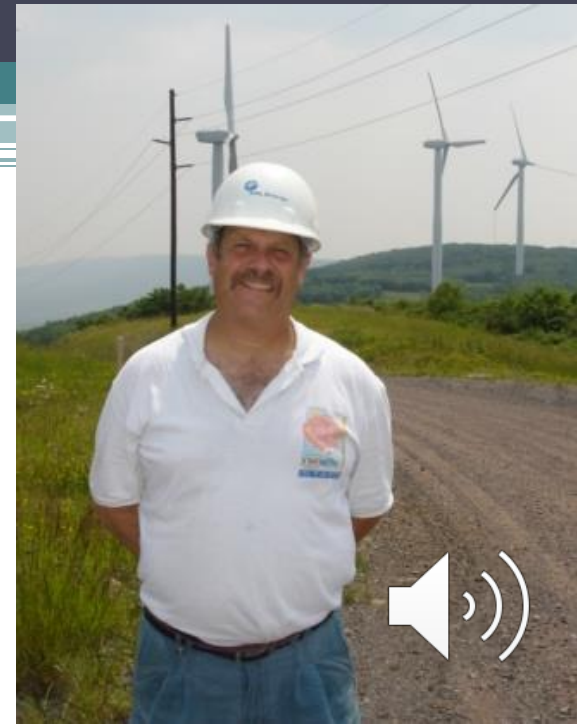


Welcome to EGY 105 - Energy in Our World:

Should renewables be an important part of the
U.S.'s goal to become “Energy Dominant?”

Kenneth M. Klemow, Ph.D.
Emeritus Professor of Biology and Earth
Systems Science



Dr. Ken Klemow



- Native of Hazleton
- Bachelor's degree in Biology: U. of Miami, 1975
- Ph.D. in Plant Ecology: SUNY-ESF, 1982
- Professor of Biology at Wilkes, 1982 – 2023
- Taught Biology, Botany, Ecology, & Energy
- Conducted research in ecological impacts of energy development
- “Retired” and moved to San Diego, May 2023



About EGY 105



- Started as FYF 101 – Alternative Energy (2007)
- Then BIO / EES 105 – EIOW (2013) F2F
- Became EGY 105 (2016)
- Went virtual Fall 2020
- Post COVID, students asked to keep it virtual
- Continued to teach it virtually after move to San Diego, 2023



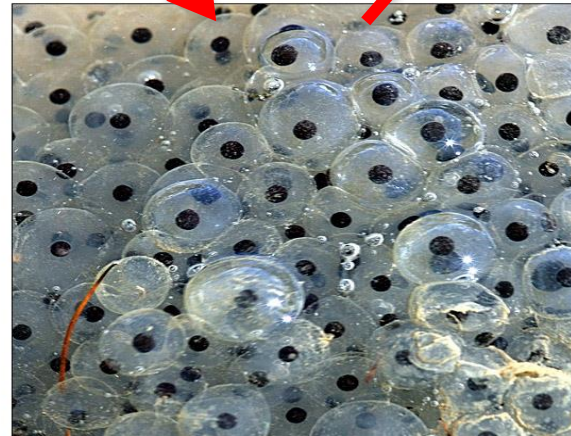
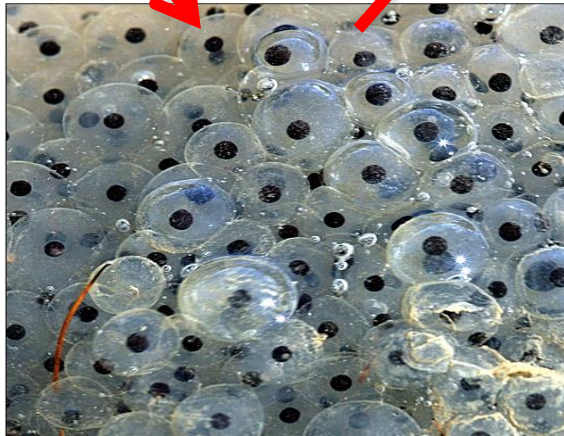
What is the purpose of life?



<http://people.eku.edu/ritchisong/>



What is the purpose of life?



How do plants and animals ensure many “grandchildren?”



<http://shelledy.mesa.k12.az.us/>



<http://www.rogerwendell.com/australia.htm>



Humans are great at modifying our environment



<http://www.nyc.gov/h>



<http://www.dot.ca.gov/hq/>



<http://www.ny.nrcs.usda.gov/>



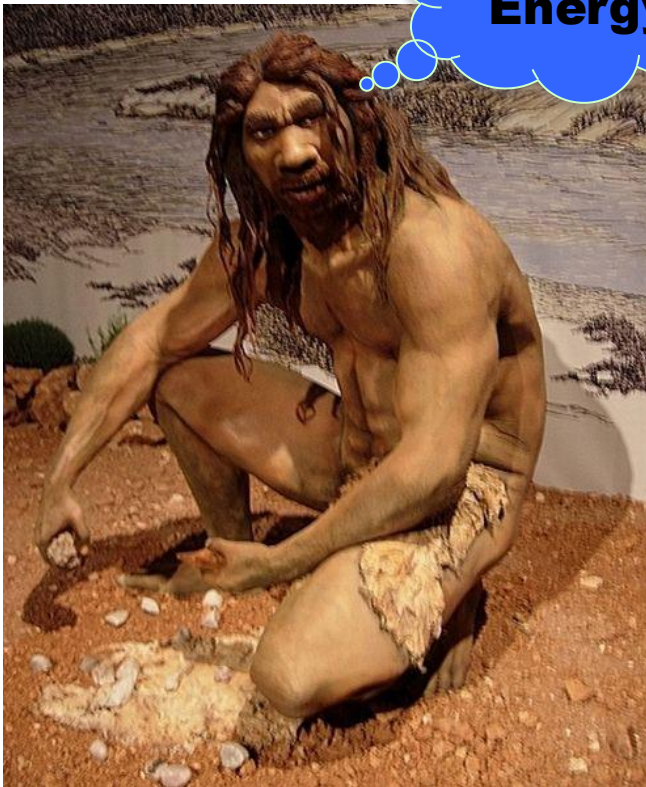


Teg (www.sxc.hu)



Securing energy has been a quest of mankind for millennia.

**Need.
Energy.**



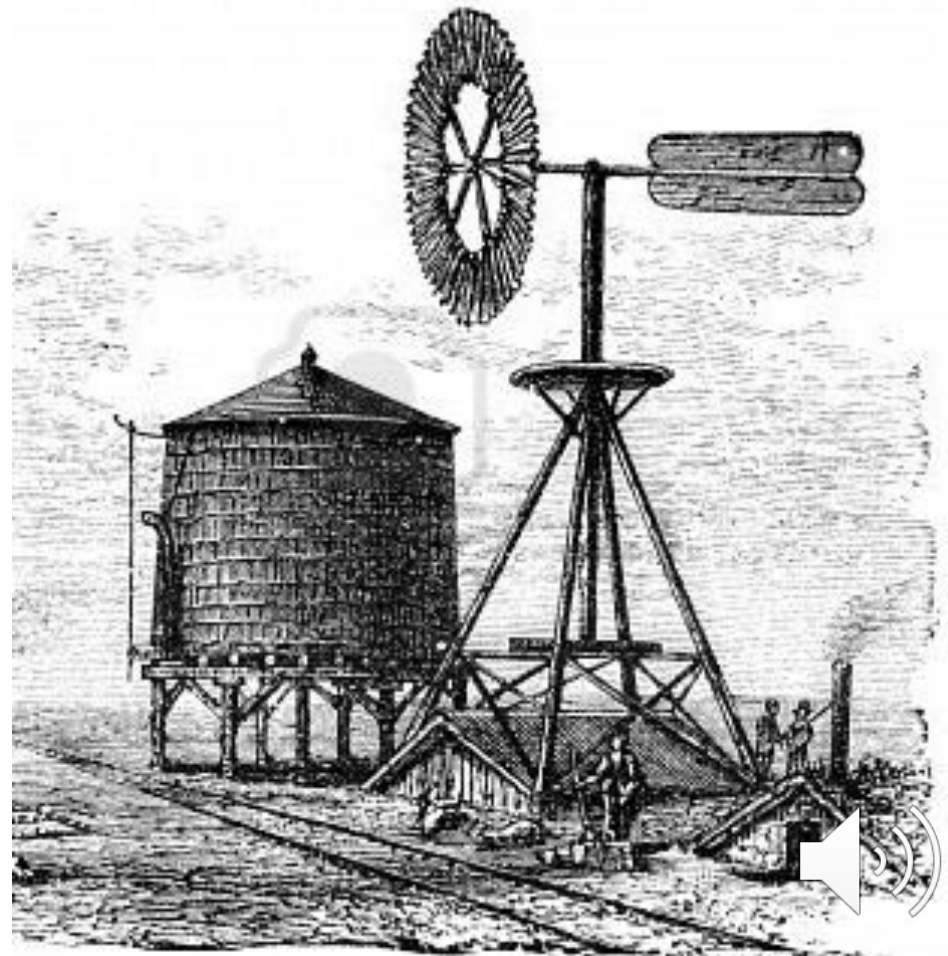
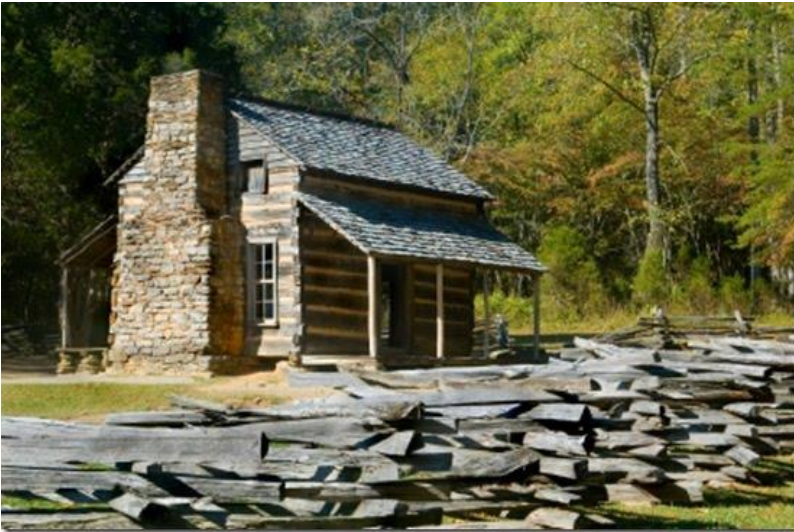
Αρι, ωε νεεδ
ενεργψ.



