OLLI Climate Change 2025 - Jan 28

This weeks main topics:

Nuclear

Heat Pumps

Biofuels

Carbon Storage

Last week

Moss landing battery facility fire. Local concerns about toxic air pollution have triggered a citizen testing program.

Hopefully the problems will be honestly addressed and prevented in the future.

WE NEED BATTERIES.

Detailed report click Jan 28 packet

Link to Lookout Article

Other recent news

Giant Antarctic Iceberg

Giant iceberg on crash course with island - penguins and seals in danger
© Getty Images

Giant iceberg on crash course with island - penguins and seals in danger
© Getty Images

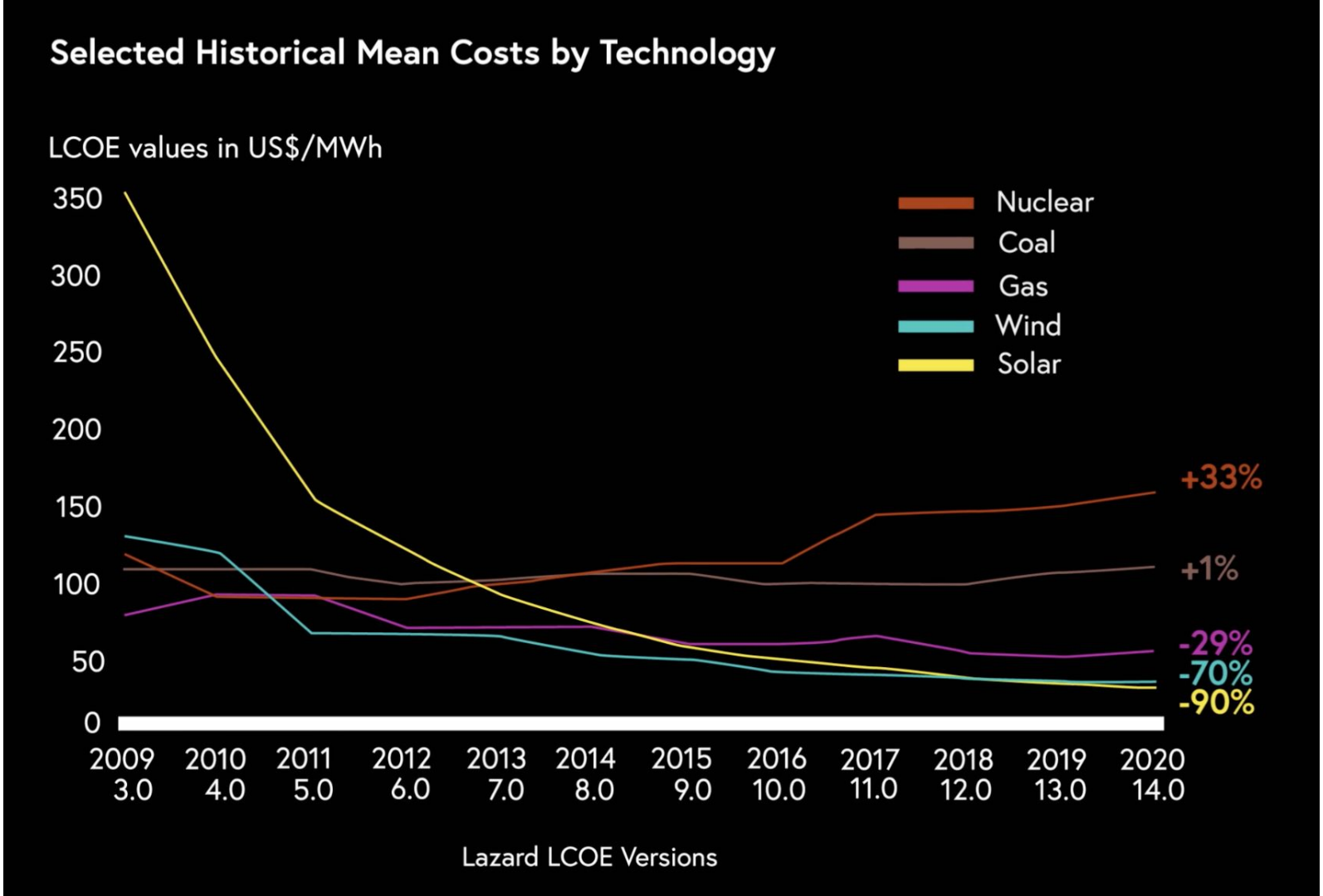
A23a is heading for S. Georgia island - size is between Delaware and Rhode island.

Great recent novel “The Fragment” by Craig Russell featured an even bigger berg and a climate denier US president.

