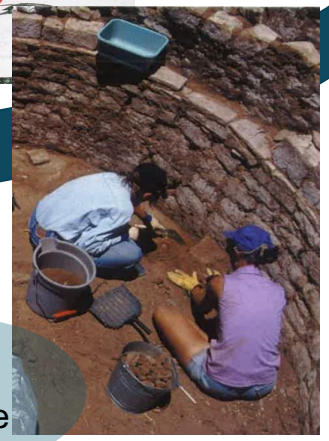

Brookhaven
National Laboratory
U.S. DEPARTMENT OF
ENERGY
The Energy-Environment-Economy Nexus
Allison McComiskey
Department Chair, Environmental & Climate Sciences
Women Economic Developers of Long Island
12 January 2023
@BrookhavenLab

government guidance of the effective use of science

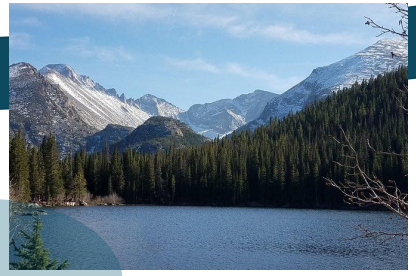
physical science

climate and weather

human-environment interactions



social science



natural environment

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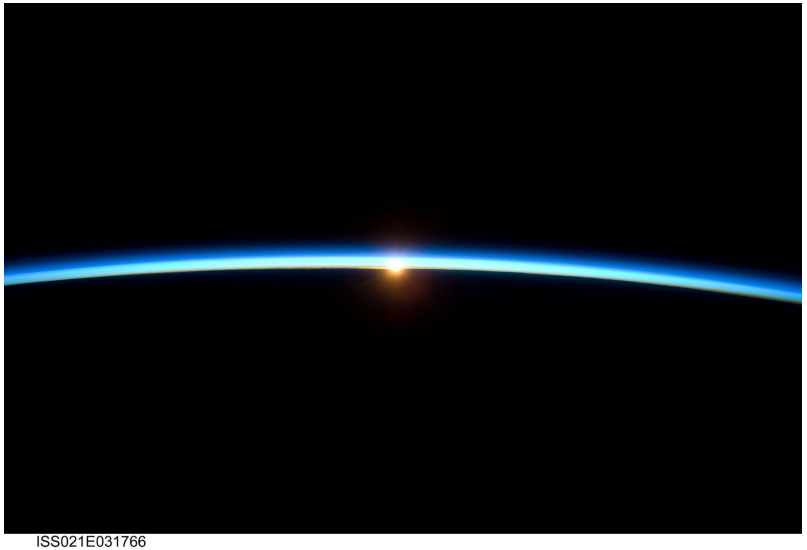
Greenhouse Gas Theory

Fourier, 1812
Tyndall, 1856
Arrhenius, 1896
Chamberlin, 1899



ISS021E031766

the carbon dioxide and water vapor of the atmosphere have remarkable power of absorbing … heat rays, while the oxygen, nitrogen, and argon of the atmosphere possess this power in feeble degree only. It follows that the effect of the carbon dioxide and water vapor is to blanket the earth with a thermally absorbent envelope

The thickness of the atmosphere above Earth is equivalent to a single coat of paint on an orange

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1965 Report of the Environmental Pollution Panel President's Science Advisory Council

Possible effects of increased atmospheric carbon dioxide on climate:

warming

Other possible effects of an increase in atmospheric carbon dioxide:

Melting of the Antarctic ice cap

Rise of sea level

Warming of sea waters (effects on fisheries, decrease in Arctic sea ice)

Increased acidity of fresh waters

"The climatic changes that may be produced by the increased CO_2 content could be deleterious from the point of view of human beings."

1968 Report to the American Petroleum Institute
Stanford Research Institute

"… CO_2 and submicron particles, may be the cause of serious world-wide environmental changes"

"Significant temperature changes are almost certain to occur by the year 2000 and these could bring about climatic changes."

"… there seems to be no doubt that the potential damage to our environment could be severe"

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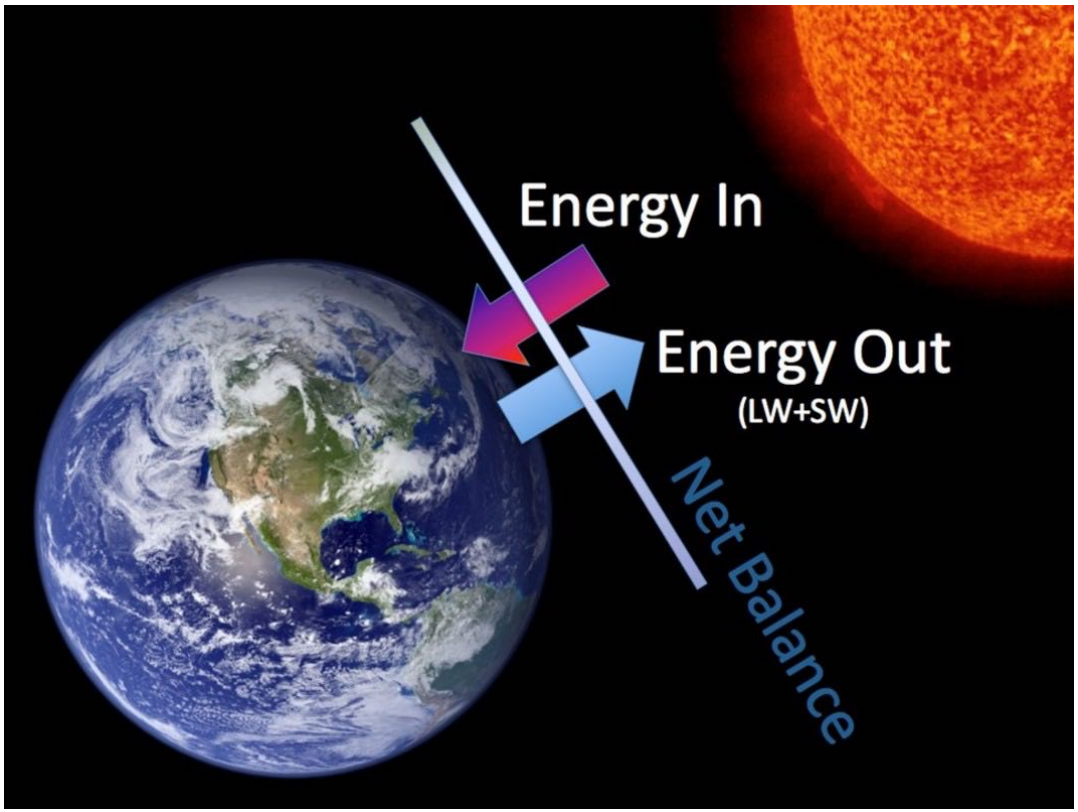
Earth's Energy Balance



