Welcome to EGY 105 – Energy in Our World:

Can we / should we move away from fossil fuels?

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WILKES UNIVERSITY

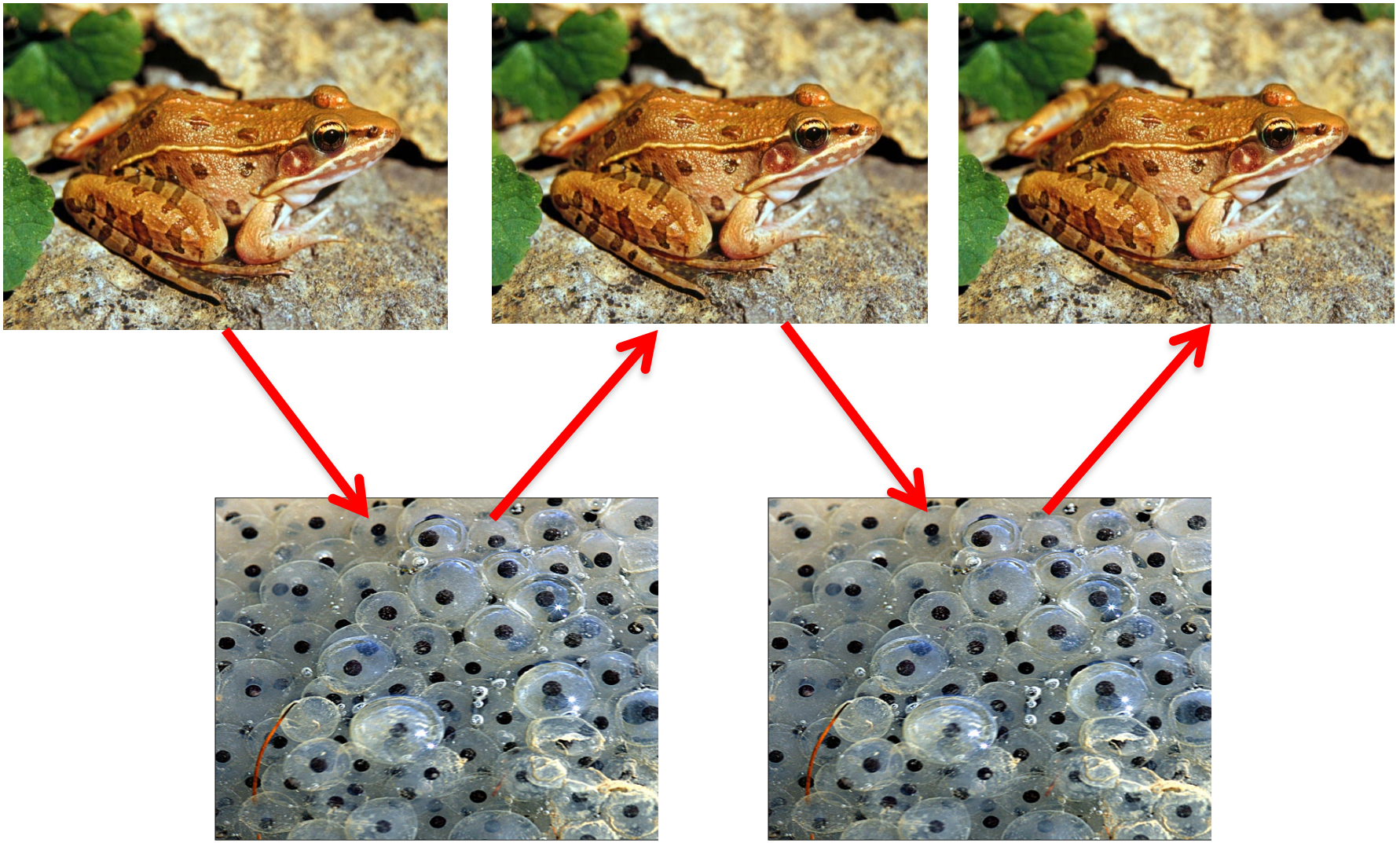
Dr. Ken Klemow

- Native of Hazleton
- Bachelor's degree in Biology: 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
- Co-Director Wilkes Energy Institute
- "Retired" and moved to San Diego, May 2023

What is the secret of life?

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

What is the secret of life?



How do plants and animals ensure many grandchildren?

http://shelledy.mesa.k12.

http://www.rogerwendell.com/australia.html

Humans are great at modifying our environment

http://www.nyc.gov/h

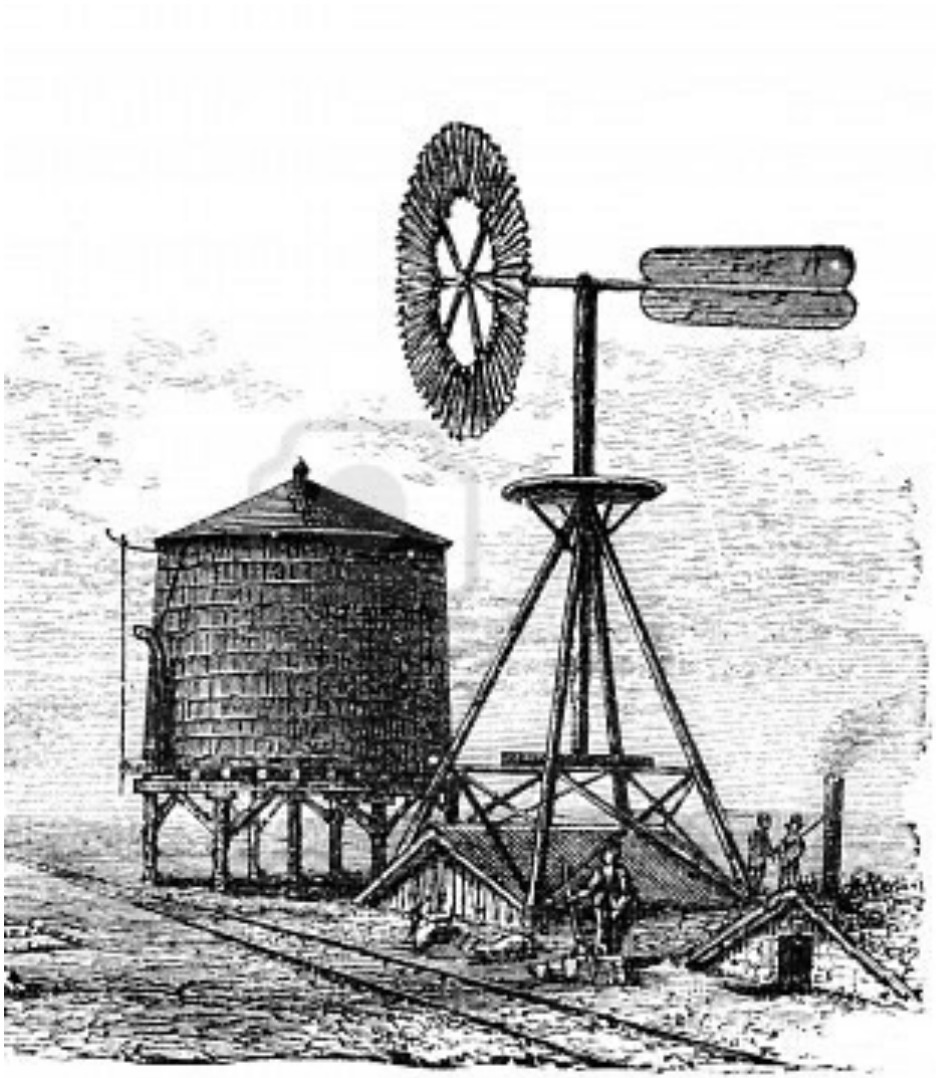
http://www.dot.ca.gov/hq/

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

Teq (www.sxc.hu)

Securing energy has been a quest of mankind for millennia.