Slowing Down Wind Energy?

Wind is now so much cleaner, safer and CHEAPER than fossil fuels that it makes no sense to curtail it - even if you deny climate change!

Let’s hope sanity prevails!


Selected Historical Mean Costs by Technology
LCOE values in US$/MWh
350
300
250
200
150
100
50
0
Nuclear
Coal
Gas
Wind
Solar
+33%
+1%
-29%
-70%
-90%
2009 3.0
2010 4.0
2011 5.0
2012 6.0
2013 7.0
2014 8.0
2015 9.0
2016 10.0
2017 11.0
2018 12.0
2019 13.0
2020 14.0
Lazard LCOE Versions

Wind Energy needs materials BUT

Did You Know?

The United States already has the recycling capacity tocost-effectively and sustainably recycle over 90% of projected wind turbine waste by 2050, meaning that 90% of the mass of (current and future projected) wind turbine materials that have reached the end of their useful livescan be transformed into value-added products. Learn more.

Nuclear Energy a Climate Solution?

Jan 6 2025 SC CAN presentation

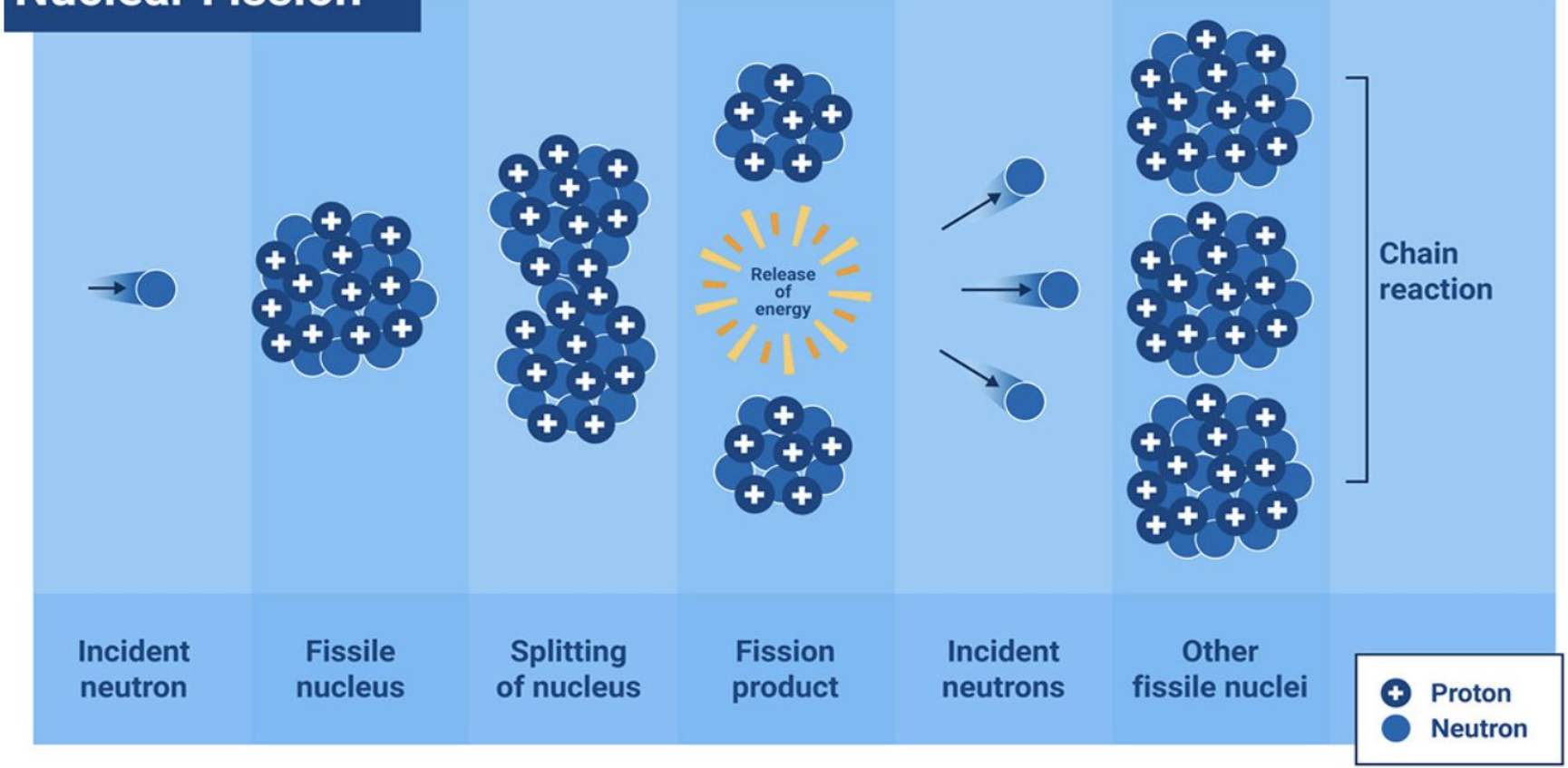
Includes presentations from 2 local experts and