My empire for
energy.



Before 1880s, energy use small scale



Beginning in 1880s, energy scaled up



<http://fineartamerica.com/featured/market-street-manchester--1890-ronald-haber.html>



<http://www.petroleumhistory.org/CivilHistory/pages/Columbia/W>

In past century, we have become reliant on centralized energy generation



<http://12degrees.com>



<http://wonderstube.com/world-wonders/>



U.S. success in first half of 20th century due to coal



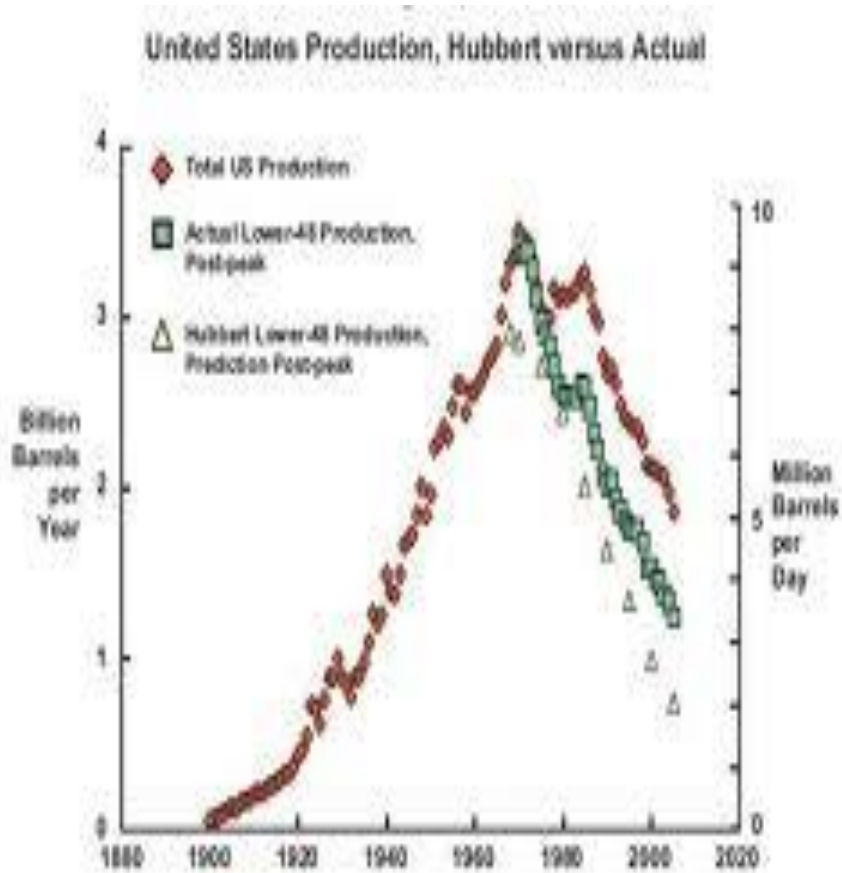
<http://info.heylopatterson.com/>



After World War II, other fuels supplanted coal



Optimism ended in 1970s



Source: Cambridge Energy Research Associates
6/10/12-1



A national debate erupted

Let's conserve
energy

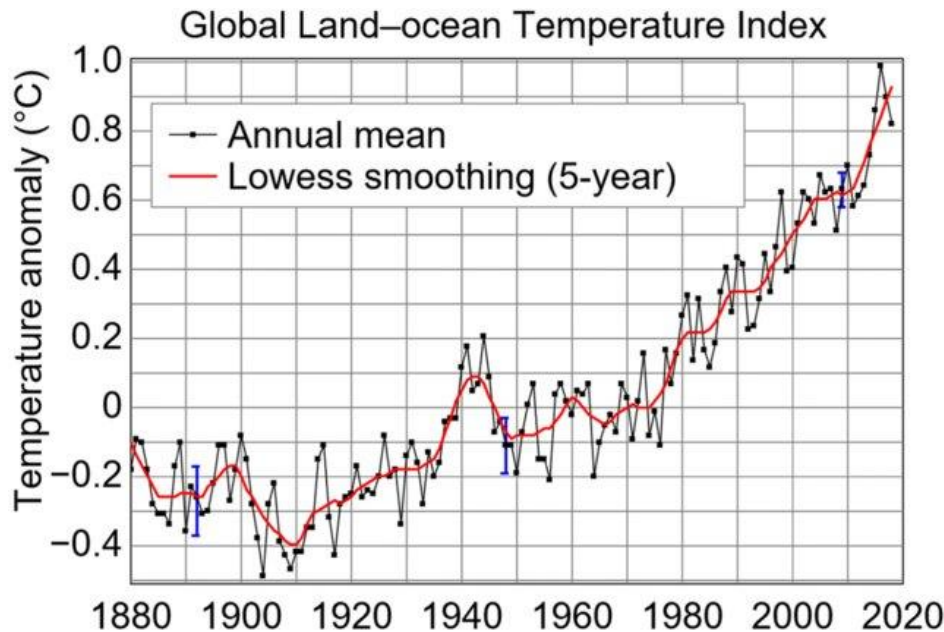


Ain't no gas
shortage,
hippie!

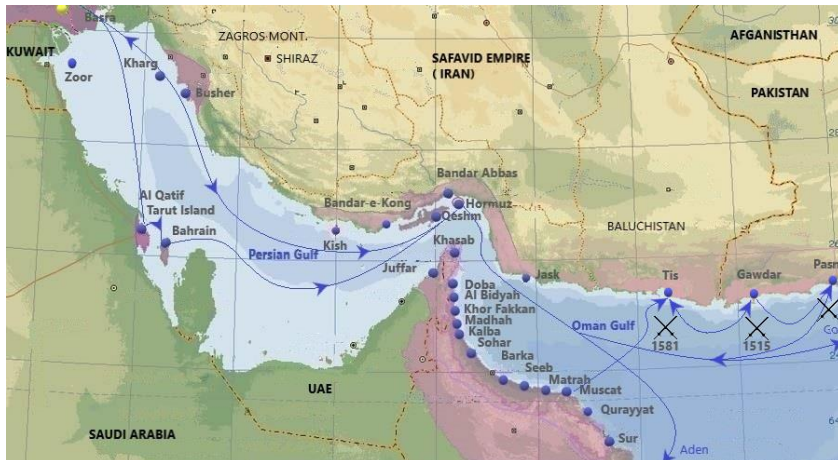
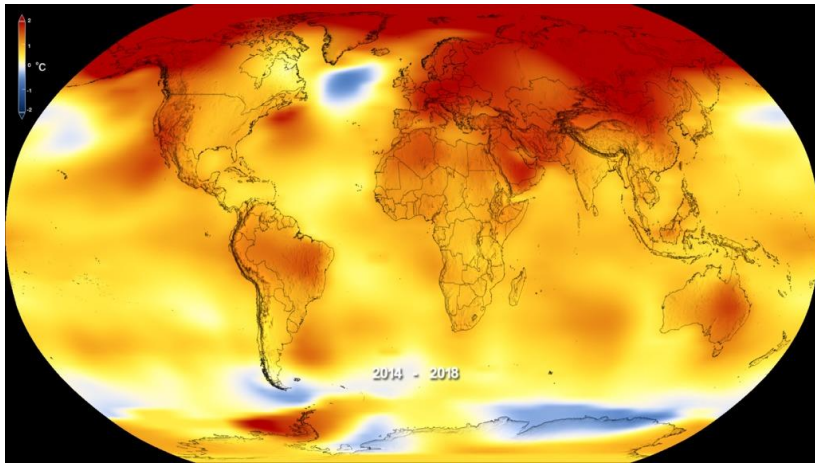


