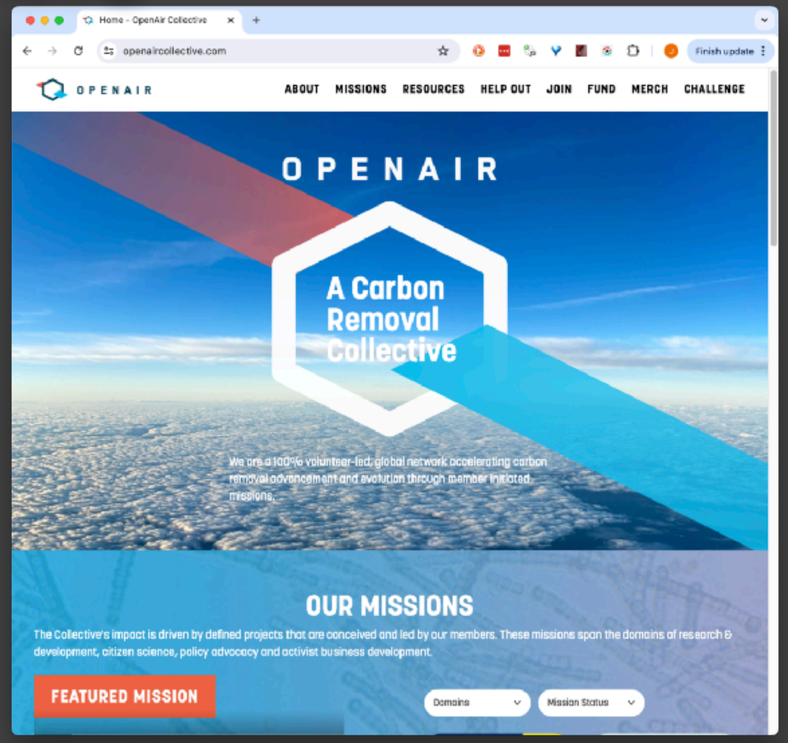
- Podcasts

Further Resources

- Neighbors at NYU



https://tmdlab.org/



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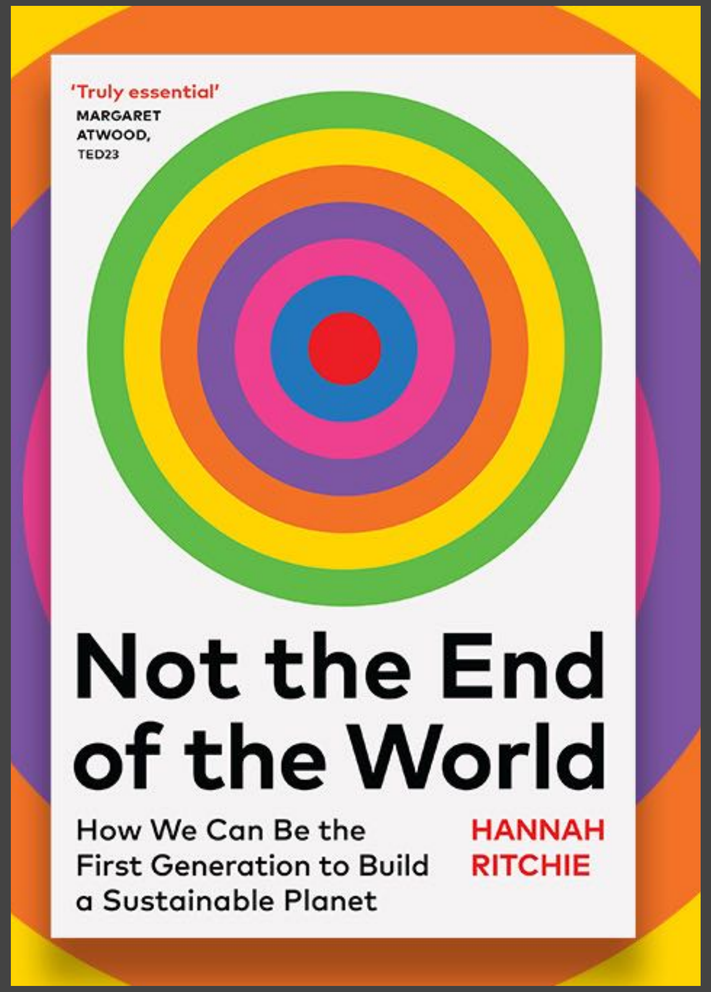
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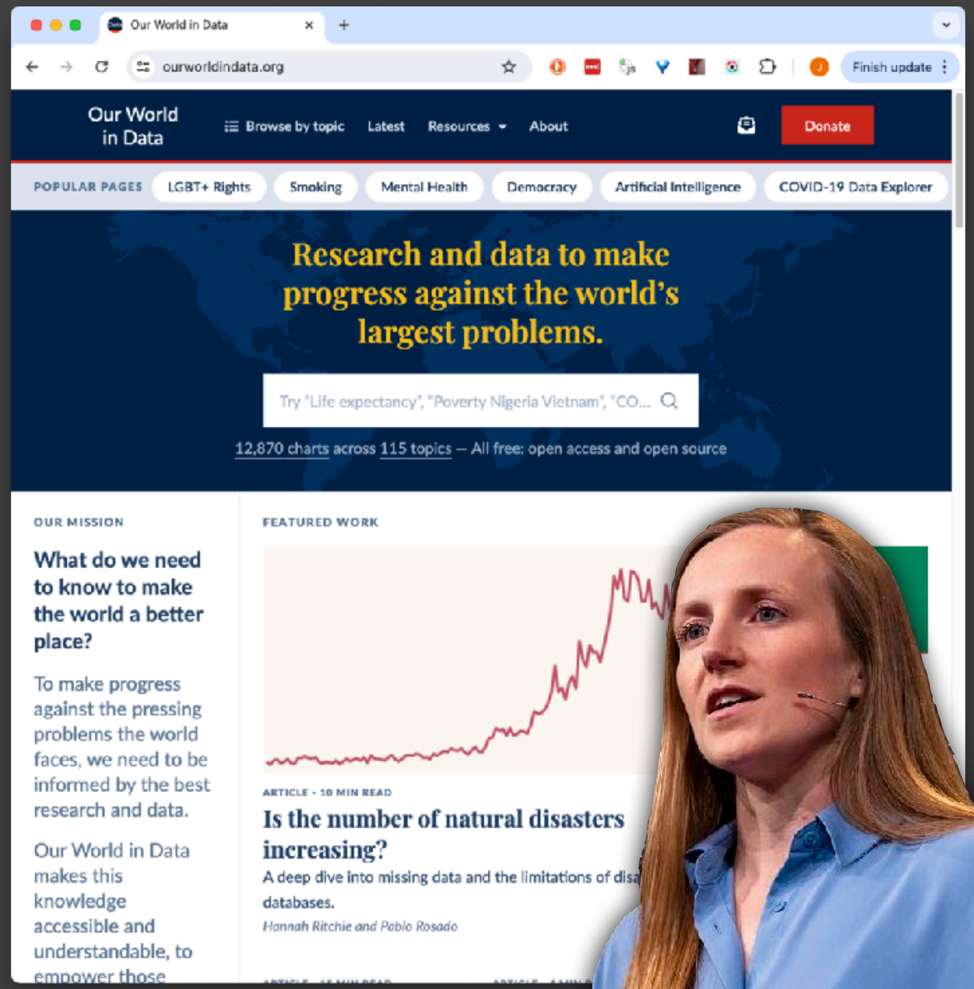