Movie – **Atomic Bamboozle** – vimeo ($4.99) – free viewing for UCSC at McHenry Library

Comparison between Nuclear power and atomic bombs

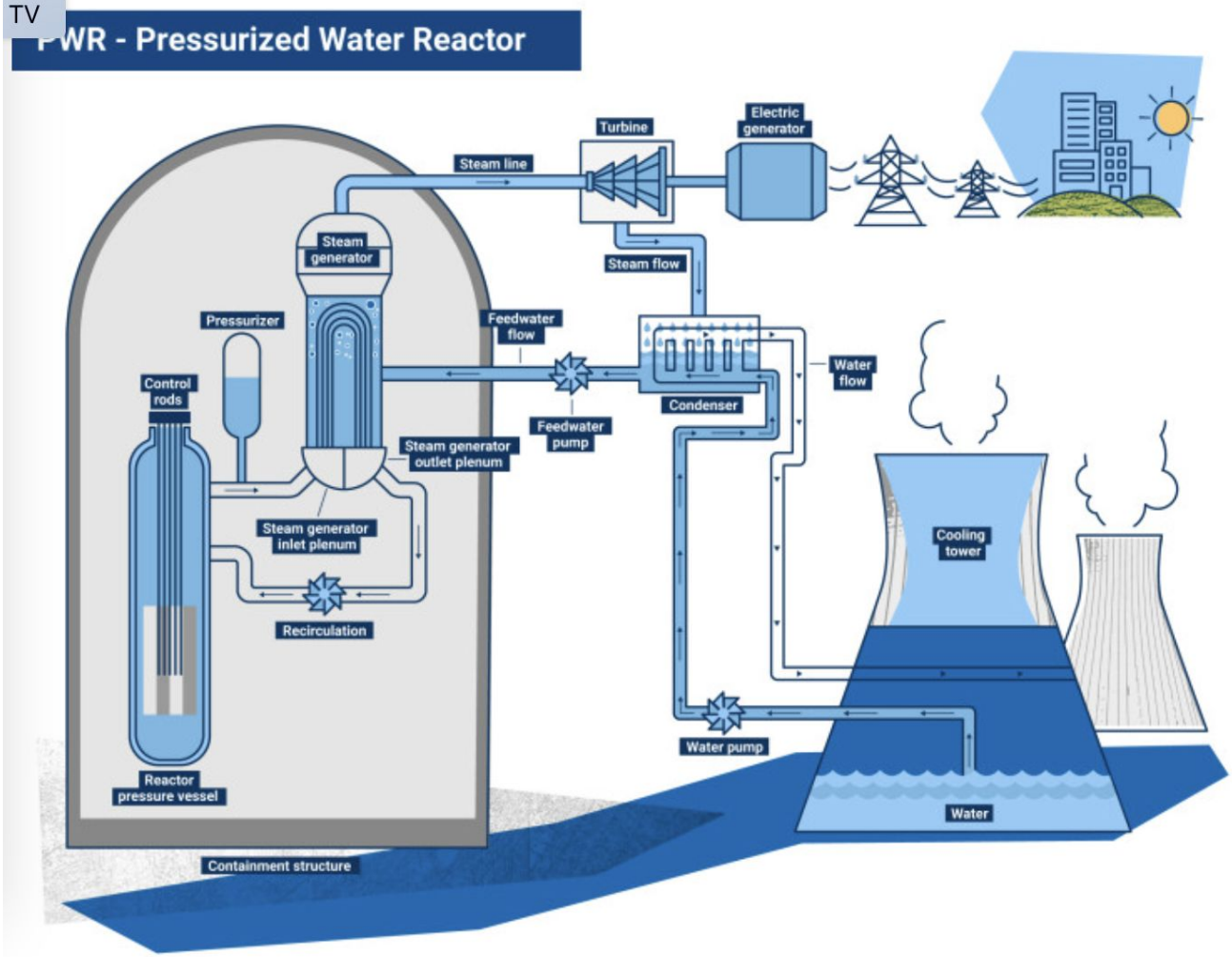
Both currently use FISSION of Uranium235 in a chain reaction

Energy	**Bombs**
4% U 235	90% U 235
Engineered to continue very **SLOWLY**	Engineered to be as **rapid as possible**



Nuclear fission (Graphic: A. Vargas/IAEA)

TV


PWR - Pressurized Water Reactor
Turbine
Electric generator
Steam line
Steam generator
Steam flow
Pressurizer
Feedwater flow
Water flow
Control rods
Condenser
Feedwater pump
Steam generator outlet plenum
Steam generator inlet plenum
Cooling tower
Recirculation
Water pump
Reactor pressure vessel
Water
Containment structure

Richard Nolthenius. Cabrillo College

Nuclear Update

Molten salt thorium breeder reactors - major advantages,

The mis-represented costs of nuclear power

Comparisons of the material/land impact of solar/wind vs.