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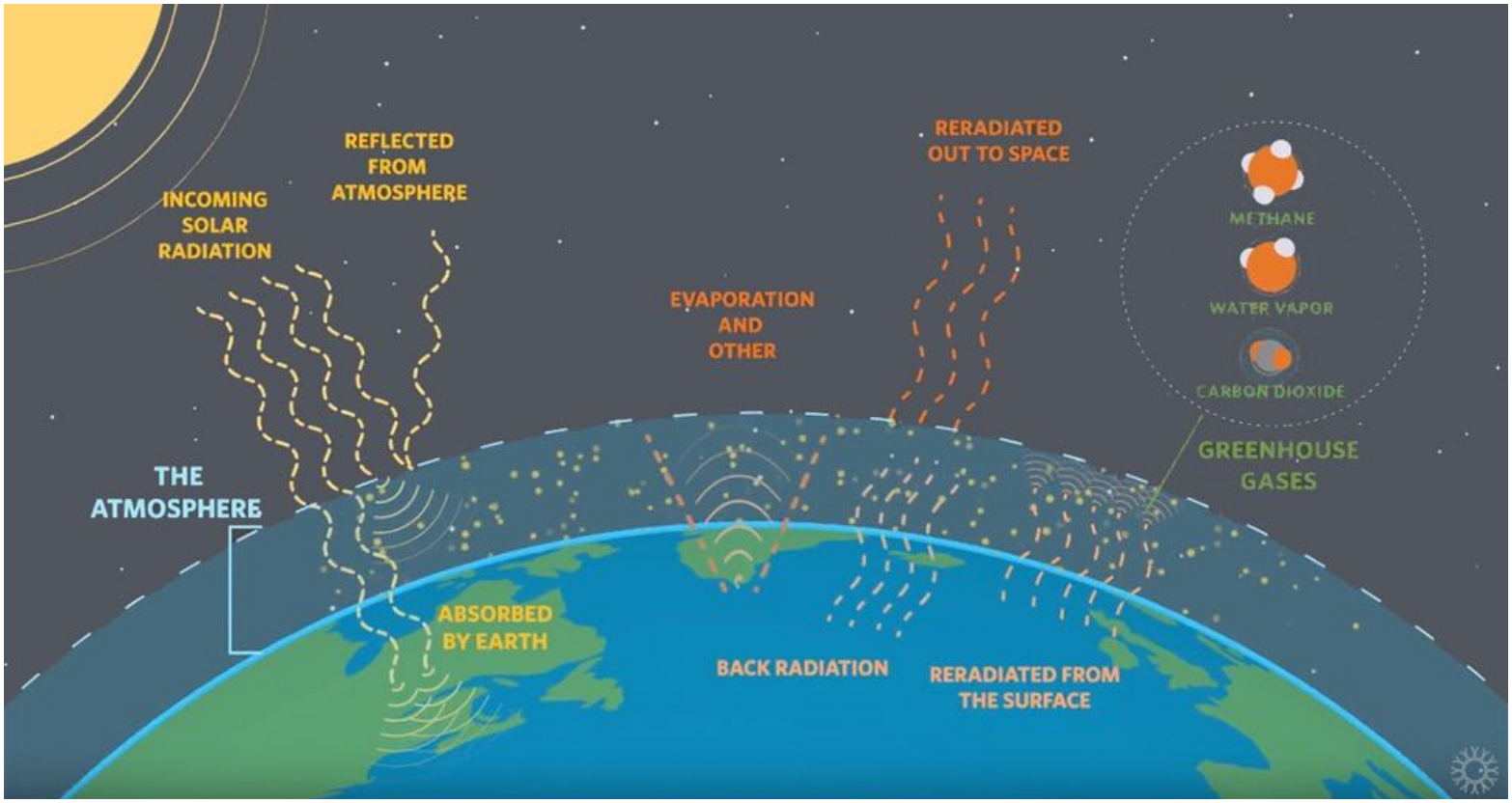
Earth's Energy Balance and the Greenhouse Effect



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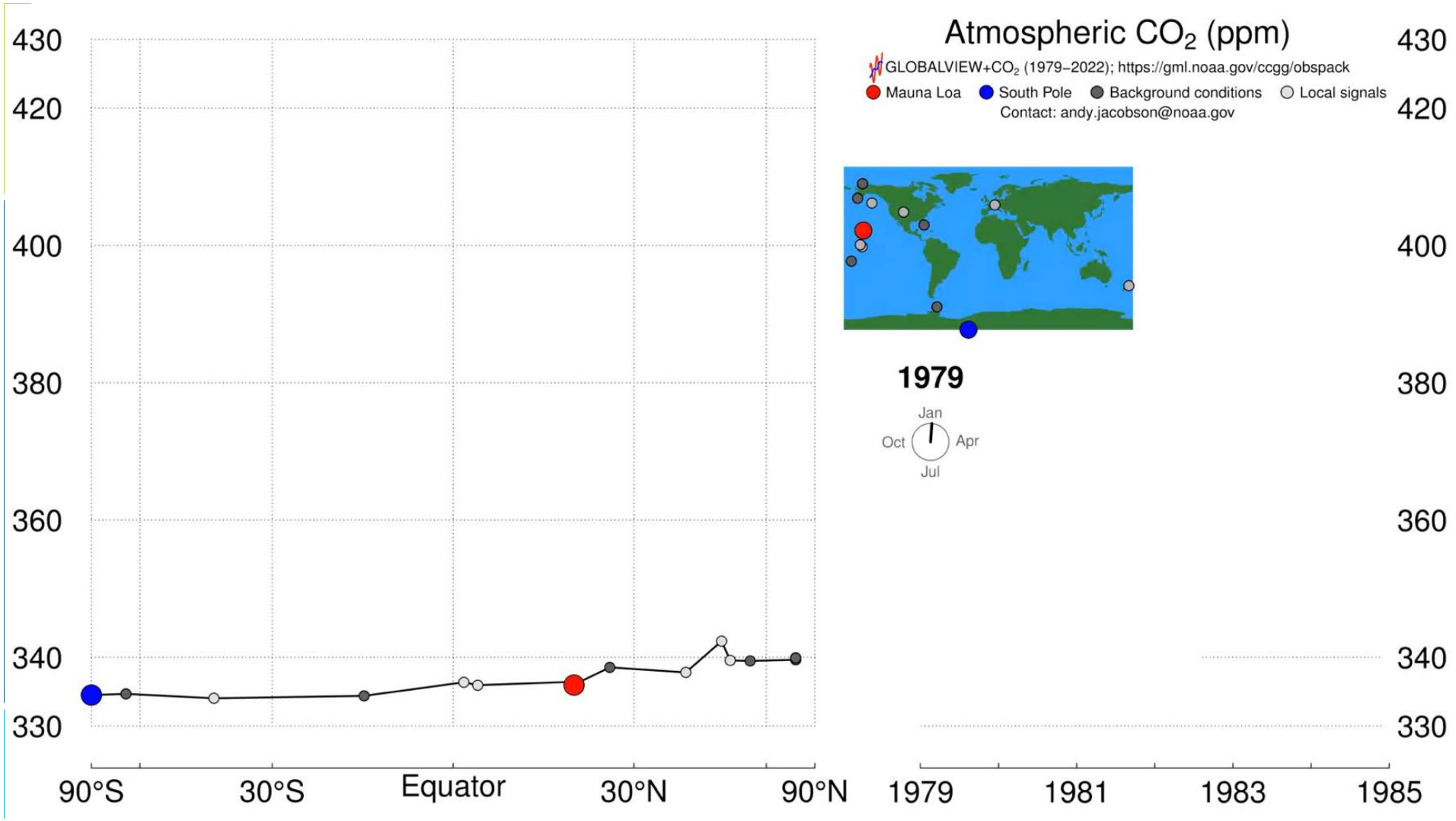
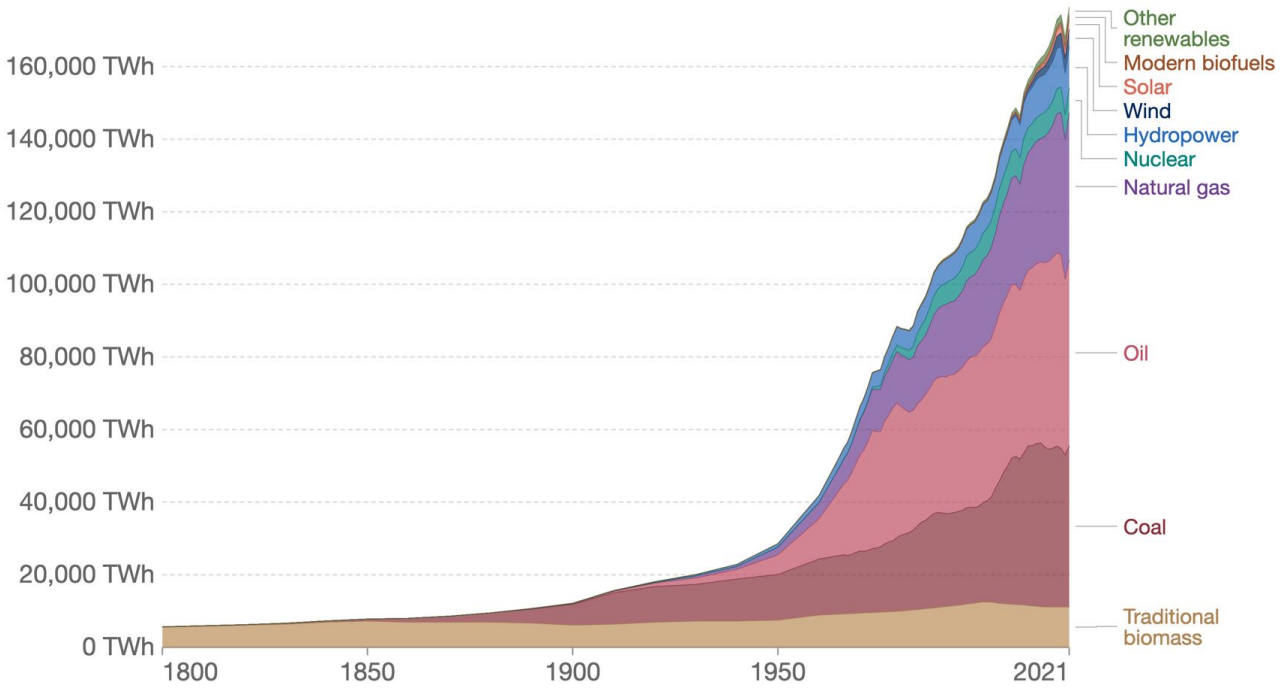