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/OilHistory/pages/Columbia/Wells.html

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

http://12degreesc

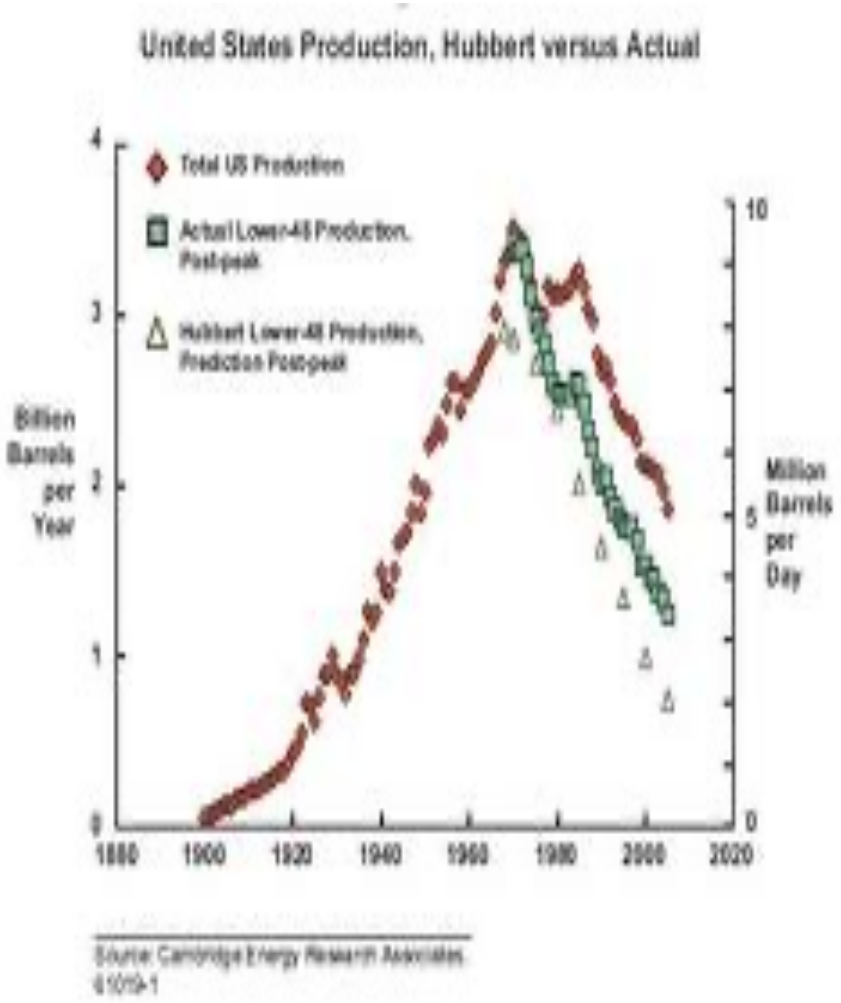
http://wonderstube.com/world-wonders/

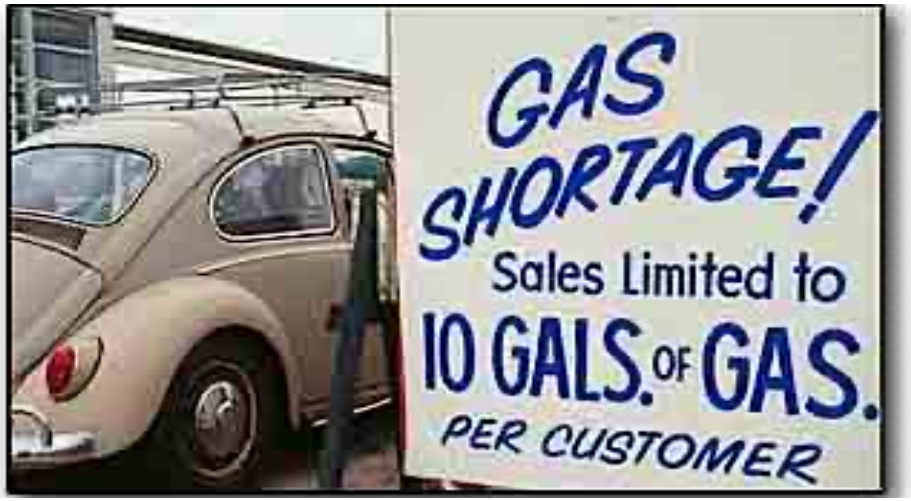
U.S. success in first half of 20th century due to coal