PWR nuclear and MSR nuclear

Thorium *vs.* Uranium

- U^{235} supplies will exhaust with current designs in a matter of ~century, but with breeders, using Thorium could last for well over 1000 years at current power needs (Shu 2011).
- There's enough thorium lying around already in mine tailings to power the globe for the rest of the century or more.
- Uranium reactors require large starter of U^{235} for fast neutrons for fissioning other nuclei. U^{235} is only 0.7% of natural uranium.
- **But Thorium is 400x more abundant than U^{235}**

MSTR: Molten Salt Thorium Breeder Reactors – The Solution?

- **Breeder reactors convert long-lived radioactive waste products into power and into short-lived radioactive waste** – requiring storage for ~several centuries, rather than tens of thousands of years as with conventional reactors.
- The volume of the end produce short-lived radioactive wastes is less than 1/10 that of conventional PWR spent fuel
- They produce nuclear fuel as they run, and so are also extremely fuel-efficient.

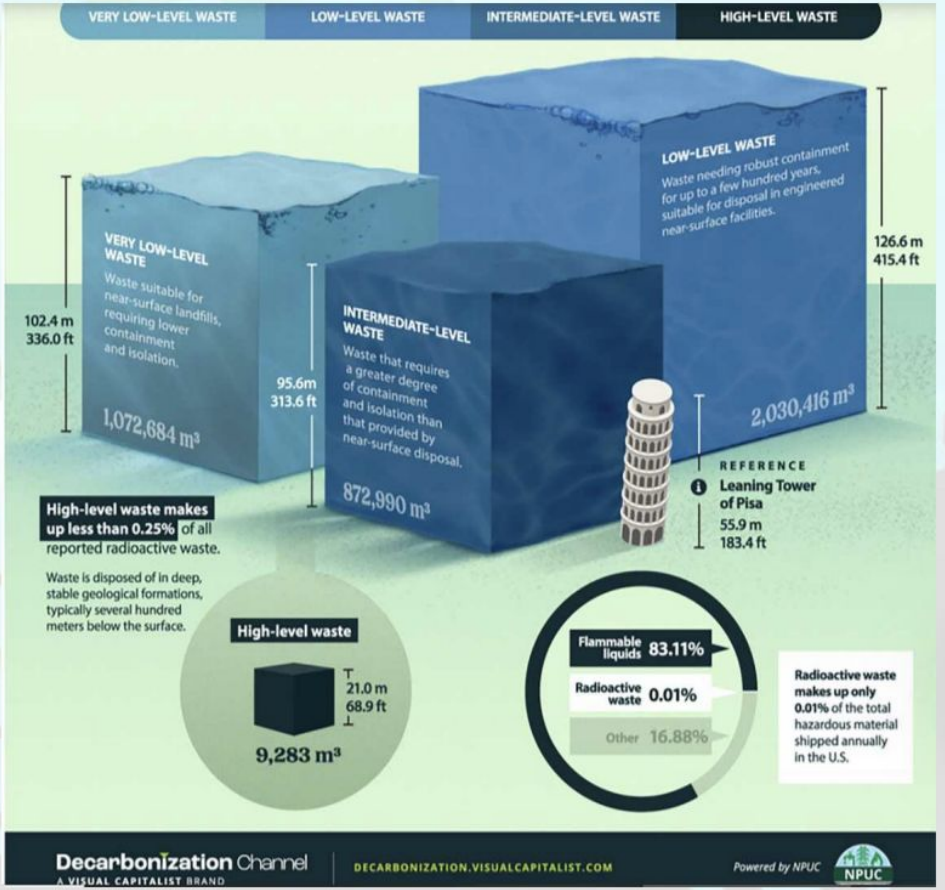
- Capital costs are only ~25% higher than for conventional PWR reactors.
- With the abundance of Uranium, Thorium breeders were not thought economical, however with the worries about radioactive waste storage and uranium not abundant enough to completely power the world, they are now more interesting.