Atmospheric CO_2 (ppm)
GLOBALVIEW+CO_2 (1979–2022); https://gml.noaa.gov/ccgg/obspack
Mauna Loa
South Pole
Background conditions
Local signals
Contact: andy.jacobson@noaa.gov
1979
Jan
Apr
Jul
Oct
430
420
400
380
360
340
330
90°S
30°S
Equator
30°N
90°N
1979
1981
1983
1985

Global primary energy consumption by source

Primary energy is calculated based on the 'substitution method' which takes account of the inefficiencies in fossil fuel production by converting non-fossil energy into the energy inputs required if they had the same conversion losses as fossil fuels.



Source: Our World in Data based on Vaclav Smil (2017) and BP Statistical Review of World Energy

OurWorldInData.org/energy • CC BY

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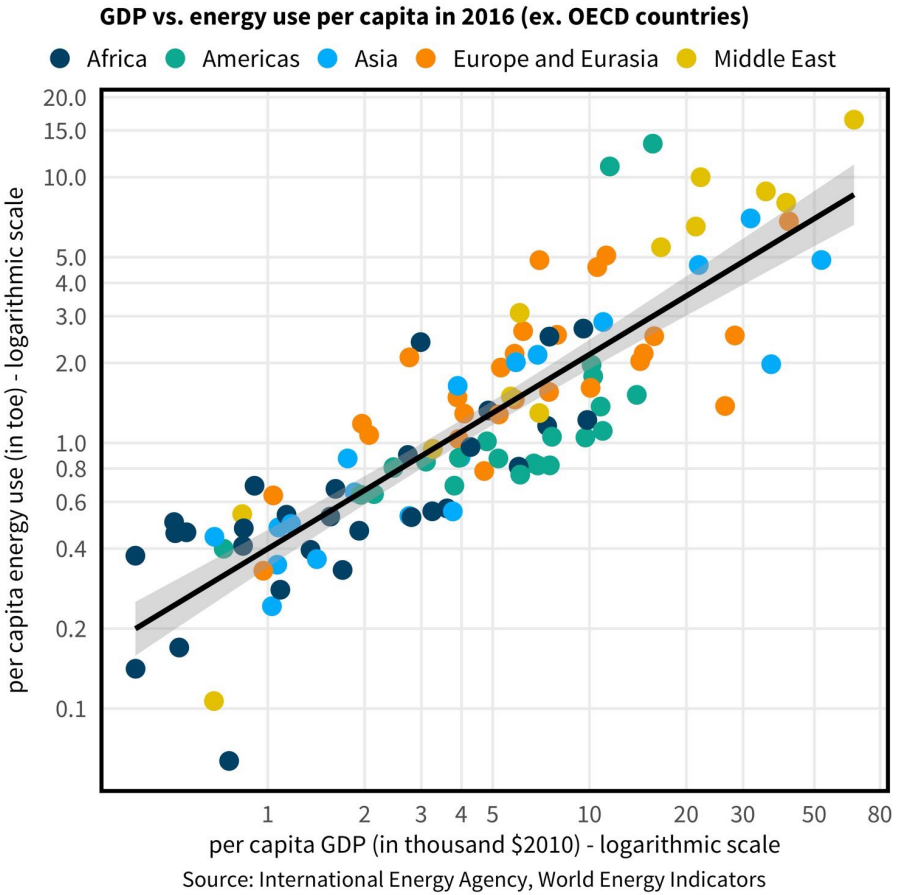
The Energy-Economy Nexus



Source: International Energy Agency, World Energy Indicators

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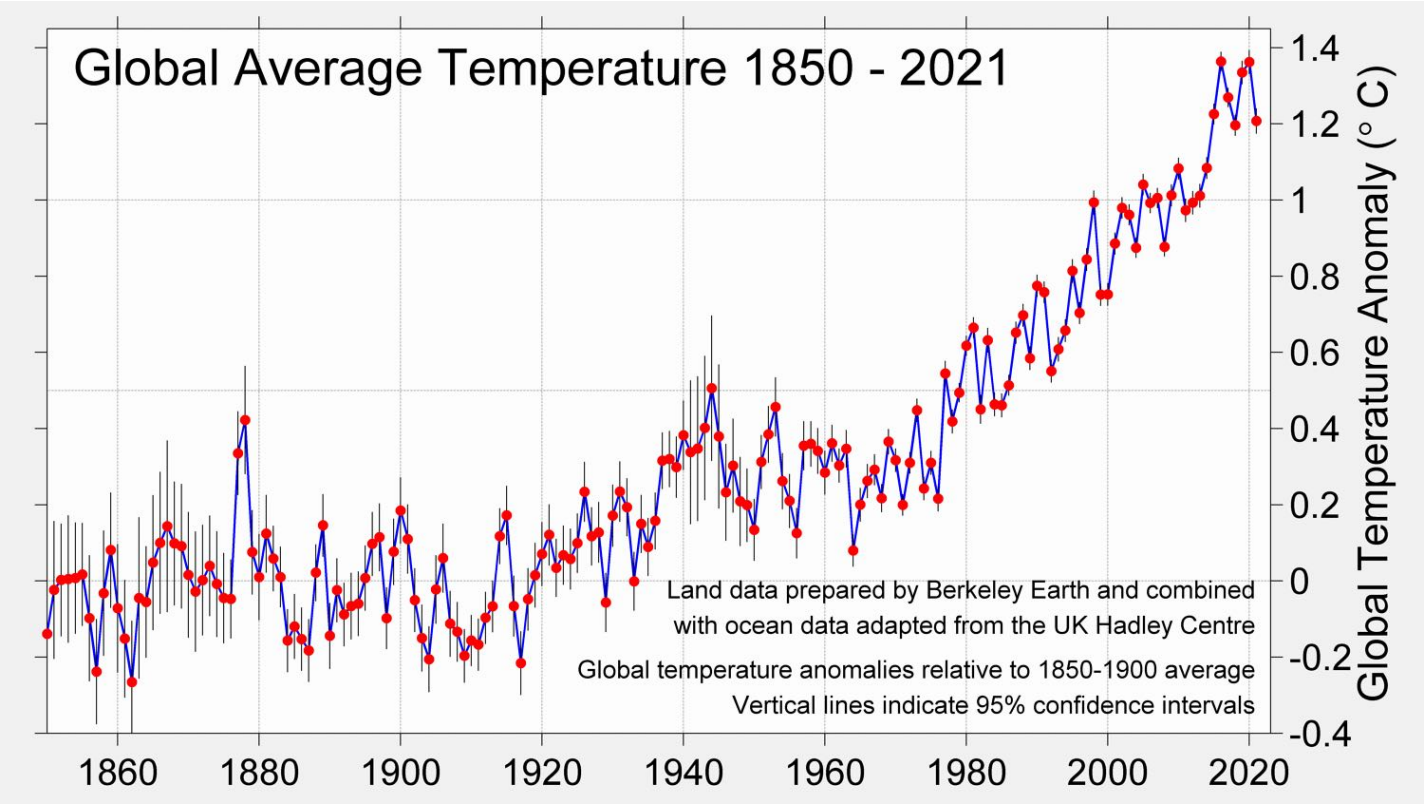