Energy debate rages on

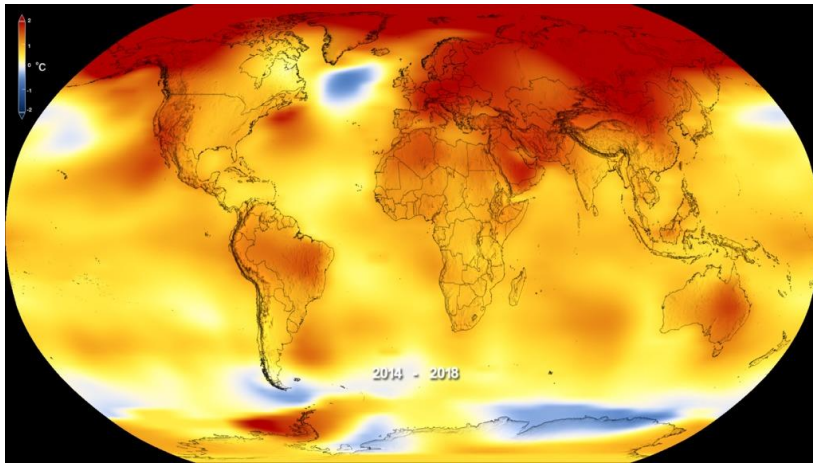
- Influences foreign policy of many nations
- Concerns over global climate change
- Concerns over nuclear waste disposal



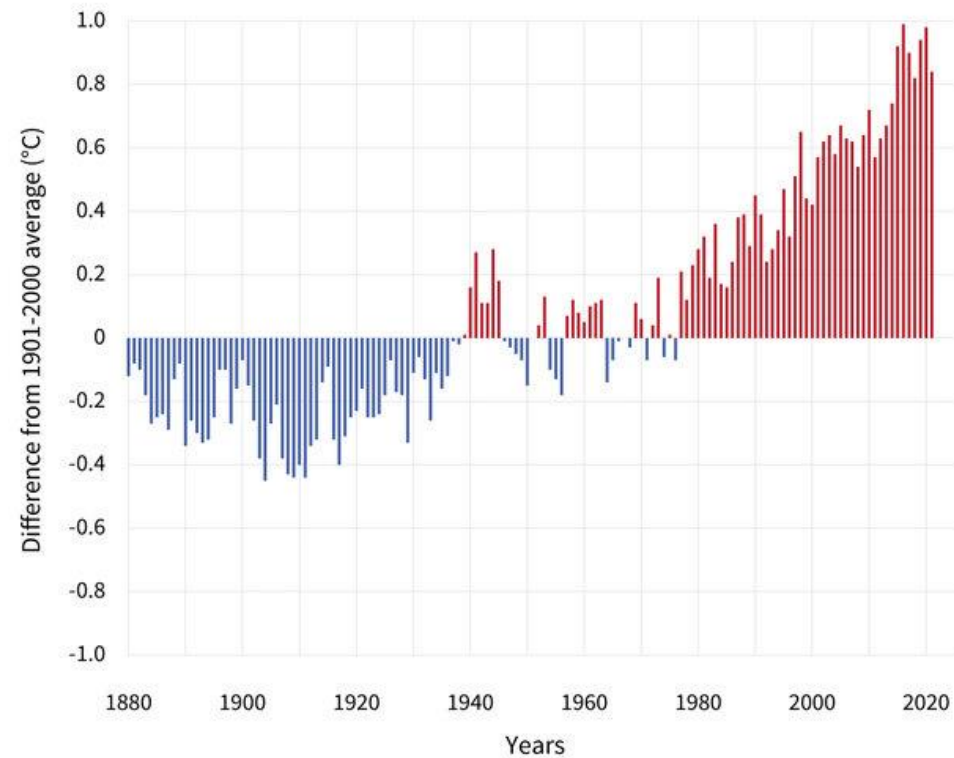
Energy is a hot topic in the news



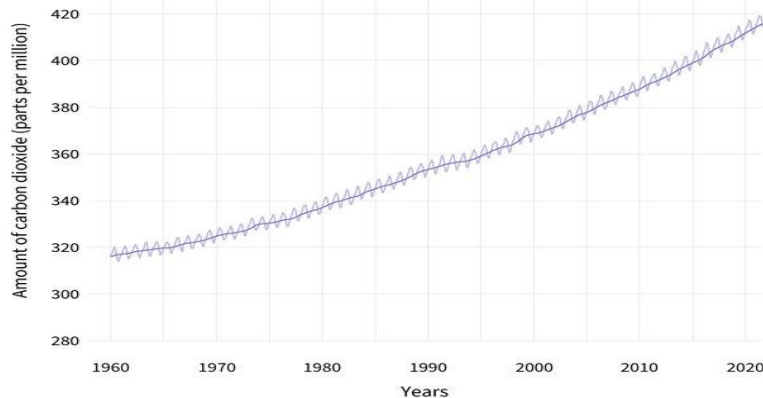
Climate change is real



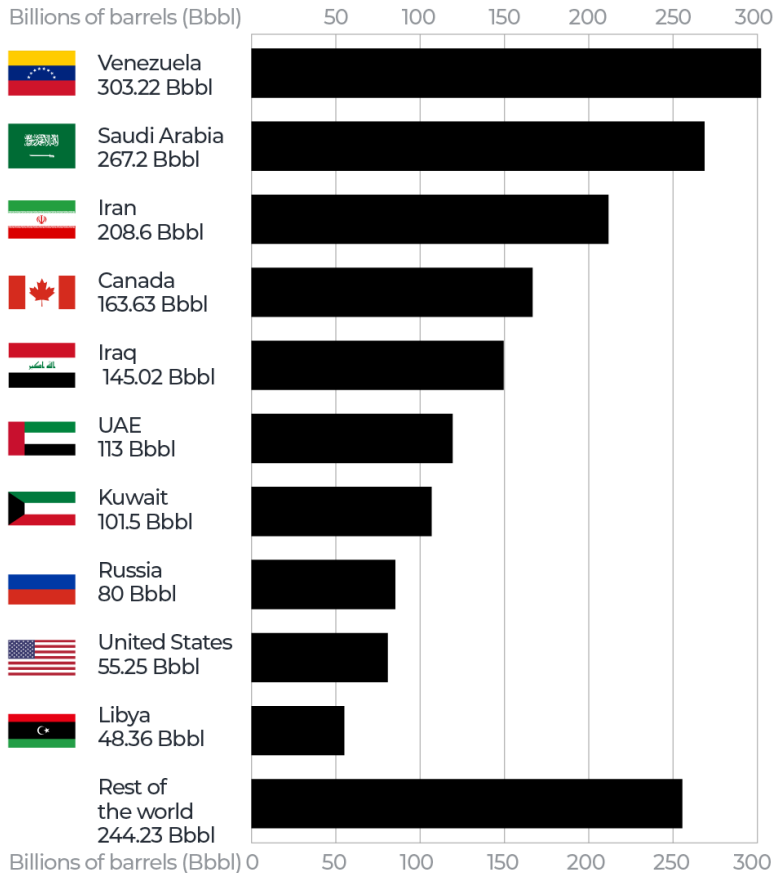
GLOBAL AVERAGE SURFACE TEMPERATURE



ATMOSPHERIC CARBON DIOXIDE (1960-2021)



Takeover of Venezuela Petroleum



Source: Oil & Gas Journal, 2023 Worldwide Reserves and Production | September 4, 2025 @AJLabs



ALJAZEERA



War with Iran



<https://news.az/news/hormuz-crisis-dozens-of-tankers-trapped-in-gulf-but-still-insurable>