Advantages of Molten Salt Thorium Breeder Design

- Cannot explode. Impossible.
- No pressurized container needed since operates at standard atmospheric pressure. Flouride salts have melting points in the 700C range which gives good Carnot energy efficiency.
- PWR's must get high efficiency by using water with a boiling temperature much higher than the standard atmosphereic pressure's boil=100 C. Only achievable by high pressure, hence the massive concrete re-bar'd domes you see.
- Material needs for MSTR's therefore **much** lower
- New designs of MSTR's have much better resistance to neutron damage than current PWR's, but even PWR's are designed to last ~50-60 years.

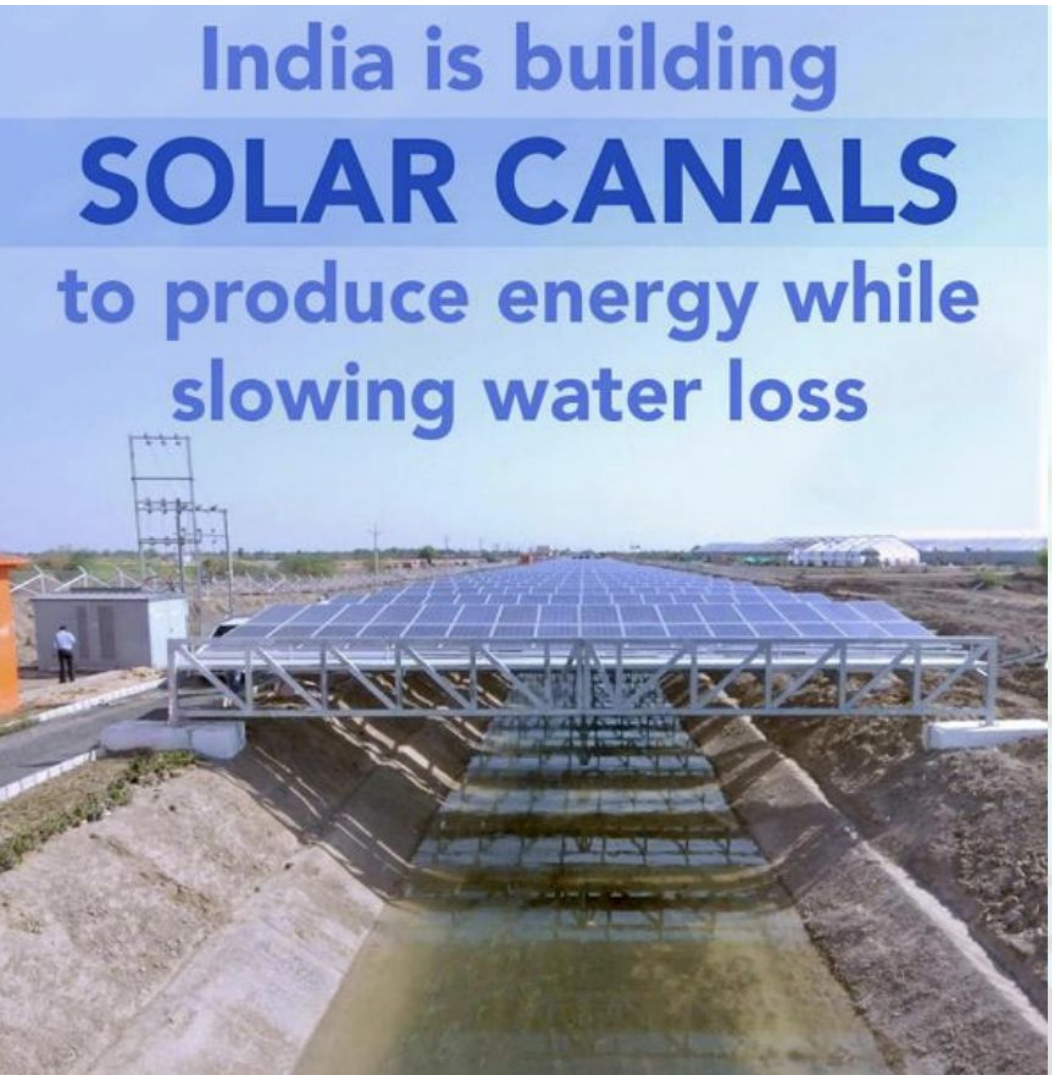
But Rick! What About…

- **The huge amount of nuclear waste that power plants produce!** In fact, nuclear power supplies 20% of all U.S. Electricity today. The total volume of spent fuel over an entire year… would barely fill a backyard swimming pool (U.S. govt energy).
- Total of all nuclear waste globally over history, is still tiny compared to the mine tailings needed to make solar and wind installations. Much of that is from nuclear medicine as well. And we don't recycle our nuclear fuel. We should, like France does.