Anomaly: a difference from the average

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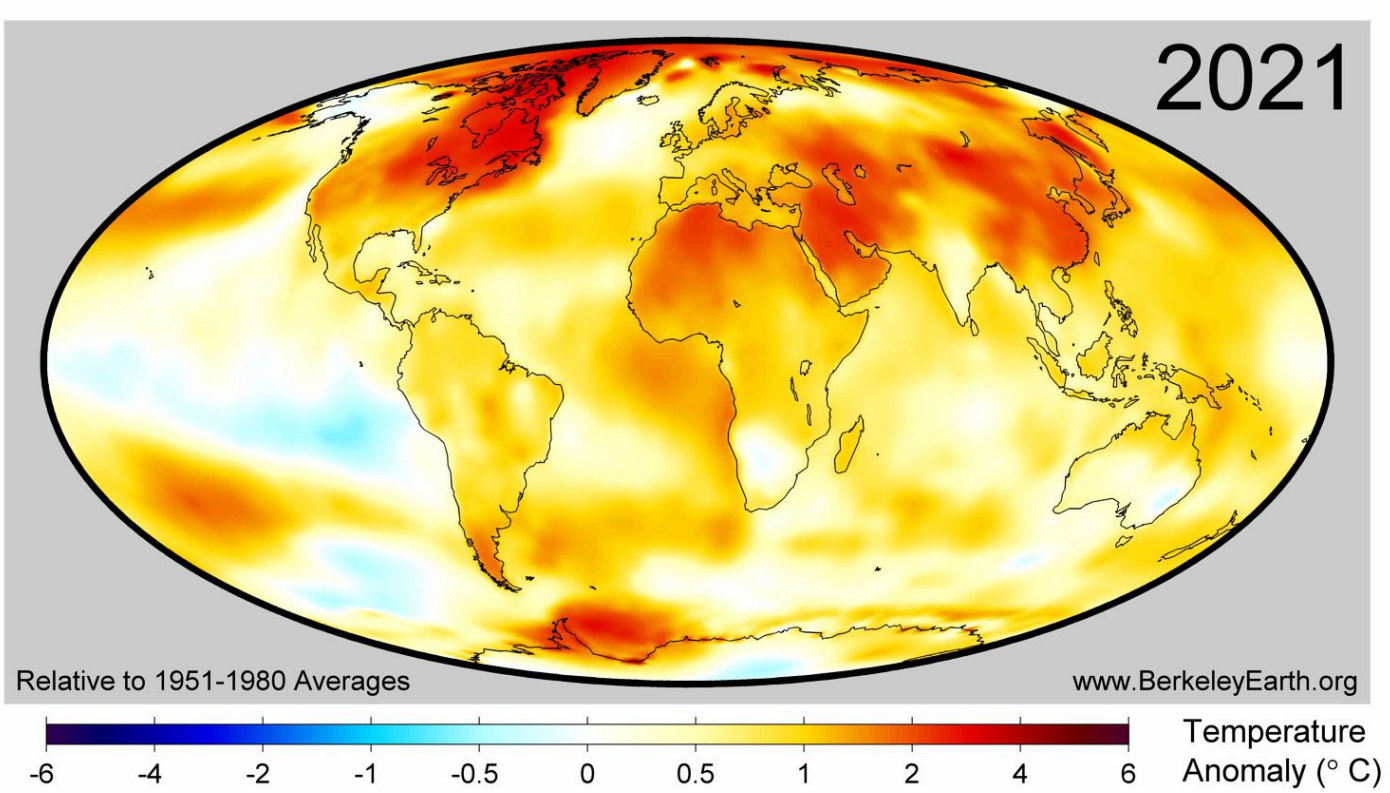
The Temperature Increase Is Not Spatially Homogeneous



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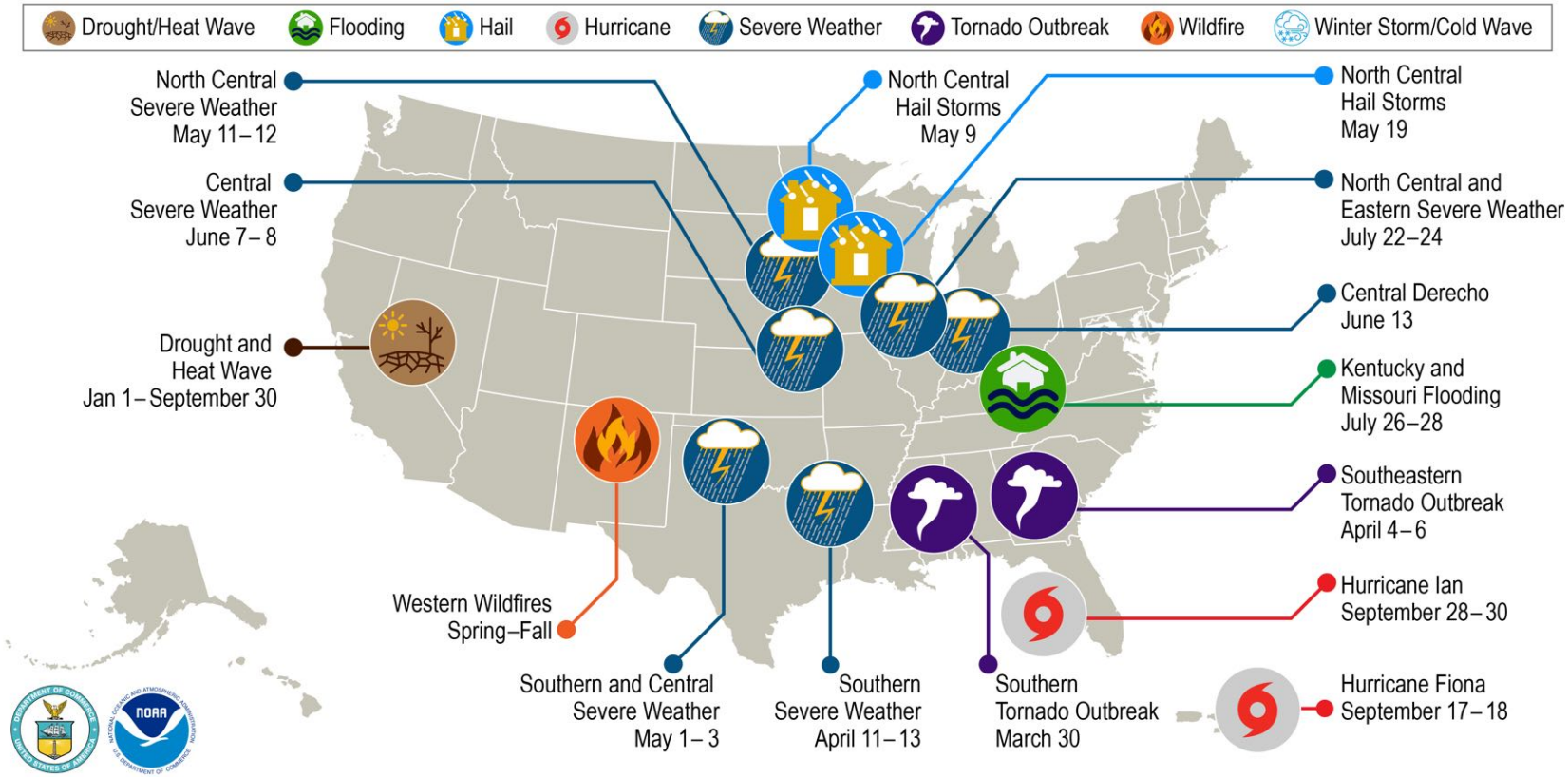
U.S. 2022 Billion-Dollar Weather and Climate Disasters



*This map denotes the approximate location for each of the **15 separate billion-dollar weather and climate disasters that impacted the United States January – September of 2022.***