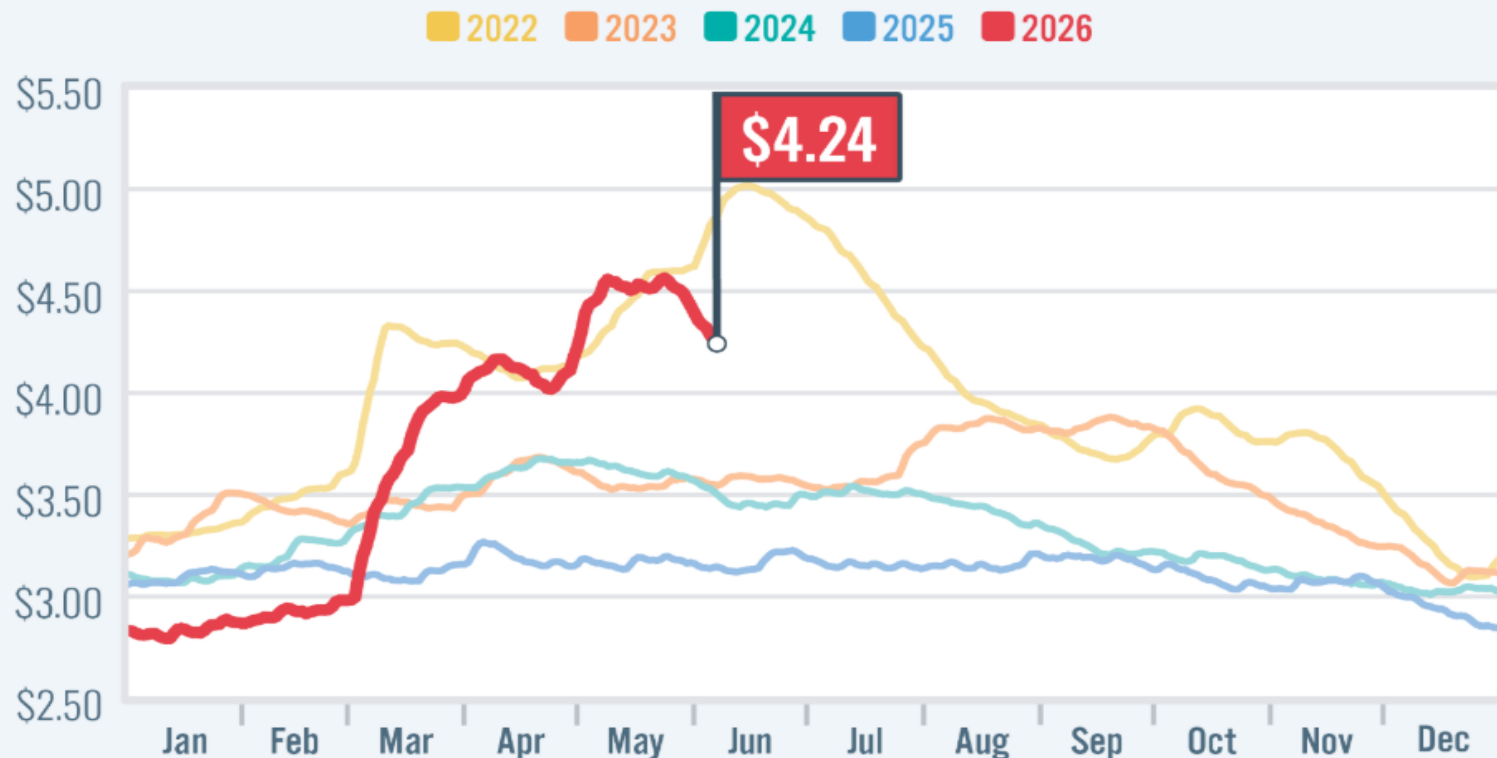
<https://www.pbs.org/newshour/world/tankers-struck-near-strait-of-hormuz-amid-iran-u-s-tensions>



Fluctuating / high energy prices

NATIONAL GAS PRICE COMPARISON | 2022-2026

06/04/26



Prices are per gallon for regular unleaded gasoline.

Source: AAA (GasPrices.AAA.com)



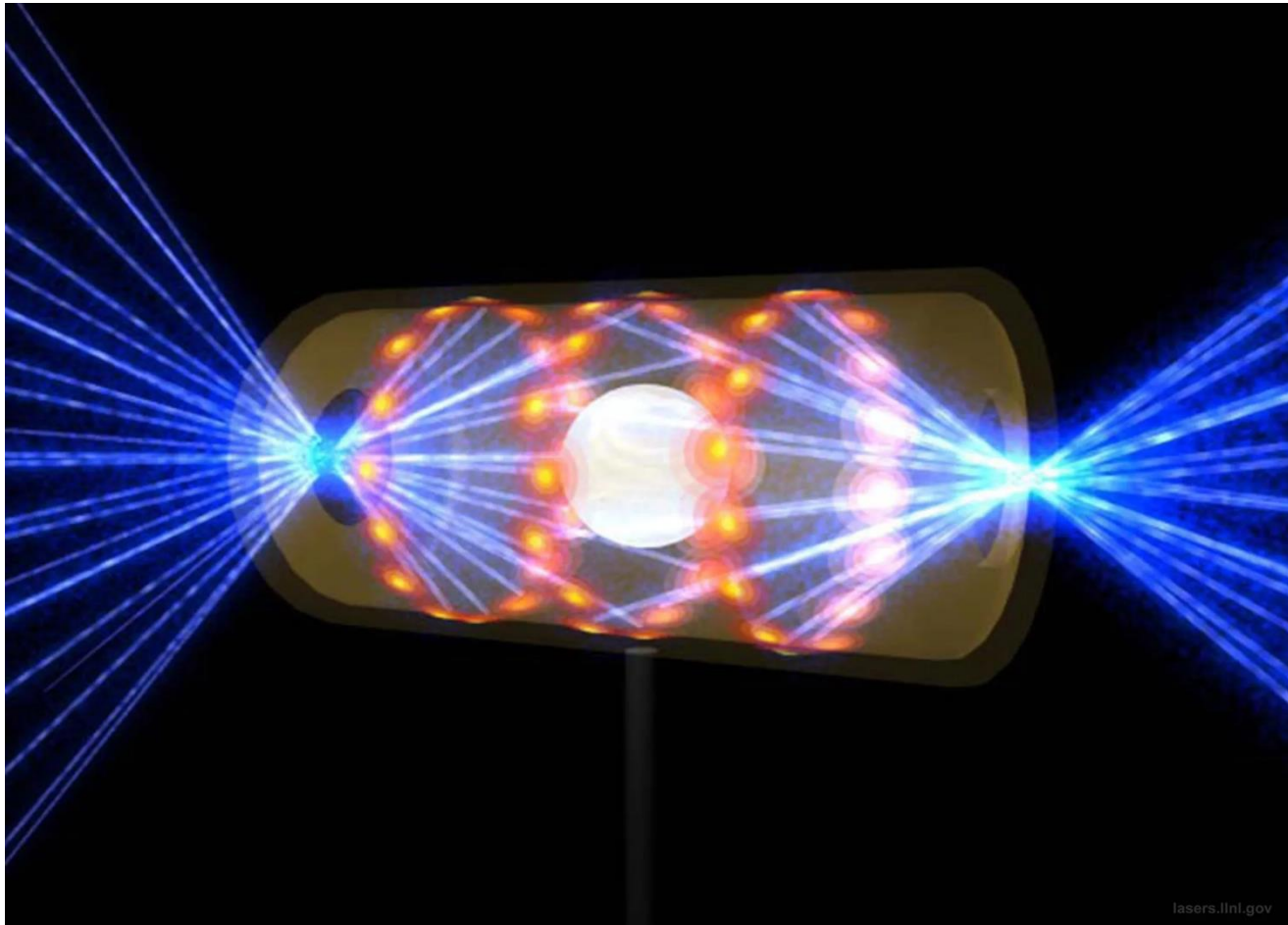
Energy infrastructure targeted during war



<https://www.newscientist.com/article/2443623-russian-occupied-ukrainian-nuclear-plant-at-risk-warn-former-workers/>



Will nuclear fusion be your future?