Land: Nuclear Wins Dramatically

- The value and cost of land is almost never explicitly considered by the anti-nuclear people. Wilderness is valued as worthless economically. Yet in a world where un-trampled nature is disappearing fast, including due to climate change… consider the land needed for equivalent power generation (2.2 billion watts electricity, or 2.2GWe): 67 min into this talk
- Nuclear: 750 acres (most is left wilderness surroundings); consider Diablo Canyon, whose power plant sits on only 12 acres.
- **Solar PV: 100,000 acres (more if include storage)**
- **Wind: 400,000 acres (more if include storage)**
- **To summarize with images…**



Solar panels covering canals.

This is surface area put to good use, cutting evaporation as well.

I'm Out of Time…

- I fear that none of these points will change anti-nuke minds
- Speaking of which – FEAR. That is what I believe lies behind this pessimistic reality
- Radioactivity is invisible, and the physics feels complicated and tech'y and scary to too many people.
- I will leave you with images of Hiroshima and Nagasaki. Remember that : **80% of the residual radiation was gone just 24 hrs after the bomb drops. And nuclear weapons are far more radiatively potent than nuclear power.**

- Stephen Williams will now lay out some numbers and points to shrink the issue of radioactivity into proper scale.

Hiroshima – Has long been a thriving City

Stephen Williams - **Repackaging Nuclear Power?**

- critical review of Atomic Bamboozle video

Review SMR designs focusing on new ones

- simpler to run and candidates for mass production.

Debunking other points from Bamboozle including

Costs, **Accidents**, **Proliferation**, **Waste**

Good reference

Today's SMRs Are a New Generation of Reactors

- Reactors are grouped in four categories:
  - Gen I - Earliest, most basic designs for public use (1950s)
  - Gen II - Began to be deployed in late 1960s, improved on Gen I designs; almost all reactors in U.S. are Gen II LWR*s
  - Gen III - Numerous improvements on Gen II designs, including safety
  - Gen IV - Simplifies reactor designs, making them even safer and enabling production of high heat for doing work
- Today's SMRs are all Gen III and Gen IV technologies, which are, by definition, "advanced" reactors that are *significantly different* from Gen II LWRs