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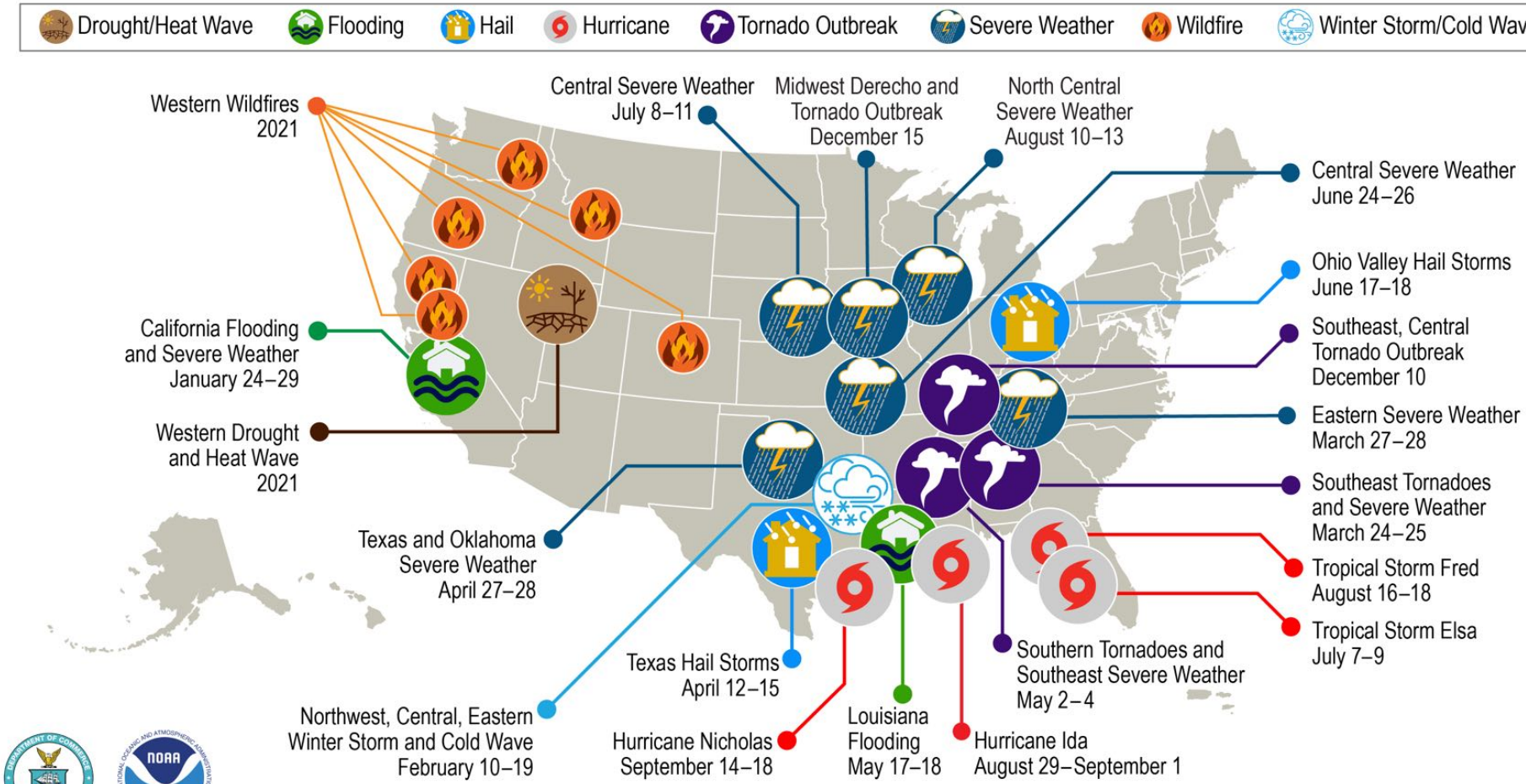
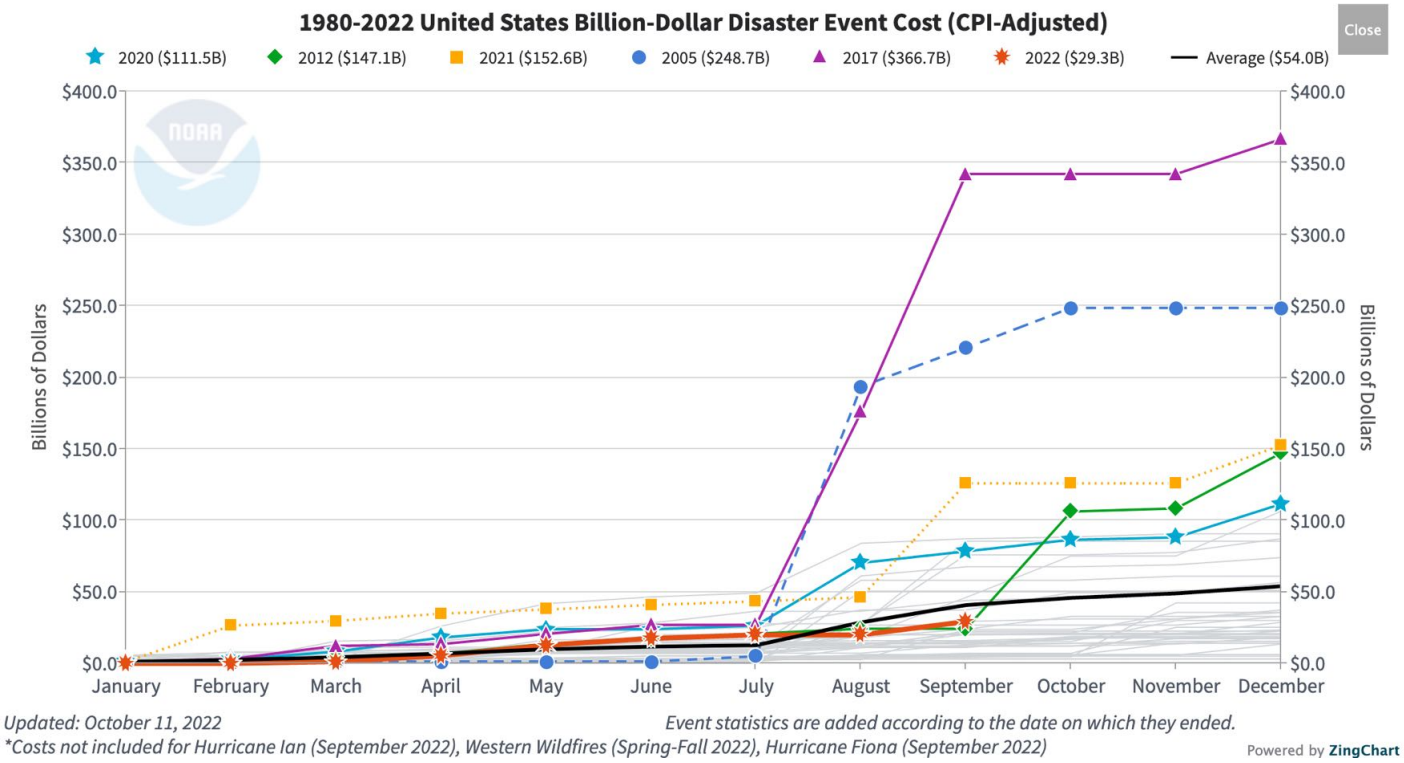
U.S. 2021 Billion-Dollar Weather and Climate Disasters



*This map denotes the approximate location for each of the **20 separate billion-dollar weather and climate disasters that impacted the United States in 2021***