http://info.heylpatterson.com/

After World War II, other fuels supplanted coal

Optimism ended in 1970s

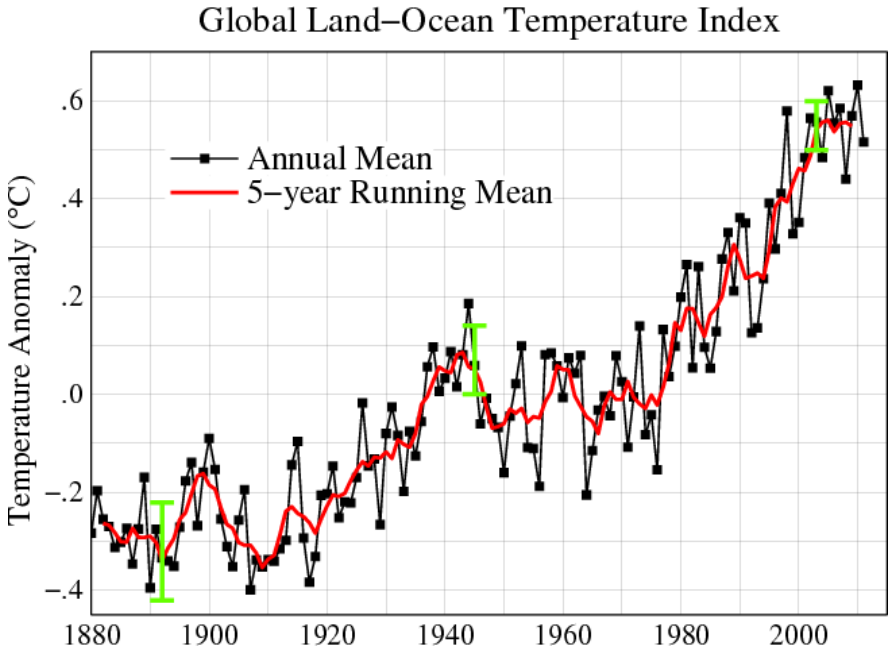




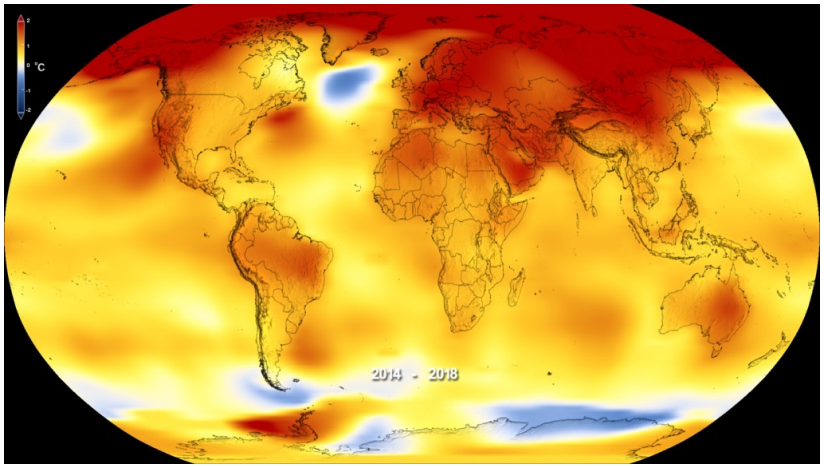
A national debate erupted

Energy debate rages on

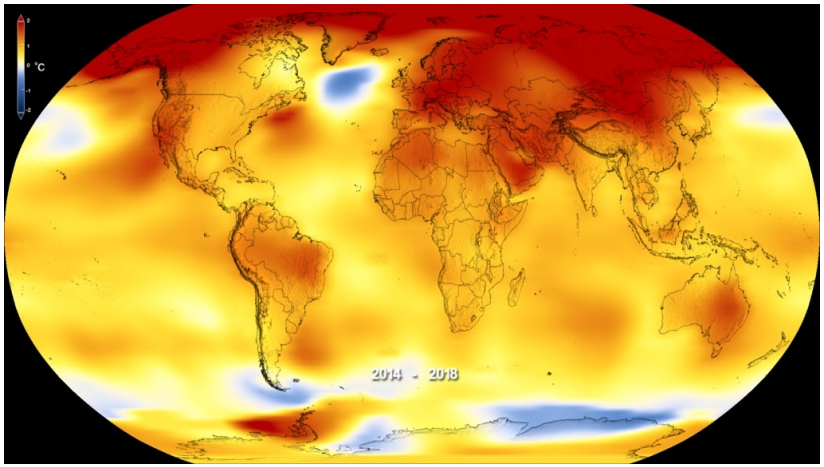
- Influences foreign policy of many nations
- Concerns over global climate change
- Concerns over nuclear waste disposal