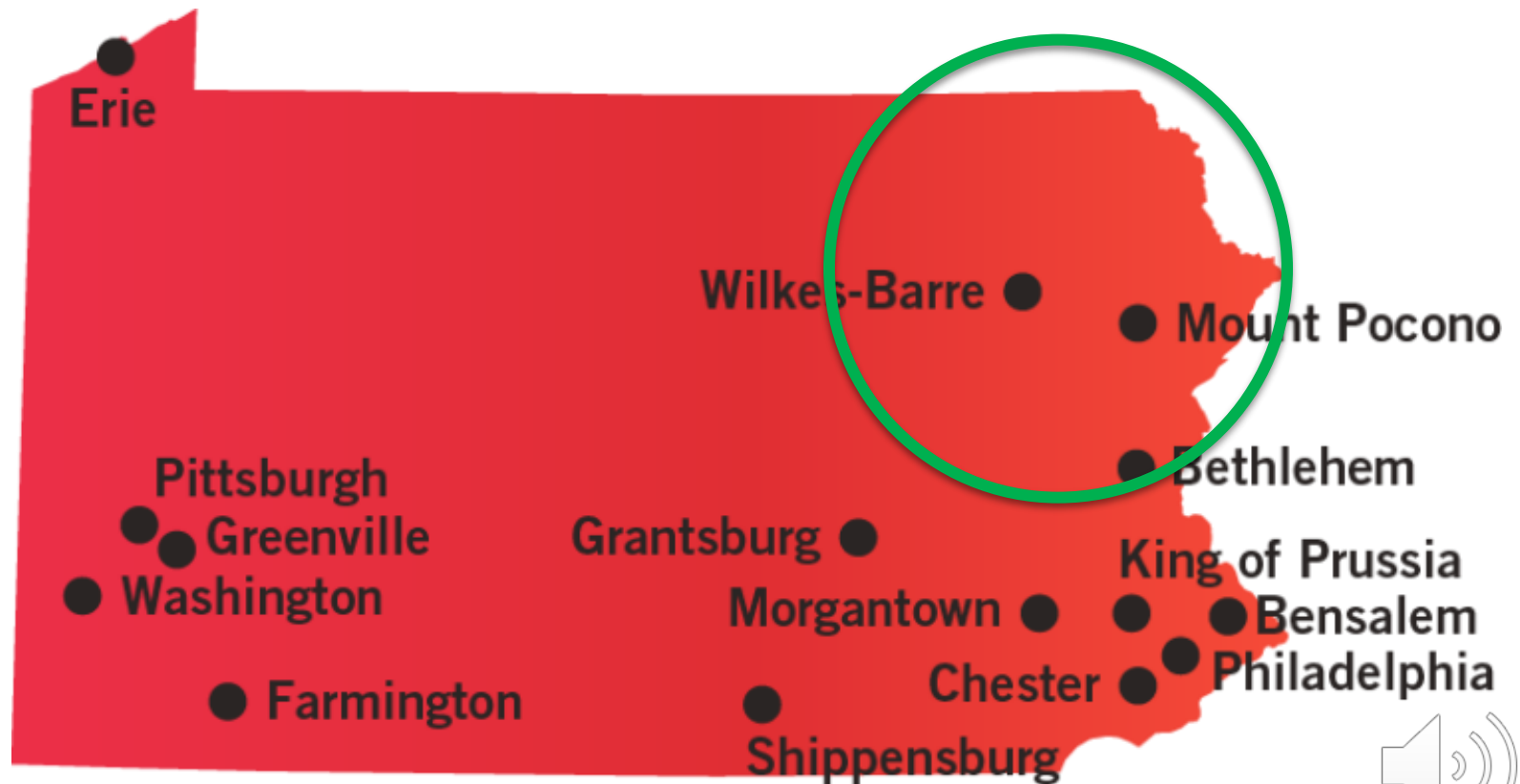
<https://www.newyorker.com/news/daily-comment/the-fusion-breakthrough-suggests-that-maybe-someday-we'll-have-a-second-sun>



California wildfires!



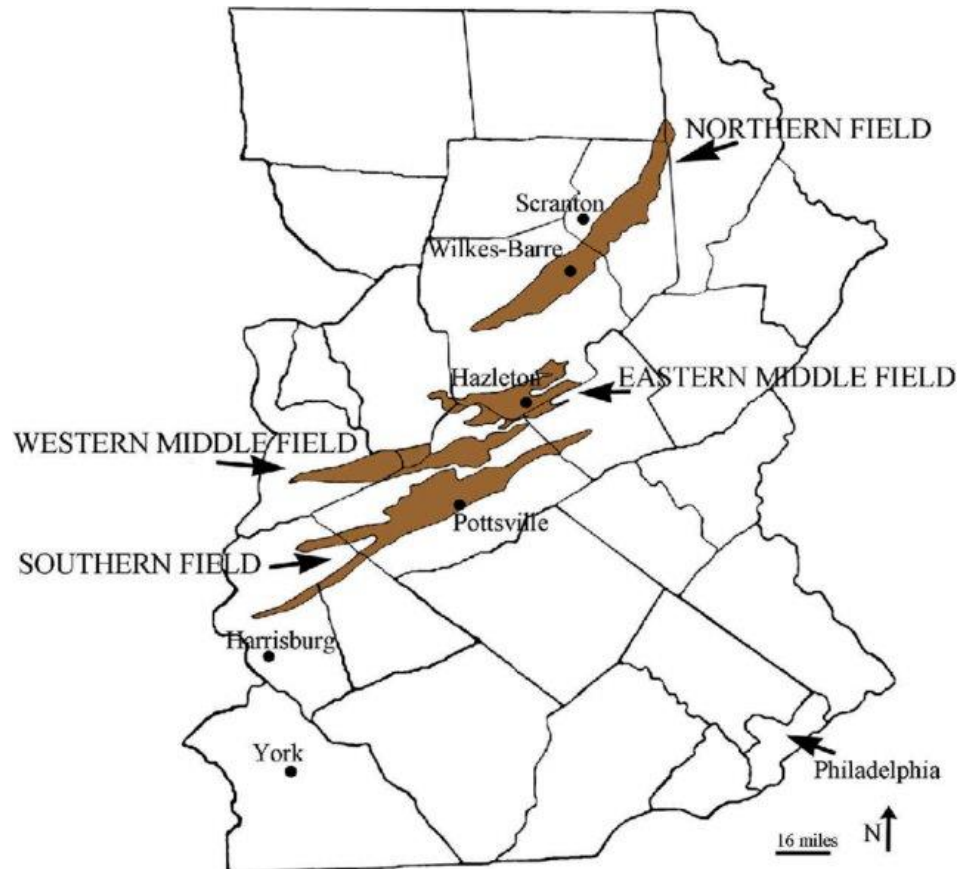
Northeastern Pennsylvania has significant energy history



Anthracite coal deposits



<https://www.wjct.org>



https://www.researchgate.net/publication/327657497_Structural_violence_and_the_industrial_landscape/figures?lo=1



Discovery in Wilkes-Barre

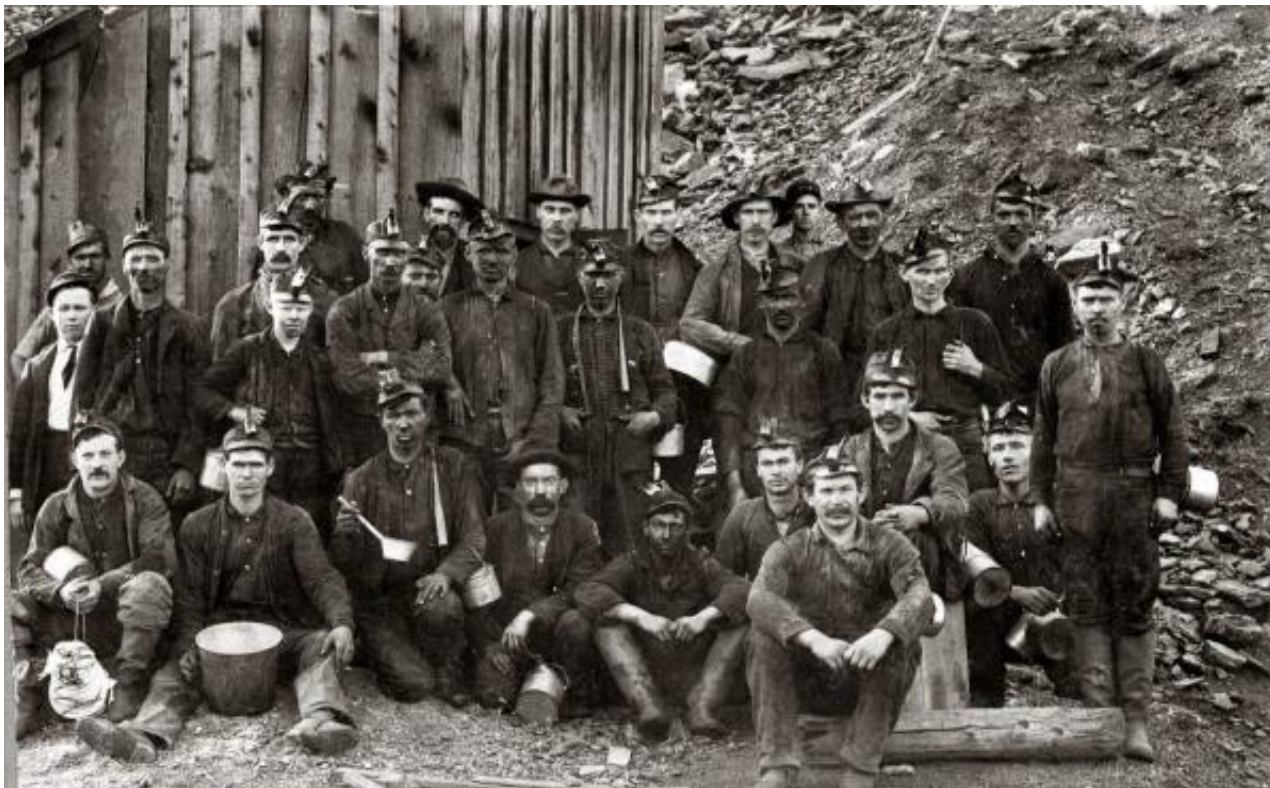


<https://patrickmurfins.blogspot.com/2016/02/jesse-fells-lit-fire-that-changed.html>



