

A photograph of a large wind farm with numerous white wind turbines scattered across a dry, hilly landscape. In the background, there are large, rugged mountains under a clear sky. The text is overlaid on the left side of the image.

Great Decisions: Climate Technology & Competition

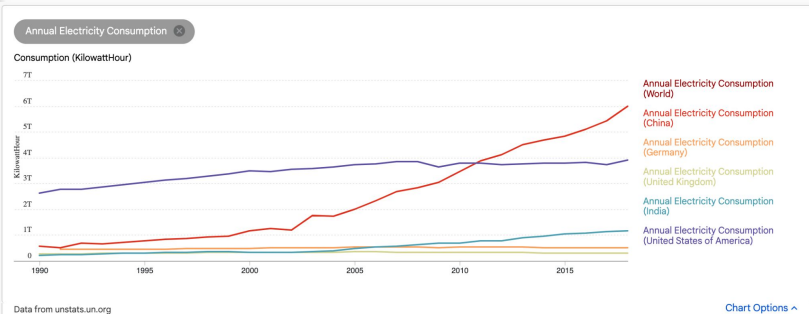
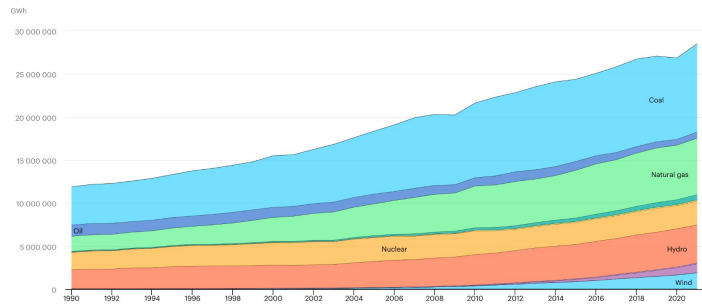
Brian Harrison Feb 26, 2024

World energy mostly fossil based fuels

US and EU are gradually decarbonizing

Rapid rise of energy consumption in China and India

China may soon reach peak of fossil fuel usage



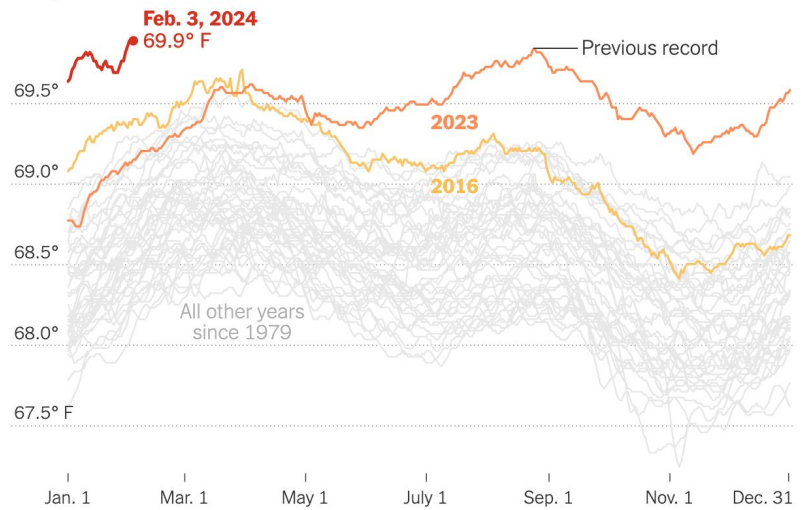
US and Europe making progress towards reducing carbon, although too slow to meet goals. World wide energy is mostly fossil, with large growth of energy consumption in China. Good news is that China may peak soon on fossil fuel consumption.