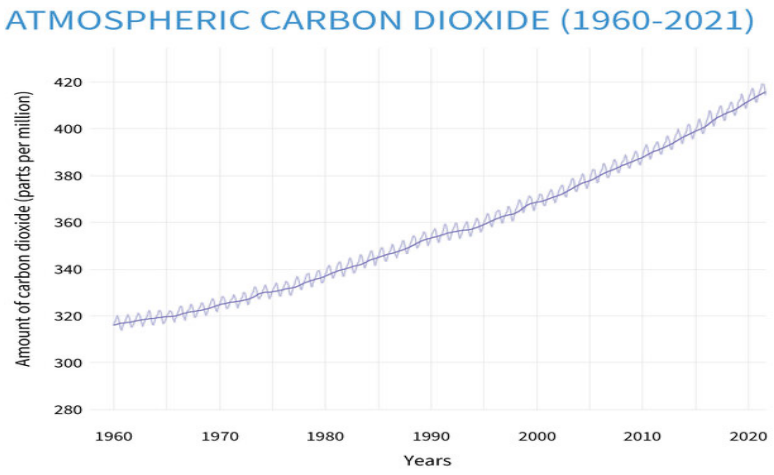


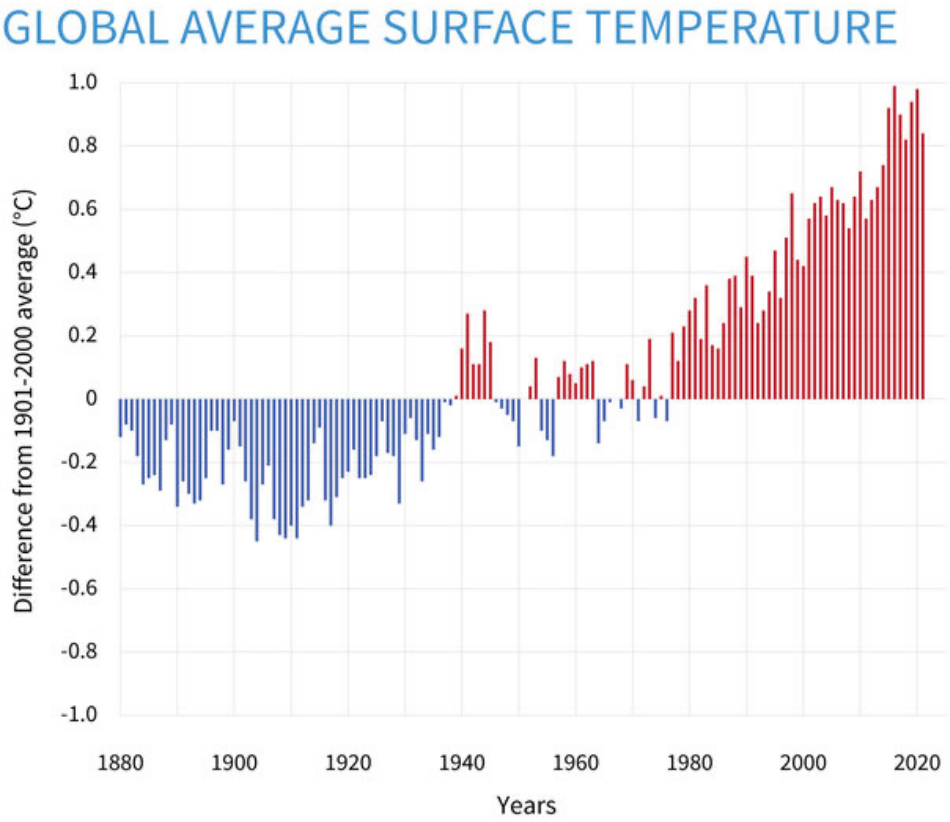
Energy is a hot topic in the news



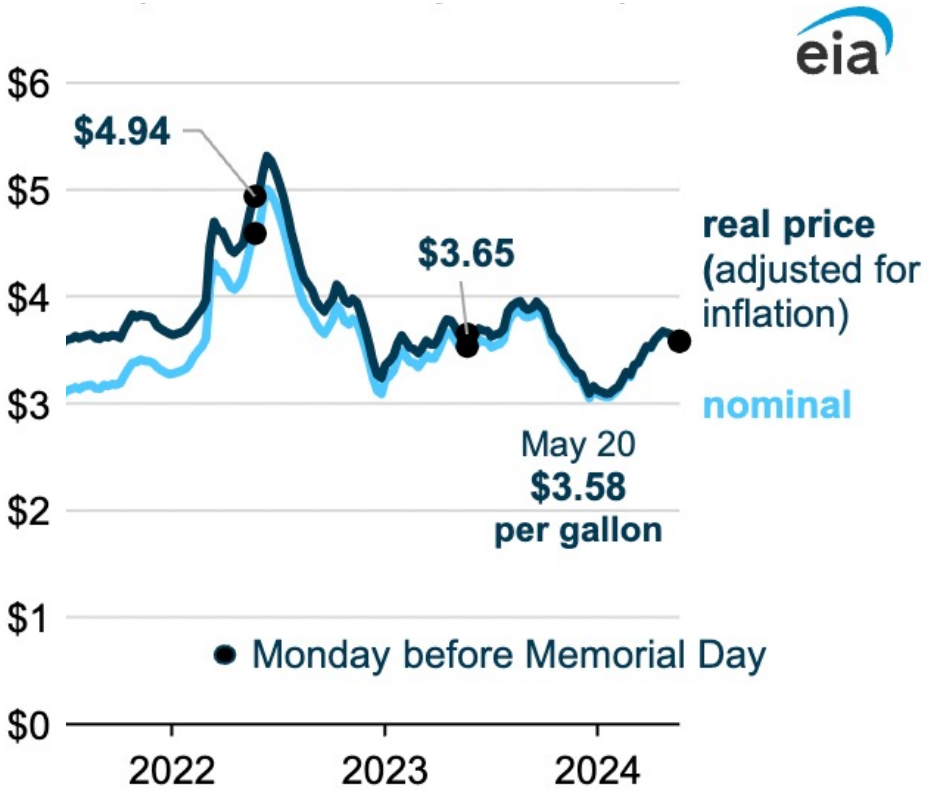
Climate change is real







Fluctuating / high energy prices

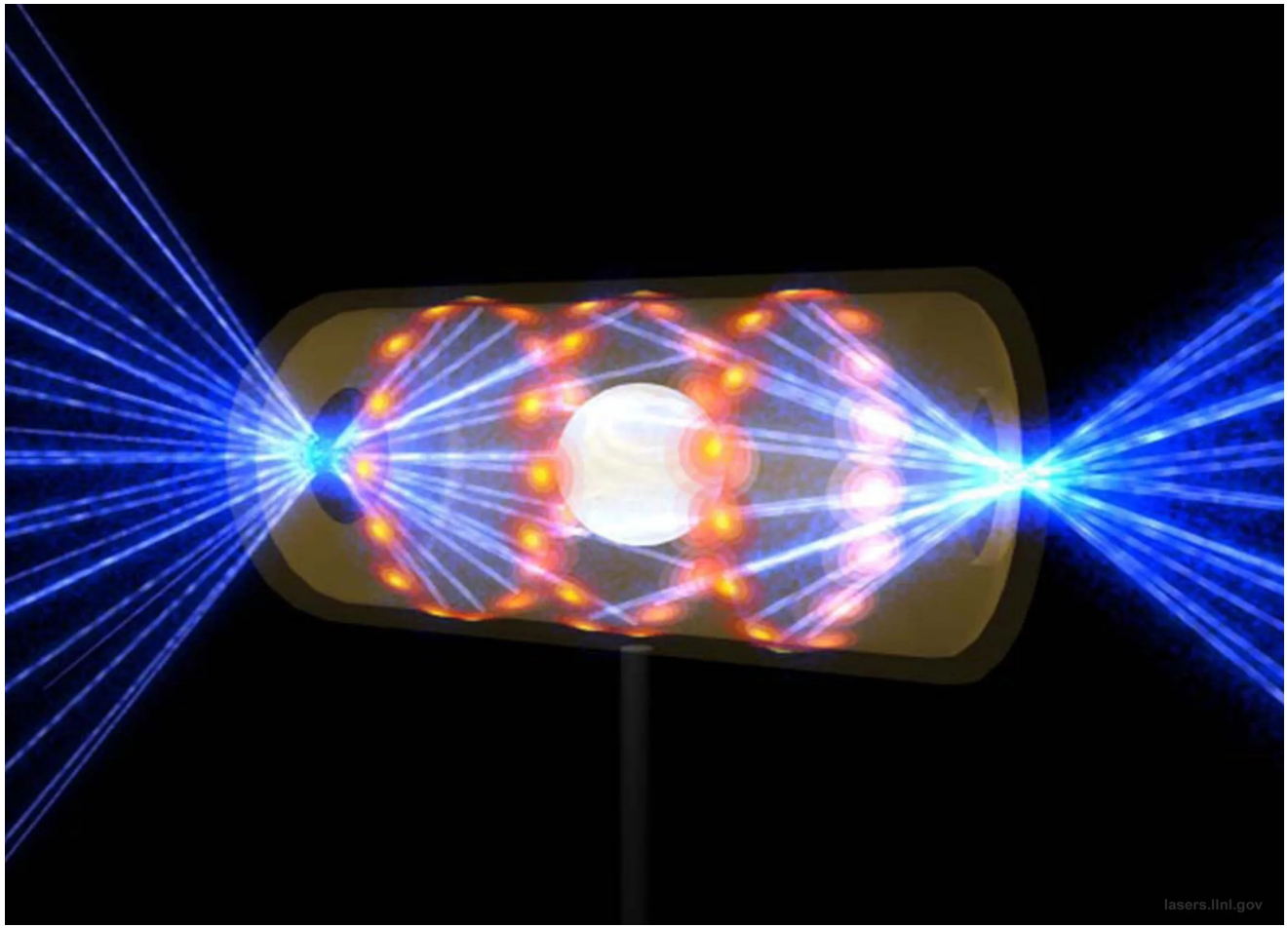


Nuclear plant under attack in Ukraine

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