<https://www.wikitree.com/>

A mighty industry arose



<https://rohrbachlibrary.wordpress.com/2011/02/11/anthracite-pa-2/>

Anthracite miners near Hazleton, PA, circa 1900



Legacy of coal mining



<https://www.flickr.com/photos/hankrogers/2332241341>

Culm bank in Swoyersville, PA



<https://www.researchgate.net/publication/263350847>

Mine drainage near Nanticoke, PA



But that legacy is being repaired



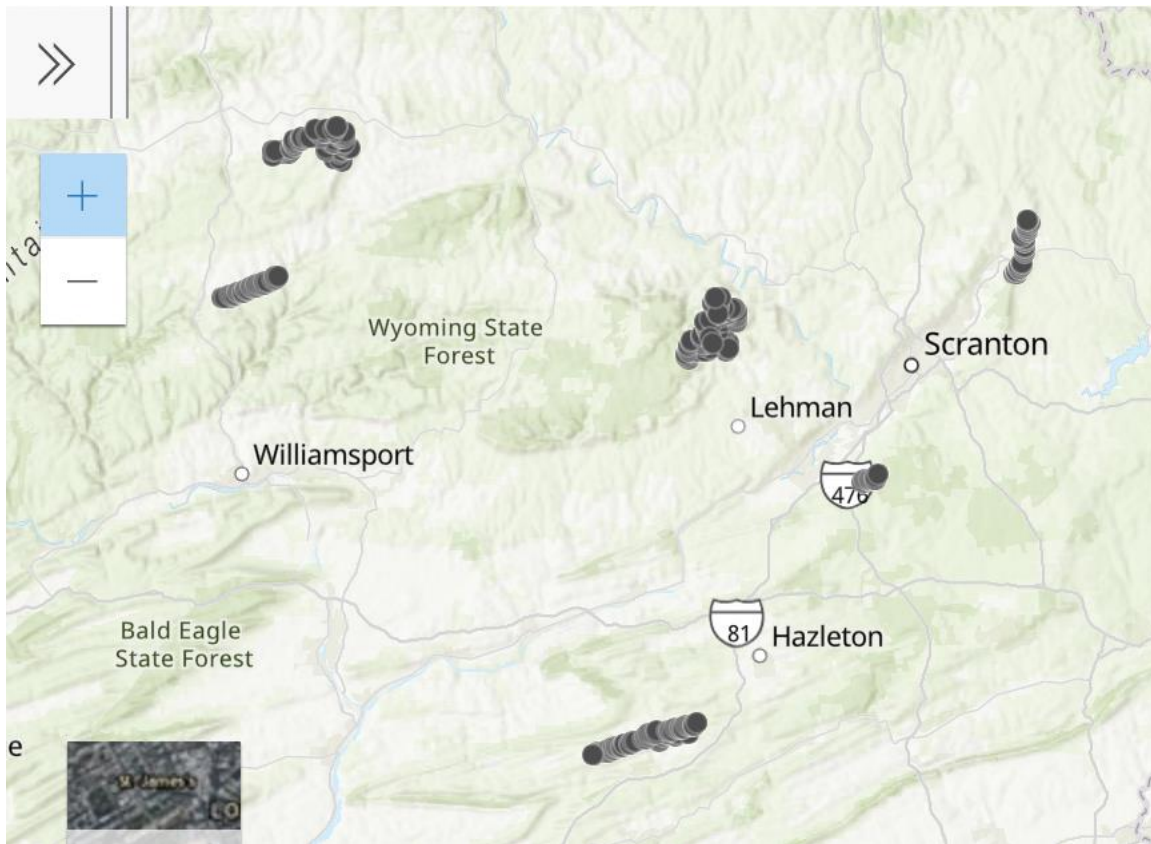
Unreclaimed site near Nanticoke, PA



Reclaimed site near Nanticoke, PA



Wind Power in NEPA

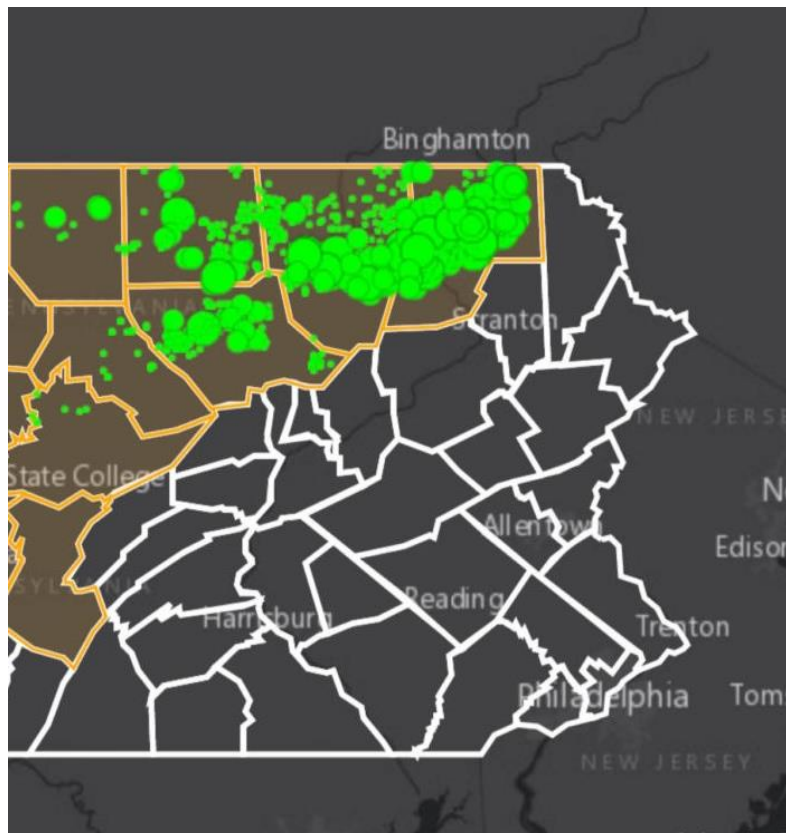


<https://www.francis.edu/wind-energy-in-pennsylvania#pa%20wind%20farms>



https://en.wikipedia.org/wiki/Wind_power_in_Pennsylvania

Fracking for Natural Gas in NEPA



<https://www.fracktracker.org/2020/01/>



<https://www.farmanddairy.com/>



Solar in NEPA?



<https://www.wesa.fm/>



<https://www.citizensvoice.com/news/hearing-on-solar-farm-proposed-in-lehman-twp-continued-to-monday/>



Data centers - huge energy users

- Large banks of computers, used for
 - Cloud storage
 - Financial transactions
 - Artificial Intelligence
- In US, they consume 4.4% of all electricity
 - Growing to 7-12% by 2028
- In NEPA, about a dozen data centers planned
 - Use electricity generated from nuclear, natural gas, and other sources.