*Light Water Reactor

Stephen's presentation in full

Display 7,8,9

14,15,16

19

23

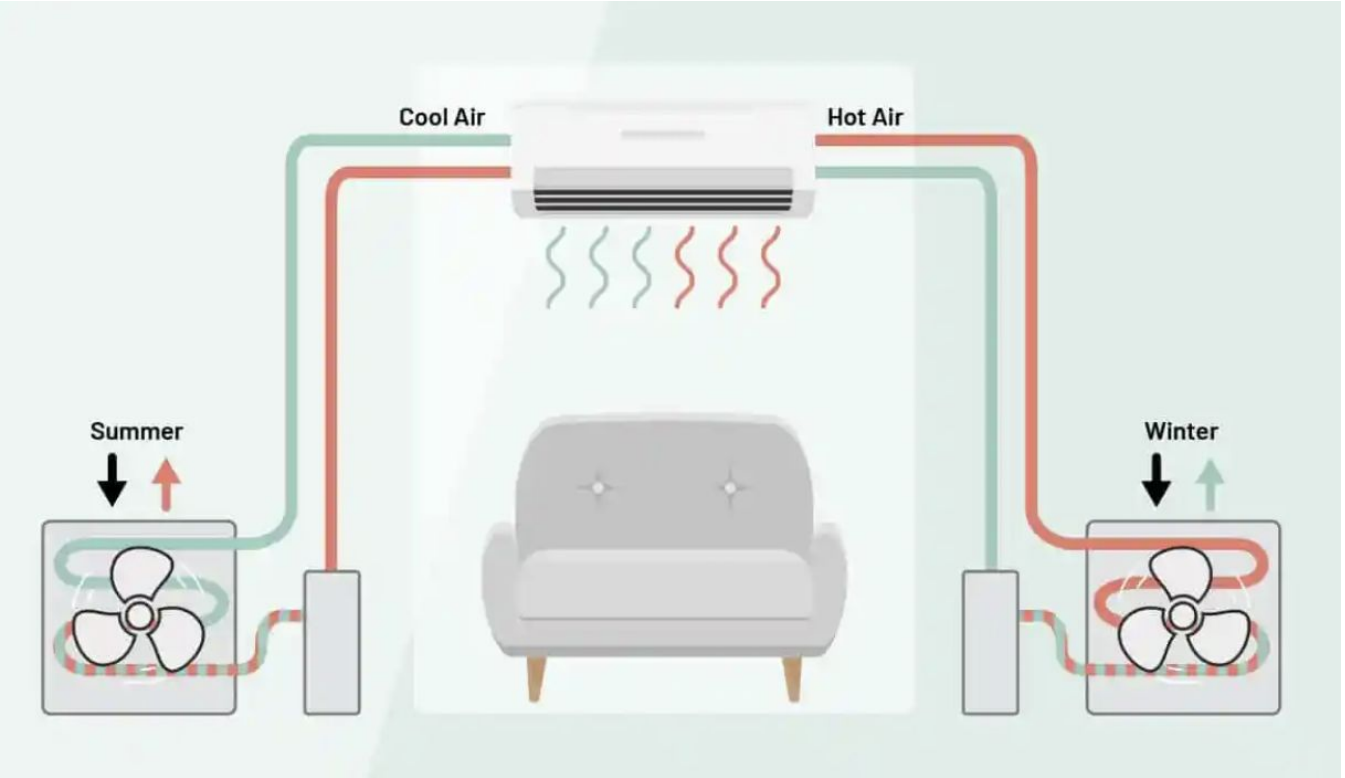
26

29

Wind and Solar provide clean Energy and heat pumps are super efficient for heating and cooling

Home Electrification - Heat Pumps

Heat pumps need very little power because they only MOVE heat - they don’t generate it. Water heaters are a good place to start.



Heat Pumps - home and water heating

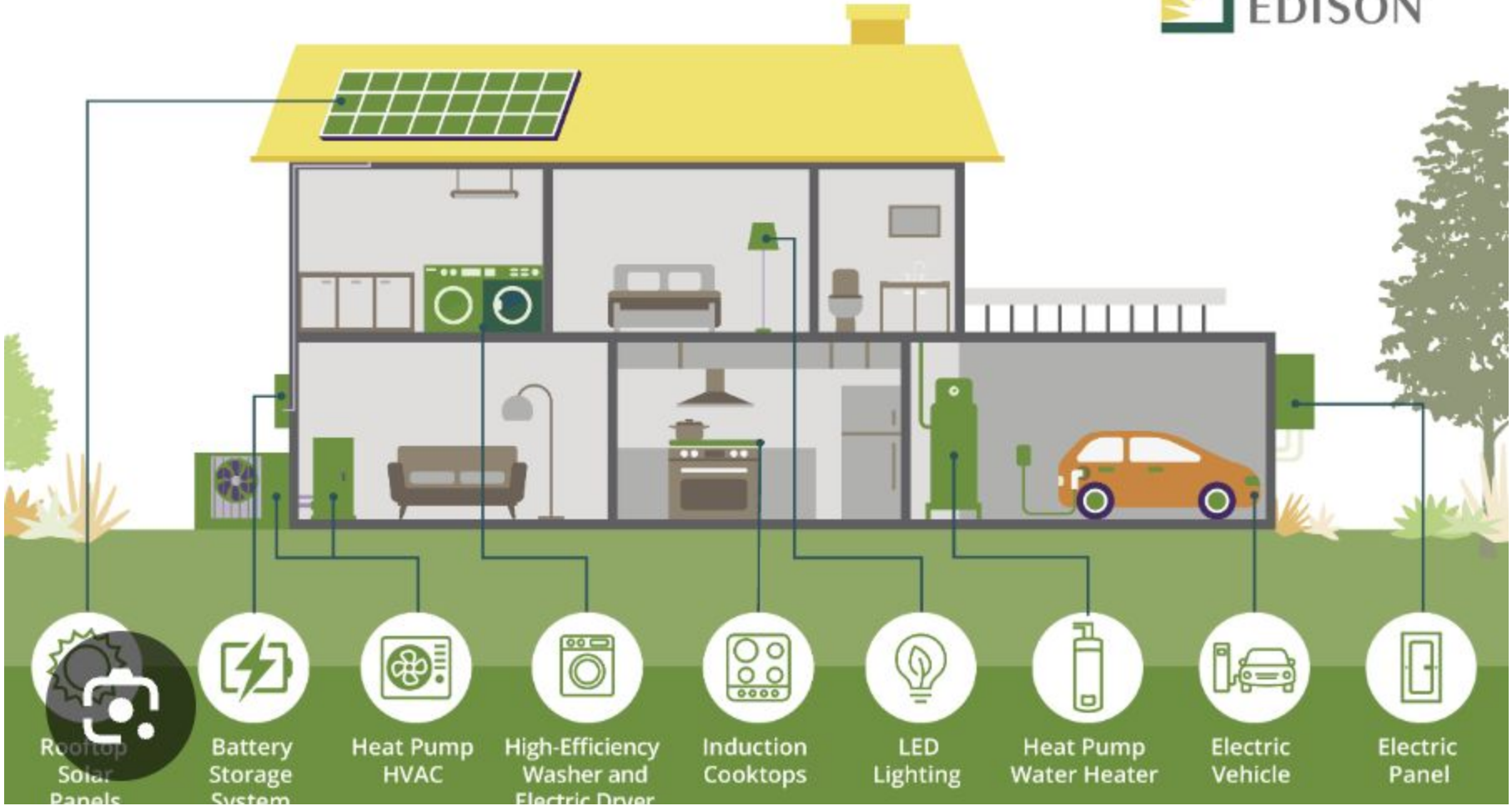
The Switch is On https://switchison.org/
Great CA website with links to local installers and rebates.
Since water heaters typically last 10-15 years, cities are working to get people to replace their older water heaters with heat pumps now.
Heat pump systems will save hugely on bills as they need only about ¼ of the energy gas heaters use.