<https://www.iea.org/data-and-statistics/data-tools/energy-statistics-data-browser?country=WORLD&fuel=Energy%20supply&indicator=ElecGenByFuel>

https://datacommons.org/tools/timeline#place=Earth%2Ccountry%2FCHN%2Ccountry%2FUSA%2Ccountry%2FDEU%2Ccountry%2FGBR%2Ccountry%2FIND&statsVar=Amount_Consumption_Electricity_PerCapita

World not on track
for 1.5°C

Daily Sea Surface Temperatures



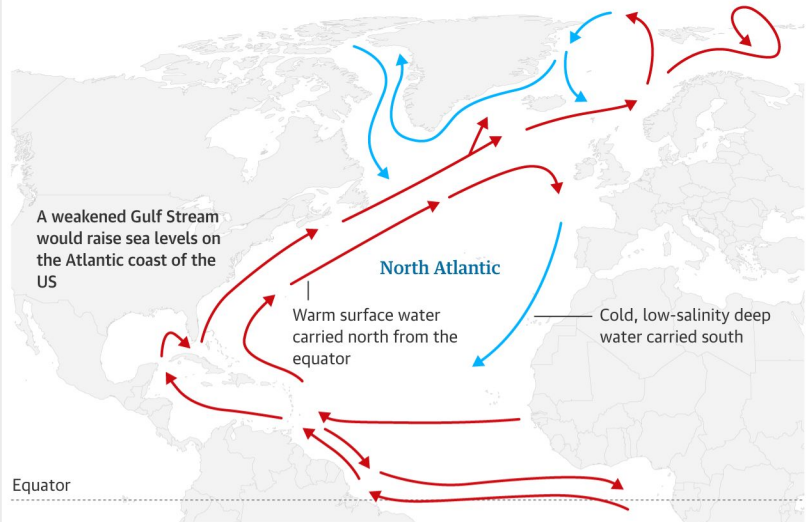
Source: Copernicus Climate Change Service/ECMWF • By Elena Shao

https://climatereanalyzer.org/clim/sst_daily/

<https://www.nytimes.com/2024/02/07/climate/2024-hottest-january-data.html>

Are we
approaching a
tipping point?

**The Atlantic Meridional Overturning Circulation is weakening
and has collapsed in the distant past**



Guardian graphic. Source: NOAA, S Rahmstorf et al from the Potsdam Institute for Climate Impact Research (PIK)

<https://www.theguardian.com/environment/2024/feb/09/atlantic-ocean-circulation-near-ing-devastating-tipping-point-study-finds>

Climate Technologies

Solar & Wind

Tides & Waves

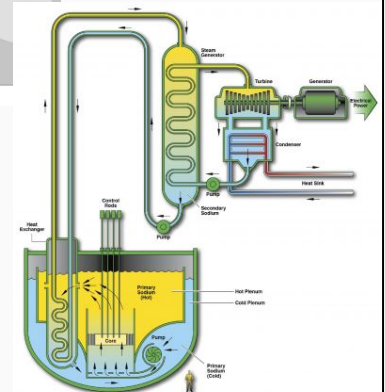
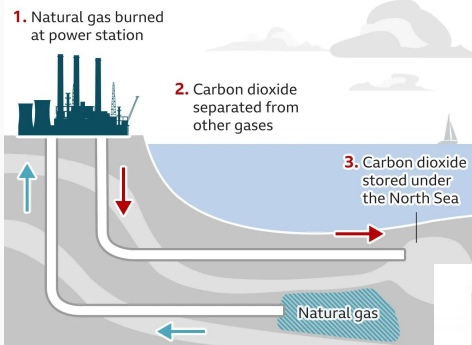
Storage: Batteries

Nuclear

Hydro

Carbon Capture & Sequestration (CCS)

Carbon capture and storage



Lots of technologies for carbon-free energy. Solar & Wind cheapest today, with Hydro declining due to climate change and silting. Tides and waves still experimental, with environmental concerns. Nuclear capacity aging, new traditional plants very expensive and time consuming to build. Promising newer technologies such as sodium-cooled fast reactor. CCS small scale, may be a distraction.