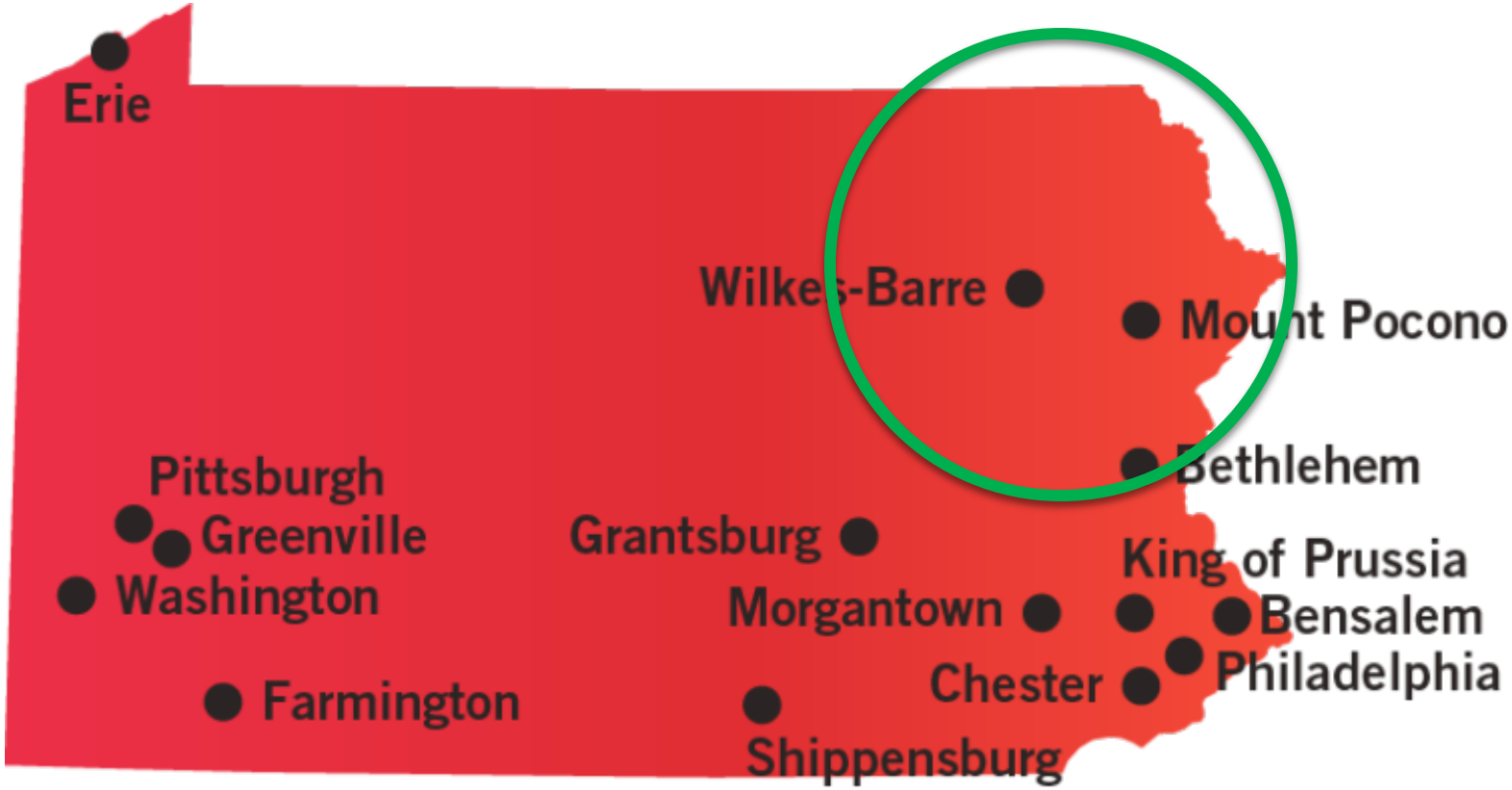
California gas car sales ban

Will nuclear fusion be your future?



https://www.newyorker.com/news/daily-comment/the-fusion-breakthrough-suggests-that-maybe-someday-well-have-a-second-sun

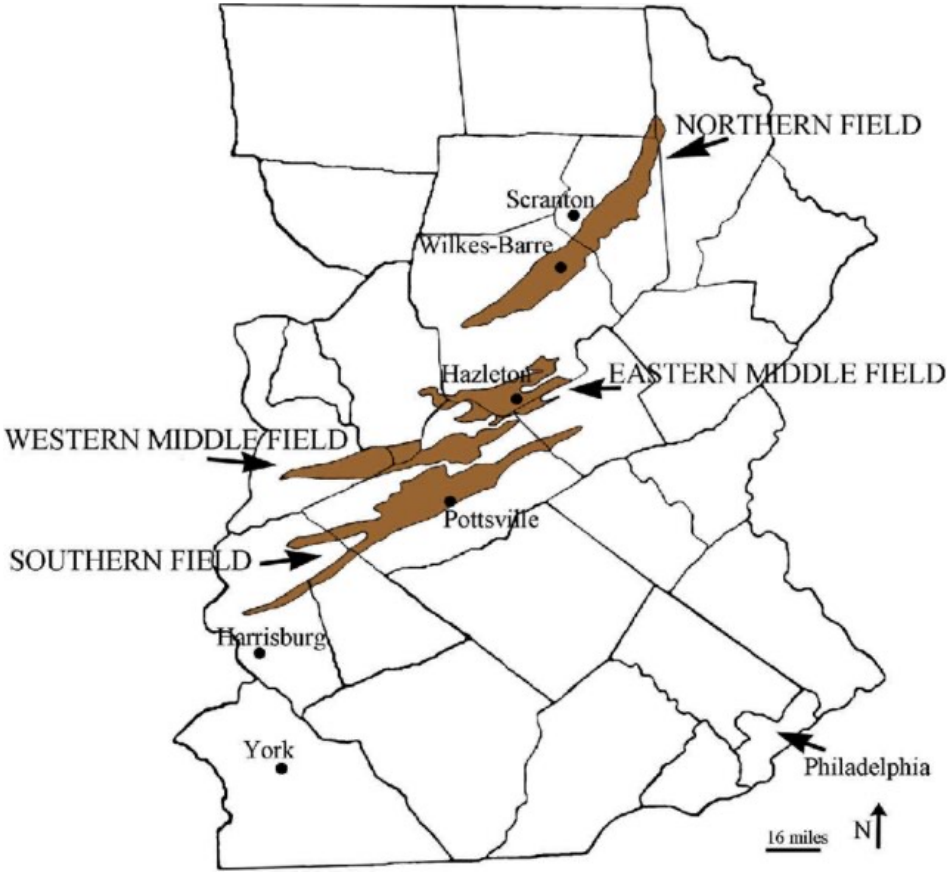
Northeastern Pennsylvania has significant energy history