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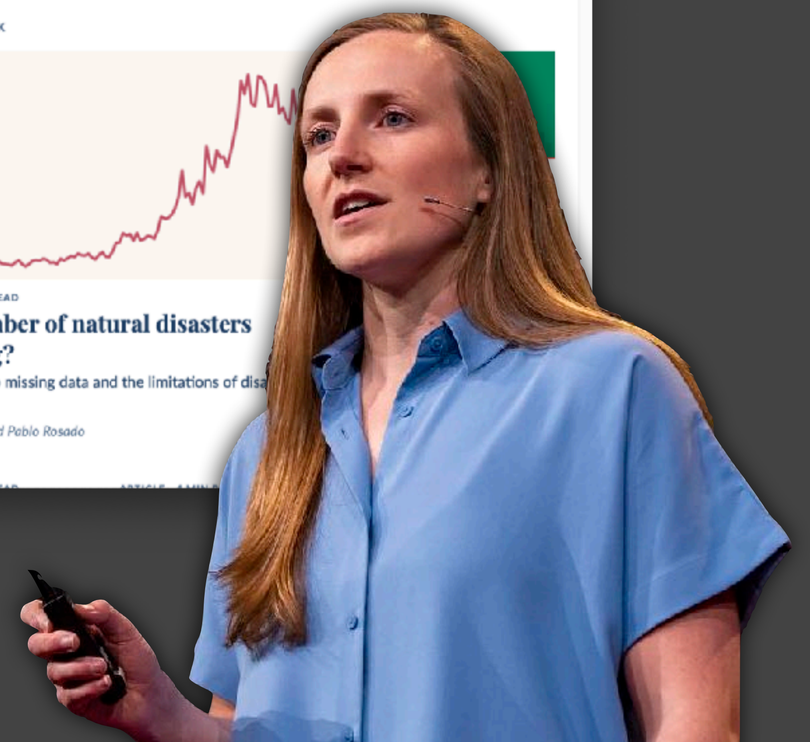

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https://www.greentechmedia.com/podcast/the-energy-gang

More here: https://www.fddrsn.net/teaching/energy/#resources

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