Talen / Cumulus



Energy classification



Fossil fuels



- Account for >90% of energy
- Based on carbon
 - Ancient photosynthesis
- Critics argue against climate change, habitat destruction, limited nature



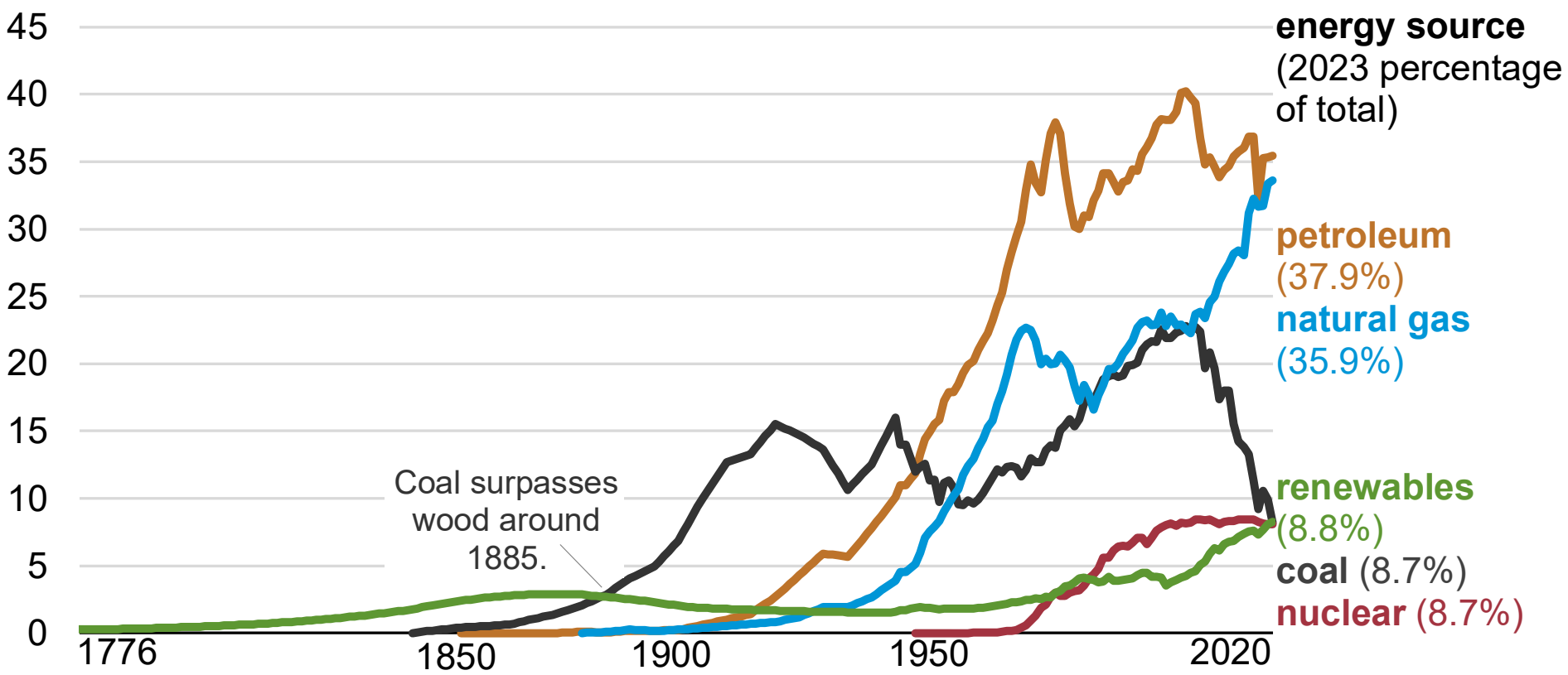
Non-fossil fuels (renewables)

- Account for <10% of energy
- Each has own drawback
- Critics argue against poor energy density, unreliability, yield



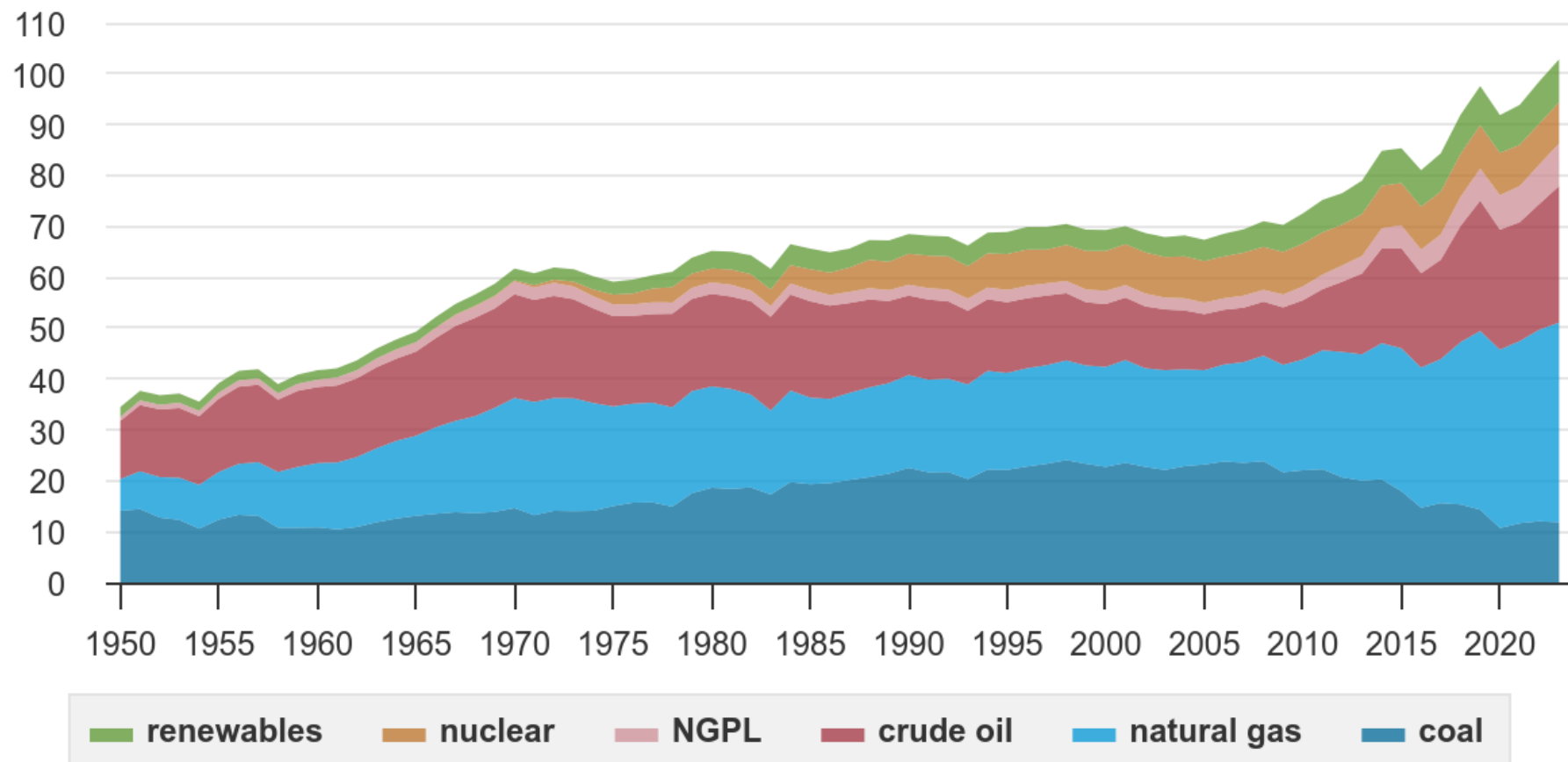
Annual U.S. energy consumption (1776–2023)