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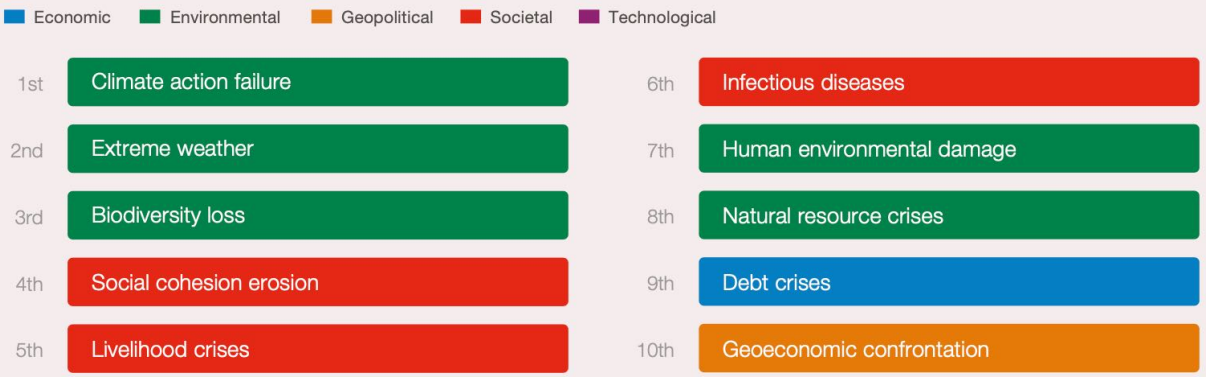
The Global Risks Report 2022

17th Edition

INSIGHT REPORT

FIGURE 1.3

"Identify the most severe risks on a global scale over the next 10 years"



Source: World Economic Forum Global Risks Perception Survey 2021-2022

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The Energy-Environment Nexus

different energy production modes have implications for climate forcers, weather and climate patterns

climate changes feedback on the efficiency and sustainability of energy production

Climate Solutions
urban infrastructure, alternative energy, or climate intervention have varied efficacy under changed climates and affect climate

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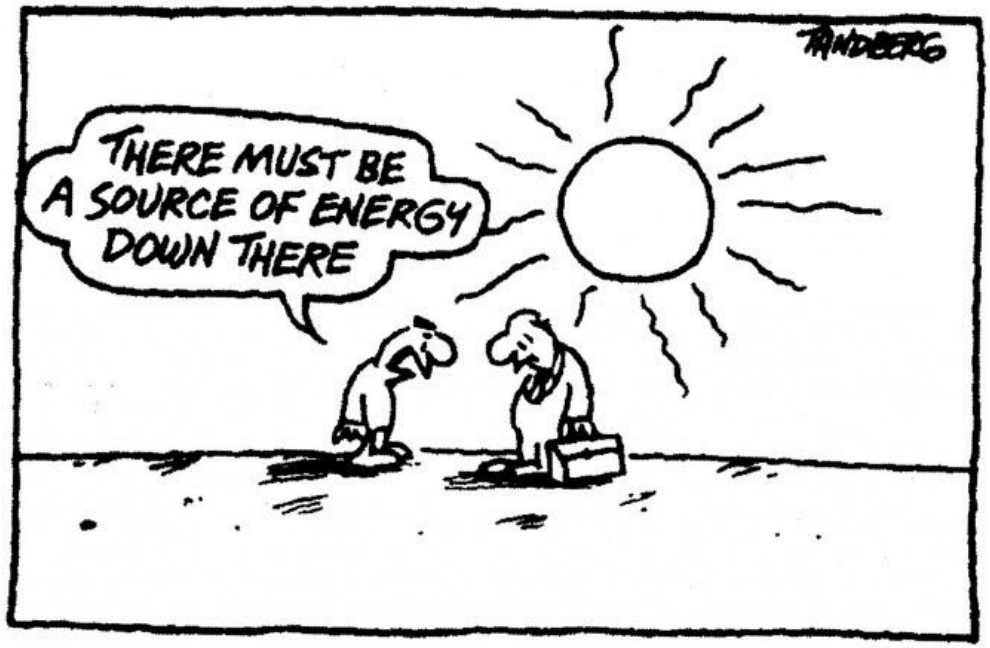

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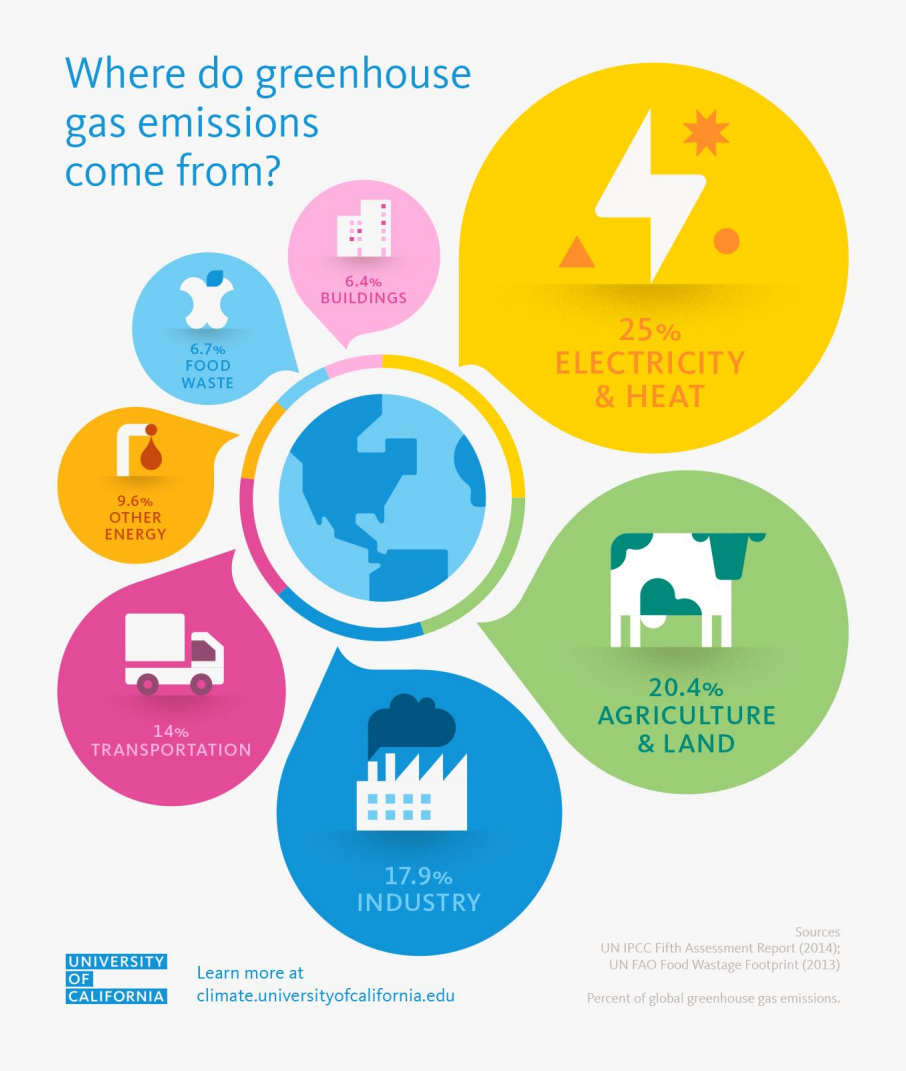

There is no single piece of the economy that accounts for greenhouse gas emissions and climate change…

…so there is no single, simple solution.

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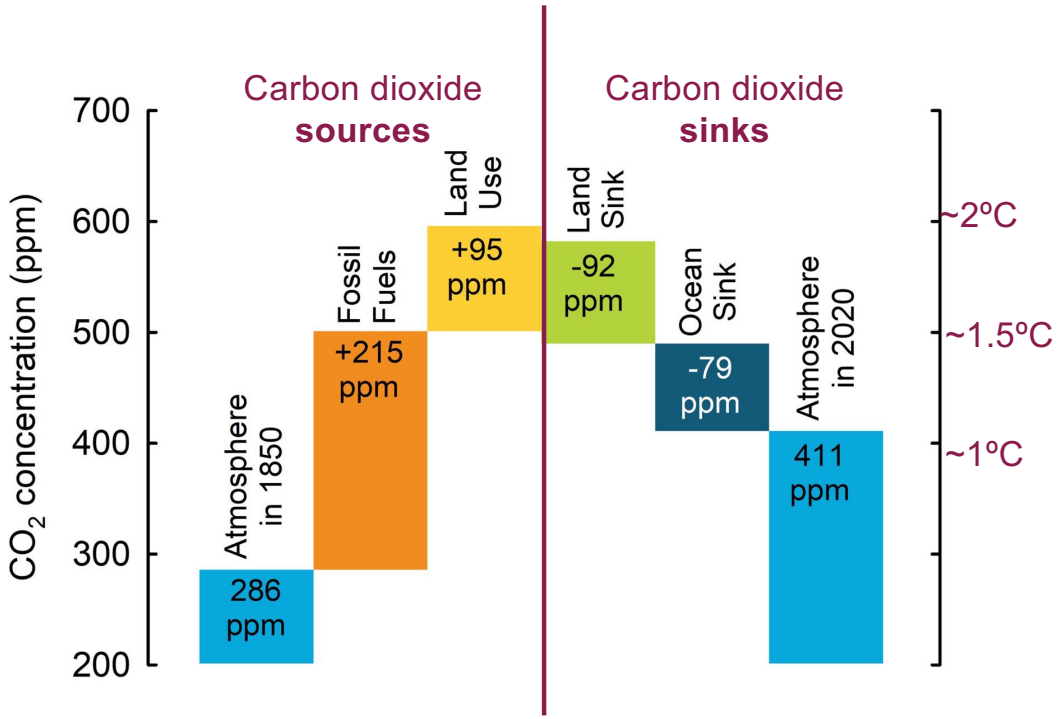