https://www.americangaming.org/state/pennsylvania/

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

Old Fell Tavern Room and Grate

https://patrickmurfin.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

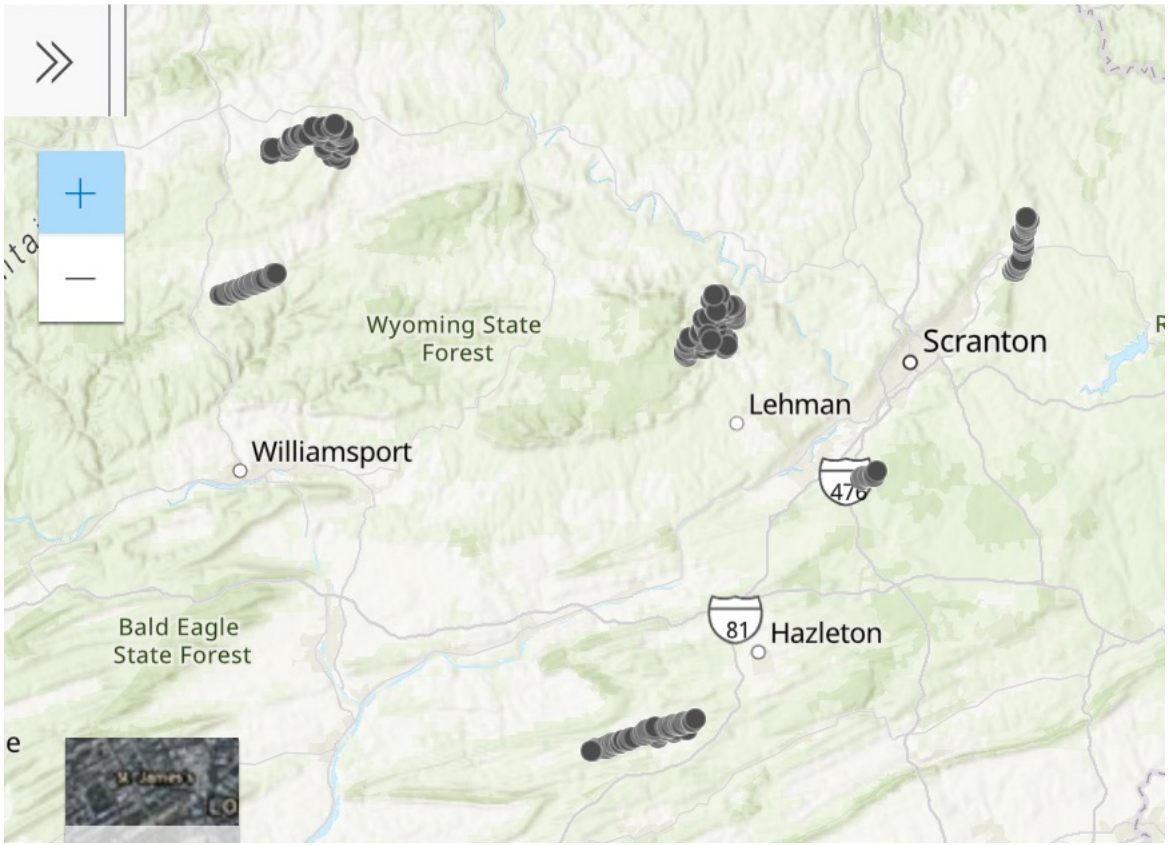
https://www.flickr.com/photos/hankrogers/2332241341

Culm bank in Swoyersville, PA

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

Mine drainage near Nanticoke, PA

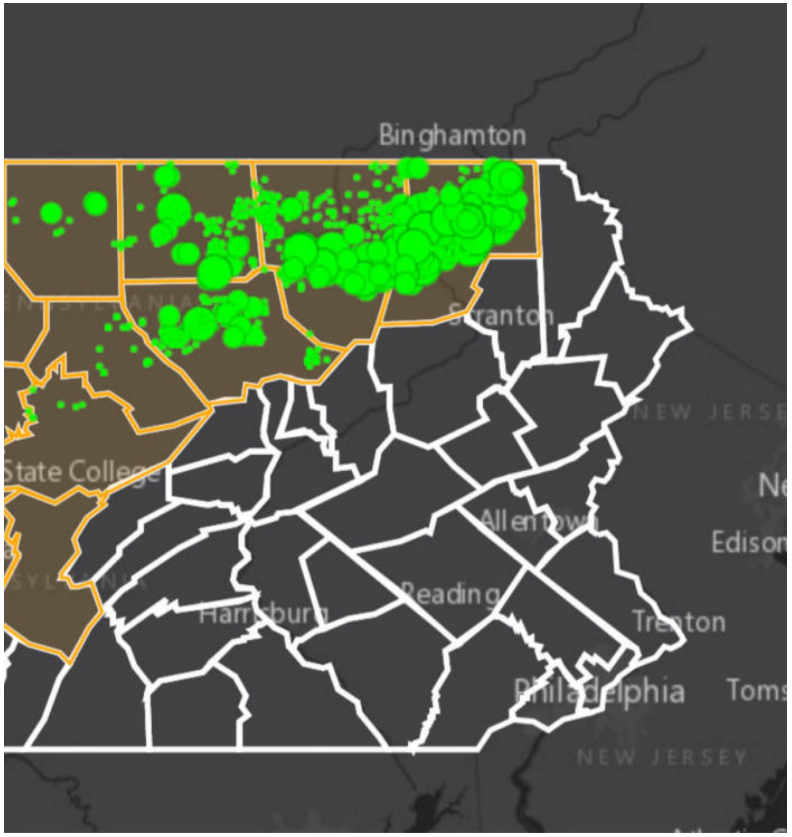
Wind Power in NEPA



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.fractracker.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/