Climate Technologies

Geoengineering

- Aerosols (Israel)
- Cloud brightening (Australia)
- Ocean alkalinity (USA)
- *Giant parasol* (US-Israel)

Tweaking the Climate

Three projects underway aim to alter the chemistry of the atmosphere and oceans to cool the planet

Stratospheric aerosol injection

Reflective particles mimic the cooling effect of volcanic eruptions.

Aircraft that can reach the stratosphere will disperse the particles.

SOLAR RADIATION

Scientists are testing chemicals that reflect sunlight.



SOLAR RADIATION

Marine cloud brightening

By spraying saltwater mist into the air, scientists hope to increase the number and surface area of cloud droplets.

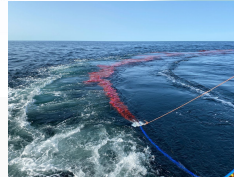
Brighter clouds will reflect sunlight, shading the ocean surface.



Ocean alkalinity enhancement

A liquid solution makes seawater more alkaline, drawing carbon dioxide from the atmosphere.

After the chemical reaction, CO_2 is stored as bicarbonate in the upper ocean.



Geoengineering solutions are being tested today. Israeli company testing stratospheric aerosols, like effect from volcanoes. Australia firing brine through high pressure nozzles to brighten low-level clouds. In US, Woods Hole Oceanographic Institute releasing sodium hydroxide (lye) near Martha's Vineyard to increase carbon holding capability of ocean. Proposals from US and Israel for a giant sunshade in space.

https://www.wsj.com/science/environment/geoengineering-projects-cool-planet-weather-f0619bf7?mod=environment_news_article_pos2

<https://www.nytimes.com/2024/02/02/climate/sun-shade-climate-geoengineering.html>

Geopolitical Implications

Brookings Institute:

"[reaching net zero] requires drastic shifts in behavior and massive policy interventions, including a degree of international cooperation that will be very difficult to attain."

Over 10% of world trade is fossil fuels

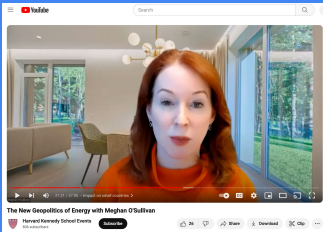
Energy Security

- 1911: Churchill transformed UK navy from coal to oil
- 1990s: Energy security through cooperation
- 2020s: Global fragmentation
 - Ukraine war sets back climate goals, constrained supply not demand
 - \$1T in energy subsidies
- Future energy trade reduced to ⅓ of today's level
 - Electricity generation usually domestic
 - Trade in raw materials may increase
- Tensions between major powers
- Tensions with developing world
 - Migration, famine, disasters

Nations prioritize energy security over climate security

Geopolitical Strategy

Energy transition must be
ENDS and MEANS



The New Geopolitics of Energy -
Meghan O'Sullivan

- An antidote to geopolitical fragmentation
- Get us to where we want to be AND mitigate negative geopolitical trends
- Can't rely on cooperative solutions
 - Industrial policy, e.g. IRA, EU Green Industry Act
 - Compete for talent - competition for climate friendly investment
- Push back on fragmentation
 - Friend-shore, not home-shore (allies)
 - Inclusive climate clubs (e.g. EU)
 - Don't give up on integration - Environmental Goods Agreement (Trade negotiation)

<https://youtu.be/CfPgWJyAk58?si=pLwxkgaYvJX3G7P1>

Discussion Topics

Focus on USA's foreign policy

1. Technologies
 - Nuclear: Safe? Cost effective? Necessary?
 - Geoengineering: Safe? Need intl. Agreements?
 - Raw materials: Increase mining? Exploitation?
 - Subsidies? World trade? Trade secrets?
2. Developing World
 - Growth means more emissions?
 - Climate and mining impacts \$\$\$
 - Leapfrog old technologies?
3. Protectionism and Nationalism
 - Trade barriers against allies?
 - "Climate Clubs"
4. International cooperation?
 - Changing world trade: petro-states to minerals
 - How to deal with China & Russia?
 - India & Brazil?
 - Middle East?