Paris Accord Limit

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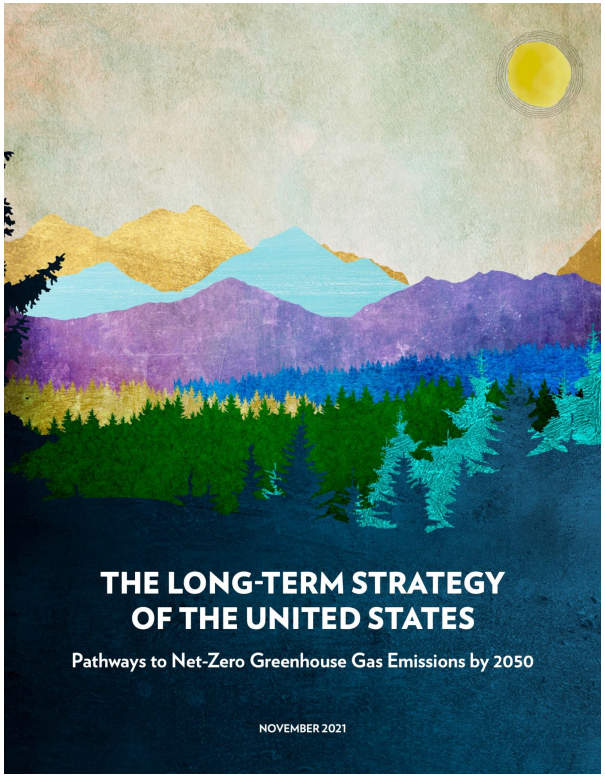
U.S. Plans for Climate Change, Clean Energy, and Environmental Justice



What:

- 50-52% GHG emissions reduction by 2030 (from 2005 levels)
- 100% carbon pollution-free power sector by 2035
- Net-zero economy by 2050

How:

- Inflation Reduction Act
  - Clean Energy Loans ($3.6B)
  - Energy Infrastructure Reinvestment ($5B)
  - Advanced Technology Manufacturing ($3B)
  - Tribal Energy Loan ($75M)
- CHIPS and Science Act
  - Energy Innovation
  - Semiconductor R&D
  - Workforce development
  - Manufacturing
- Nature-based Solutions
- Geoengineering

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Solutions & Approaches to Climate Change Mitigation

Fossil Fuels Phase-out, Renewables, Green Tech, Electric Mobility, Reforestation, Plant-based Diet, Carbon Capture …

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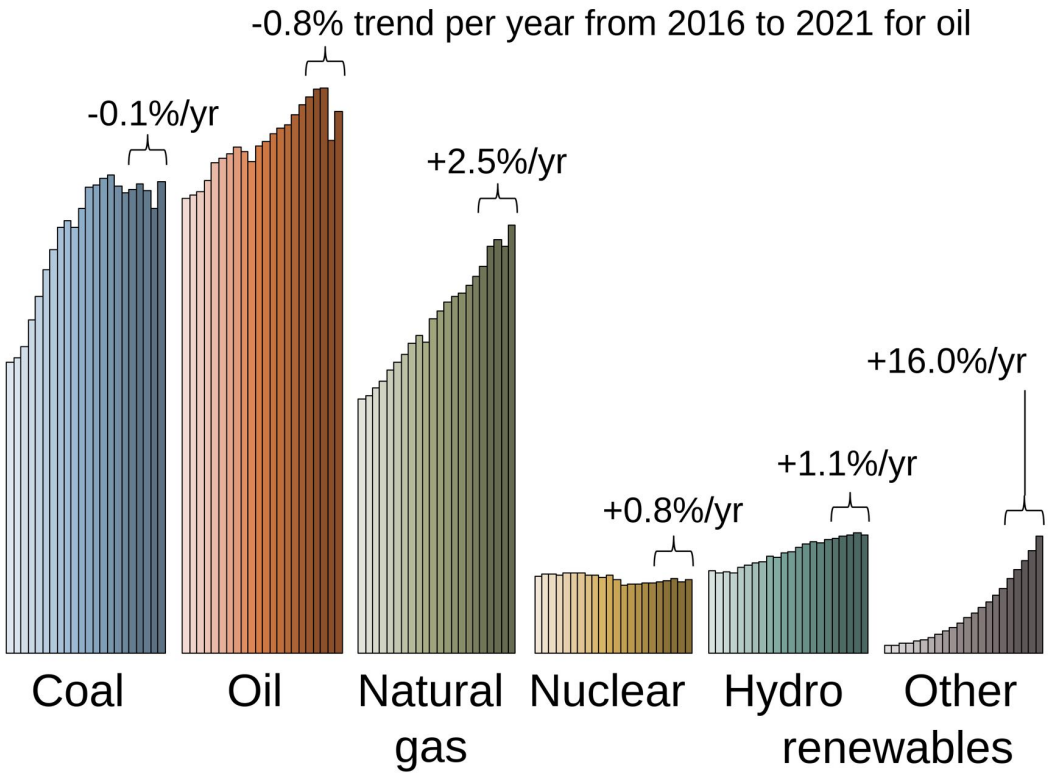
Global energy consumption, 2000 to 2021



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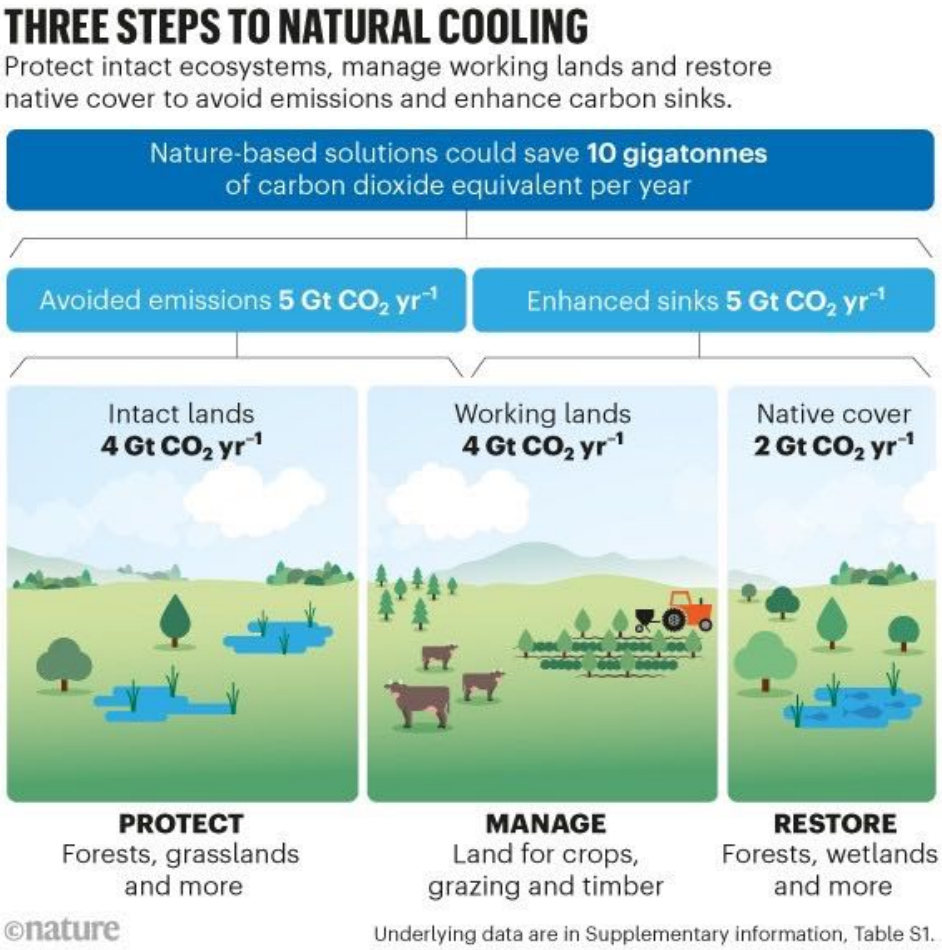
Nature-Based Climate Solutions