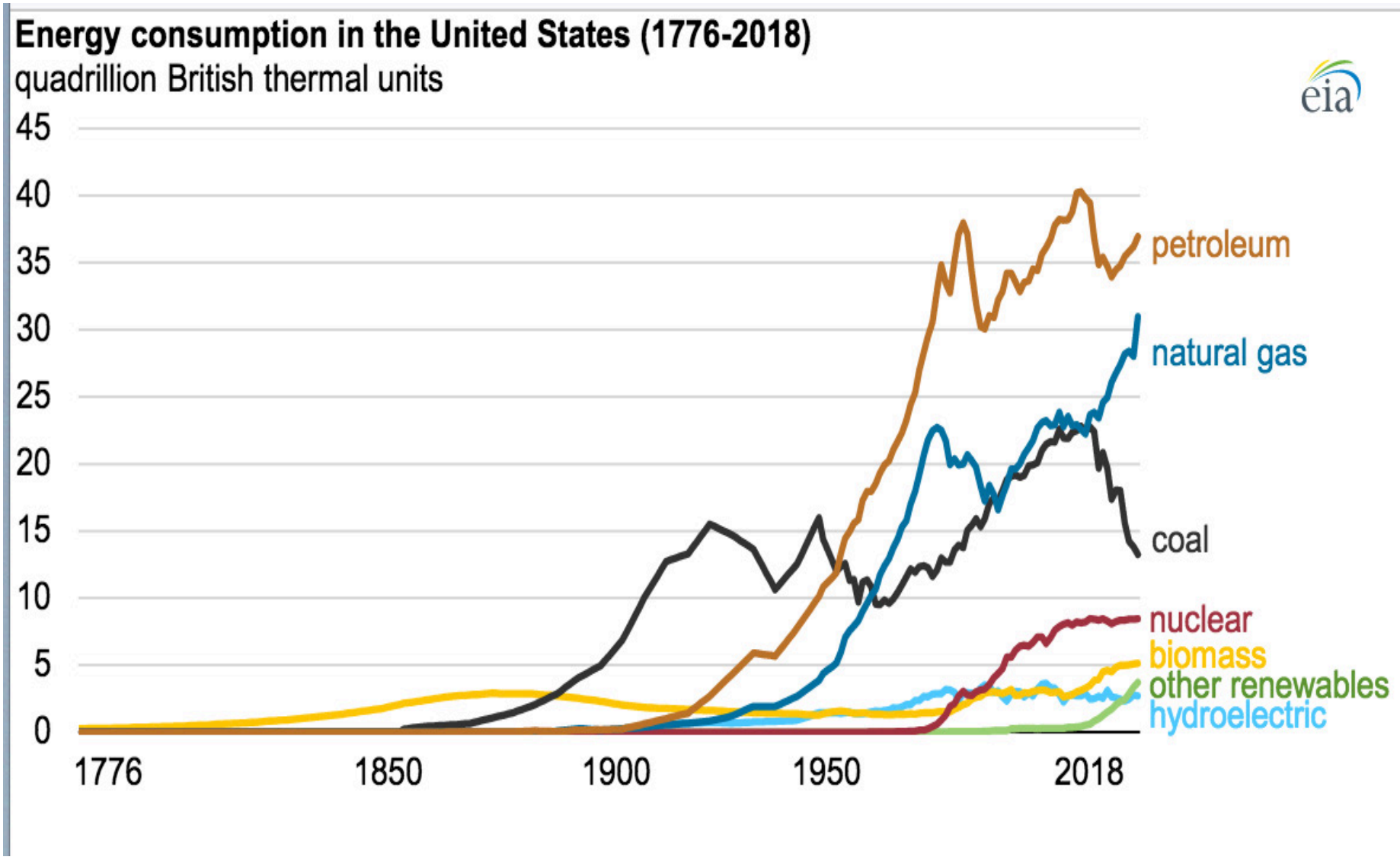
Energy classification

Fossil fuels

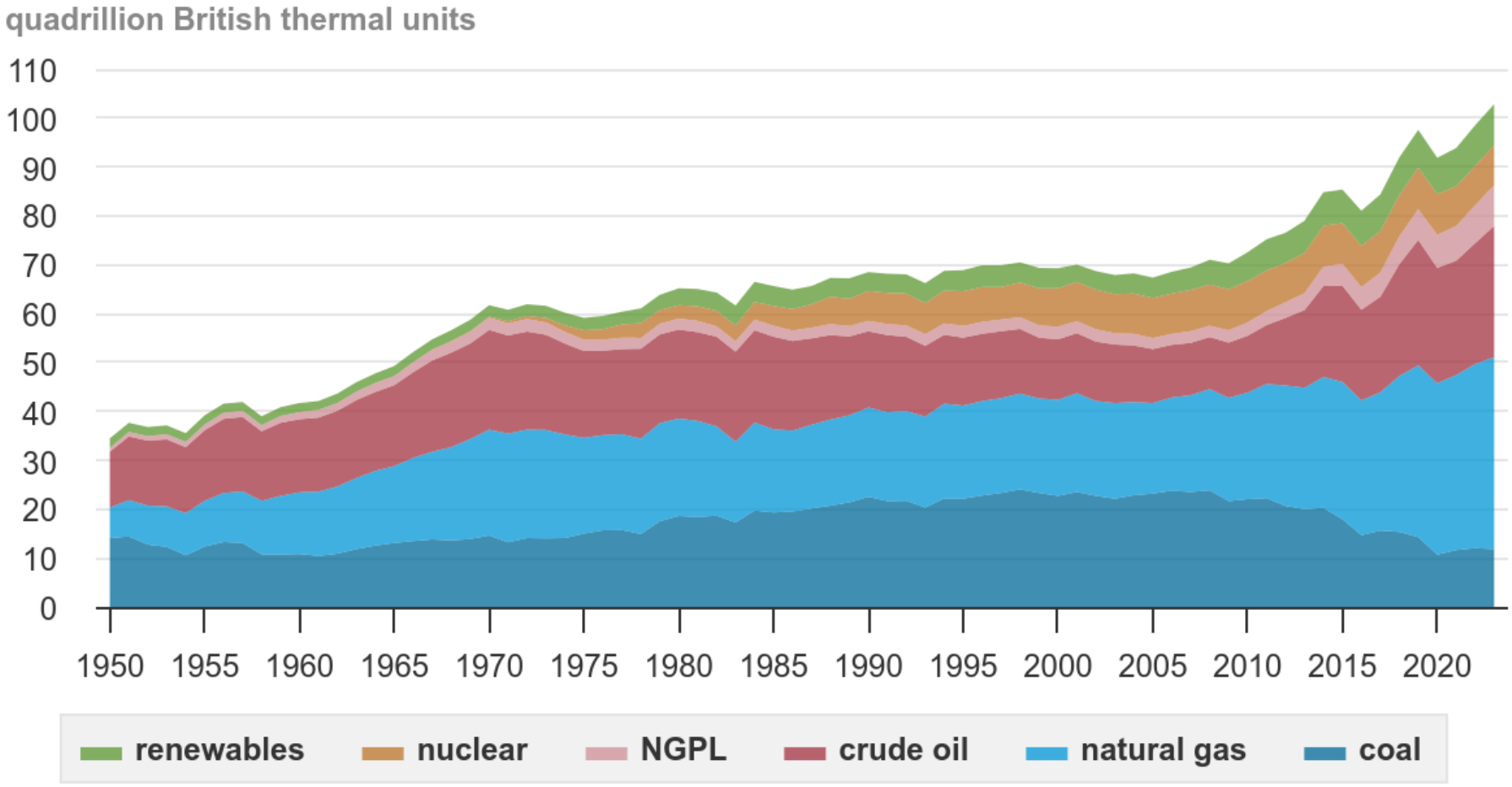
- Account for >90% of energy
- Based on carbon
  - Ancient photosynthesis
- Critics argue against climate change, habitat destruction, limited nature

Non-fossil fuels (renewables)

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


Energy consumption in the United States (1776-2018)
quadrillion British thermal units
eia
45
40
35
30
25
20
15
10
5
0
1776
1850
1900
1950
2018
petroleum
natural gas
coal
nuclear
biomass
other renewables
hydroelectric