quadrillion British thermal units



U.S. primary energy production by major sources, 1950-2023

quadrillion British thermal units



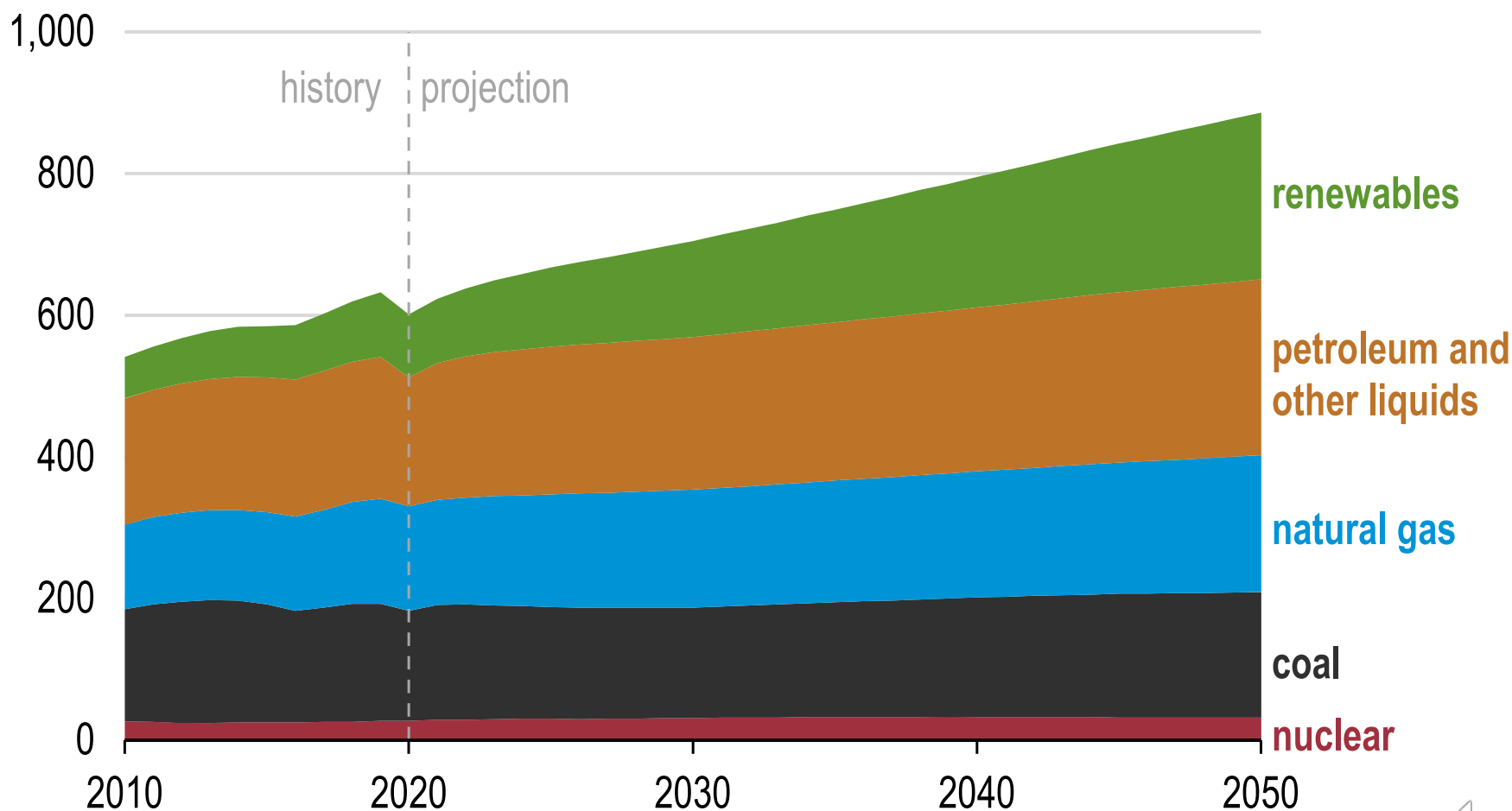
Data source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.2, April 2024, preliminary data for 2023

Note: NGPL=natural gas plant liquids



Global primary energy consumption by energy source (2010–2050)

quadrillion British thermal units



<https://www.eia.gov/todayinenergy/detail.php?id=49876>



Every energy form has benefits and drawbacks

Form	Benefits	Drawbacks
Coal	Abundant, cheap, high energy density	GHG impacts, habitat destruction
Oil	High energy density, flexible	GHG impacts, foreign policy concerns
Conv. gas	High energy density, abundant	GHG impacts, declining availability
Nuclear	Non fossil fuel, high density	Impacts of waste and accidents
Biomass	Renewable, non fossil fuel	Energy yield questionable
Wind	Renewable, non fossil fuel	Intermittent, impacts to wildlife
Solar	Renewable, non fossil fuel	Intermittent, PV requires rare earths
Hydro	Renewable, non fossil fuel	Limited potential, impacts to rivers
Geothermal	Renewable, non fossil fuel	Limited potential in some areas



Energy is a “Wicked Problem”

- A wicked problem is a social or cultural problem that is difficult or impossible to solve because of:
 - incomplete or contradictory knowledge
 - the number of people and opinions involved
 - the large economic burden
 - the interconnected nature of these problems with other problems.

https://www.wickedproblems.com/1_wicked_problems.php



Three classes of problems:



Tame



Messy



Wicked

<http://www.girlsguidetopm.com/2012/08/book-review-tame-messy-and-wicked-risk-leadership/>



Why would energy be a wicked problem?

- Proposition 1
 - We need energy to run our modern lives.
 - Transportation especially depends on fossil fuels.
 - American's unwilling to sharply curtail energy use.



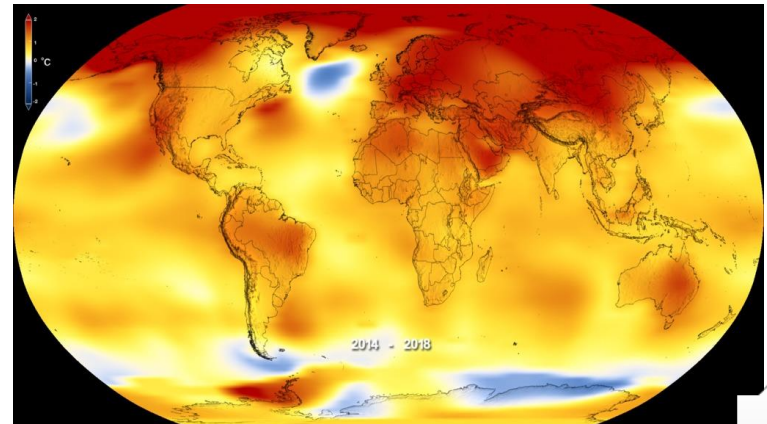
Why would energy be a wicked problem?

- Proposition 2
 - Consumers expect energy to be delivered without interruption and want it to be cheap and clean.



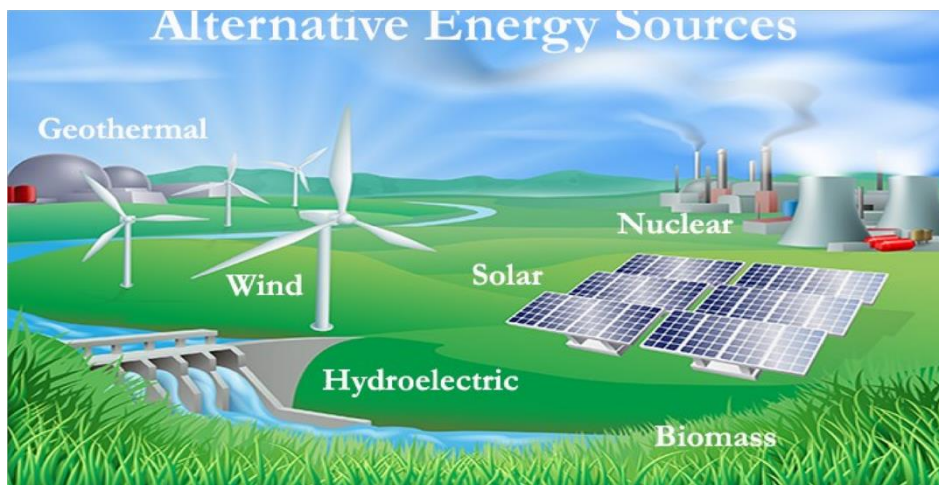
Why would energy be a wicked problem?

- Proposition 3
 - We depend on fossil fuels
 - They are energy-rich, reliable, and relatively cheap.
 - But their extraction is environmentally problematic, and use leads to climate change.



Why would energy be a wicked problem?

- Proposition 4:
 - Many people advocate for alternatives
 - Renewable and don't lead to climate change
 - Presently lack enough energy density to take the load, unreliable, and sometimes expensive.



Why would energy be a wicked problem?

- Proposition #5
 - Proponents of fossil fuels actively discourage alternative energy development
 - Proponents of alternatives actively discourage fossil fuel use



Energy picture in 2026

- Fossil fuels dominate our mix.
 - Lead to climate change
 - Sometimes from unreliable sources
- Alternatives cleaner, but unreliable – more costly (but becoming cheaper)
- Eliminating fossil fuels require conservation, rethinking our transportation systems
 - How do we do that without major economic upheaval?
- Current federal policy promotes use of fossil fuels, discourages wind and solar.



Energy is a focus of the Trump administration

- Wants to make U.S. “Energy Dominant”.
- Signed numerous E.O.s relating to energy.
- Favors coal, oil, and natural gas
 - “Drill Baby Drill”
- Disapproves of wind and solar power



President Trump Executive Orders promoting “Energy Dominance”



- [Unleashing American Energy](#) (1/20/25)
- [Declaring a National Energy Emergency](#) (1/20/25)
- [Evaluating Wind Projects](#) (1/20/25)
- [Unleashing Alaska's Extraordinary Resource Potential](#) (1/20/25)
- [Protecting American Energy from State Overreach](#) (4/8/25)



Should renewables be an important part of the U.S.'s goal of becoming “Energy Dominant?”