A counterpart to technological solutions

Can account for up to 37% of emissions reductions needed to stay below 2ºC by 2030



Come with ecological, economic, societal, and health benefits

- Cleaner air and water
- Preservation of biodiversity
- Preservation of soil cover and quality

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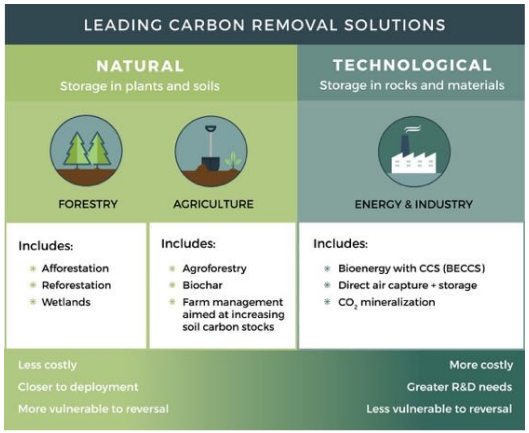
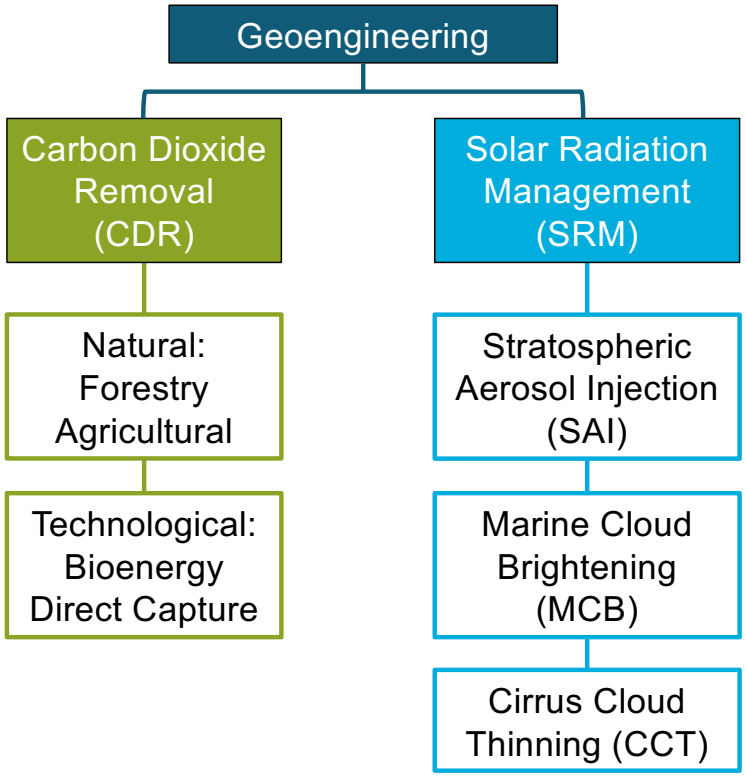
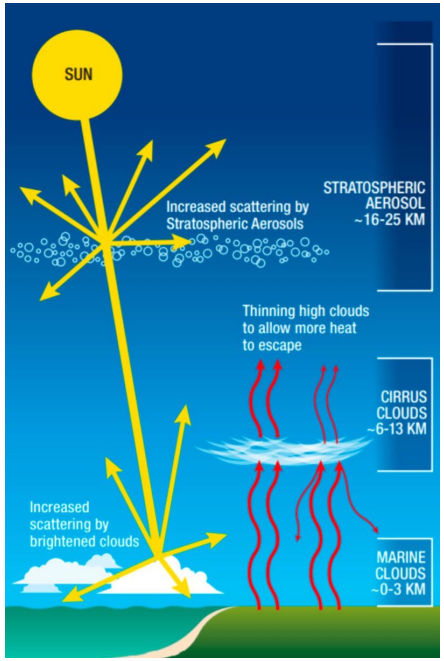
Climate Intervention/Geoengineering 101







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Cover art of New York 2140, by Kim Stanley Robinson

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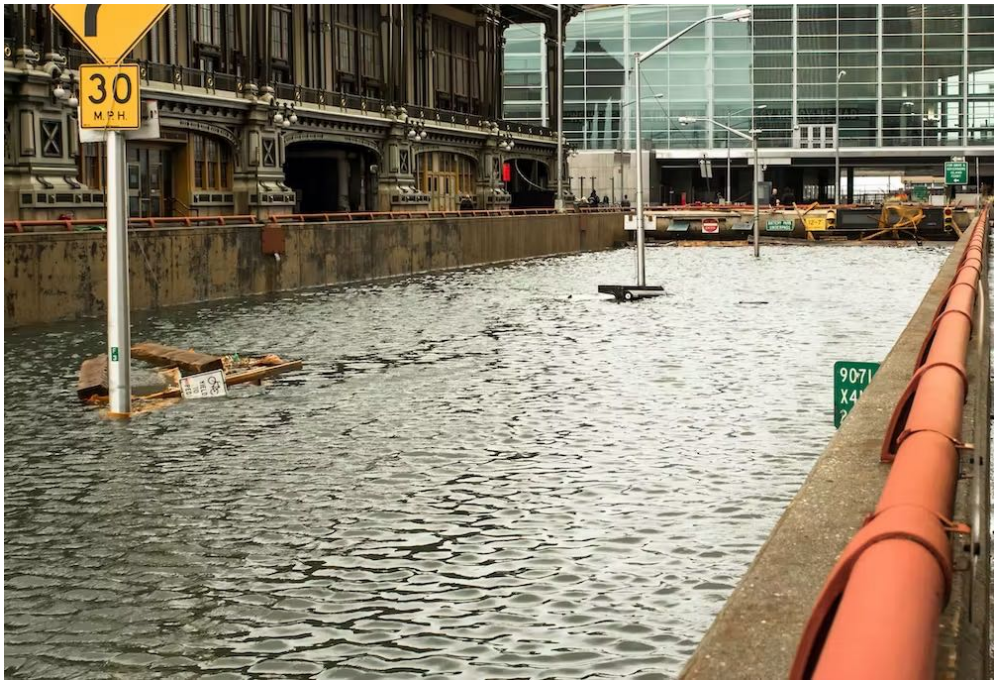

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NEW YORK'S CLIMATE LEADERSHIP and COMMUNITY PROTECTION ACT

Environmental Justice (EJ40)
40% of benefits directed to underserved communities

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The Solution Space

Technological solutions

Electrify all possible sectors

Decarbonize electricity – develop wind, solar, nuclear, hydropower

Requires new infrastructure

Adopt heat pump technology

Develop alternative fuels

Nature-based Solutions

Protect

Manage

Restore

Behavioral Solutions

Reduce food waste

Reduce energy usage

Adopt a plant-based diet

Drive and fly less (or get an EV)

Choose to live in a walkable community

Educate girls

Personal and Business Step to Climate Action

Educate yourself

- Use reputable sources
- What are the issues?
- What are the solutions?

Understand business requirements to avoid financial penalties

Assess what you can do

- Choose one simple action…then another and another
- Focus on actions that fit your interests and lifestyle or business needs

…then educate others

As business leaders in your community you have power and influence

VOTE!

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