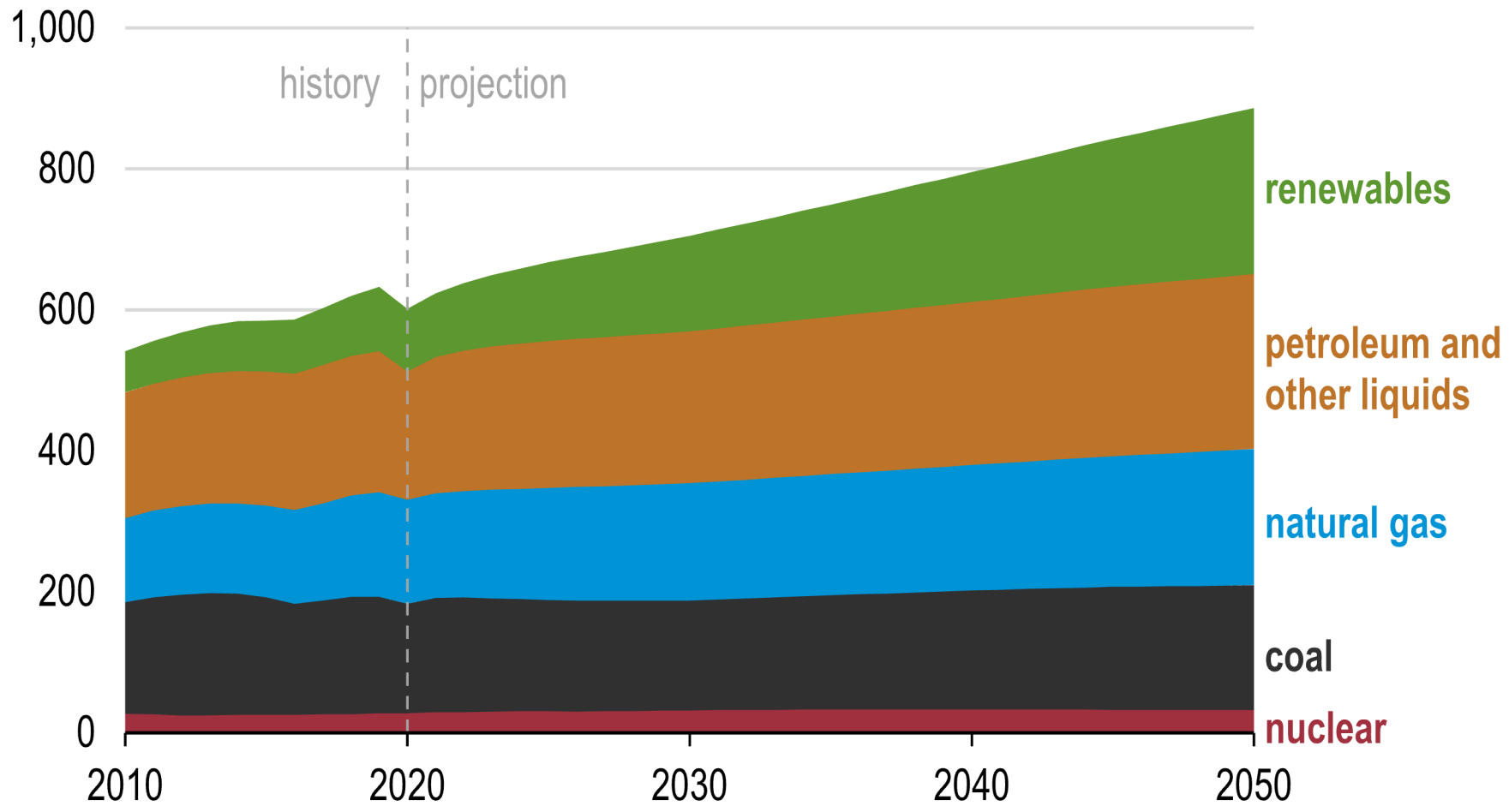
U.S. primary energy production by major sources, 1950-2023



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



Every energy form has benefits and drawbacks

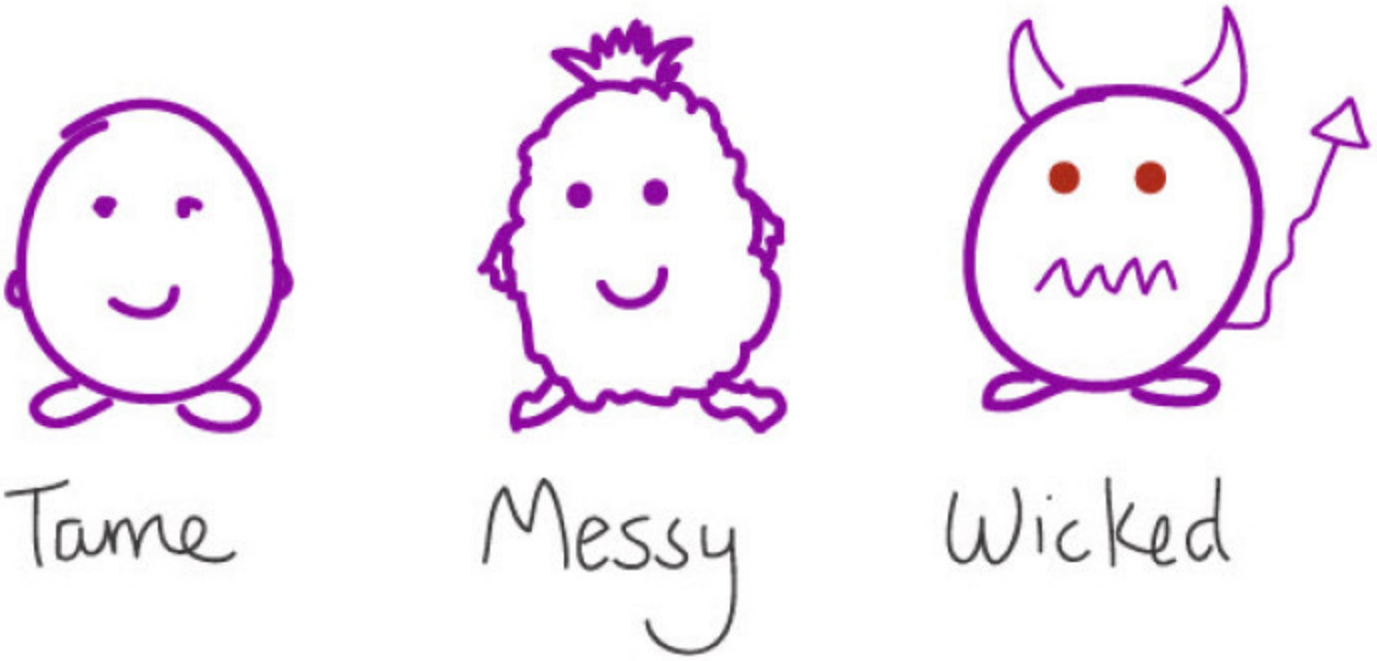
Form	Benefits	Drawbacks
Coal	Abundant, cheap, high energy density	GHG impacts, habitat destruction
Oil	High energy density, flexible	GHG impacts, foreign policy concerns
Conv. gas	High energy density, abundant	GHG impacts, declining availability
Nuclear	Non fossil fuel, high density	Impacts of waste 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:



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 tout 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 2024

- Fossil fuels dominate our mix.
  - Lead to climate change
- 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 to decrease use of fossil fuels.

Will energy be a big issue in Presidential campaign?

https://www.cnn.com/politics/live-news/kamala-harris-trump-election-08-07-24/index.html

So can we / should we transition away from fossil fuels?