Insulating & air sealing:
Heating system's job is easier.

Higher efficiency heat pump:
Heating up to daytime temperature
takes less electricity.

Excellent rebates now available for Heat Pump systems

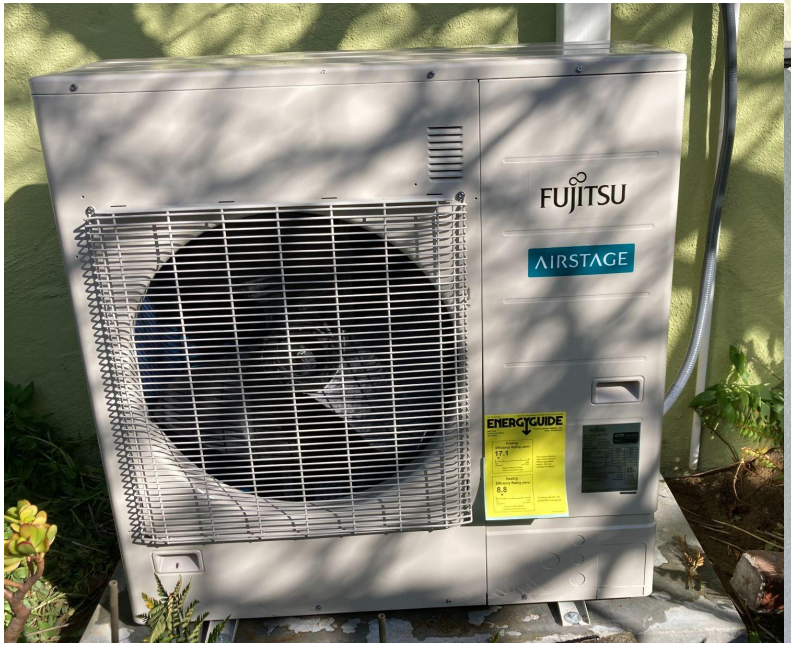
Future all electric house

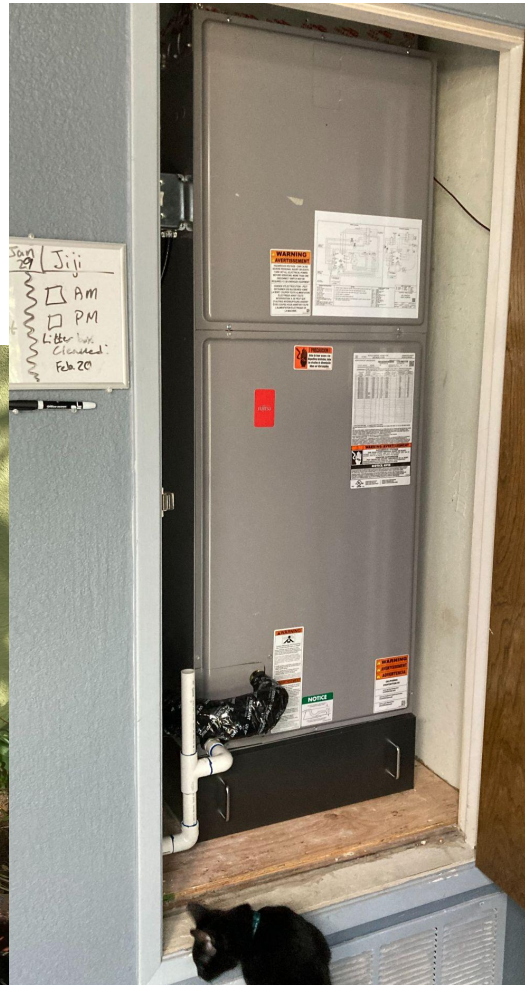


Example of an Home Heating Pump

The downstairs house is 1300 sq ft, 3 bedrooms, 2 bathrooms

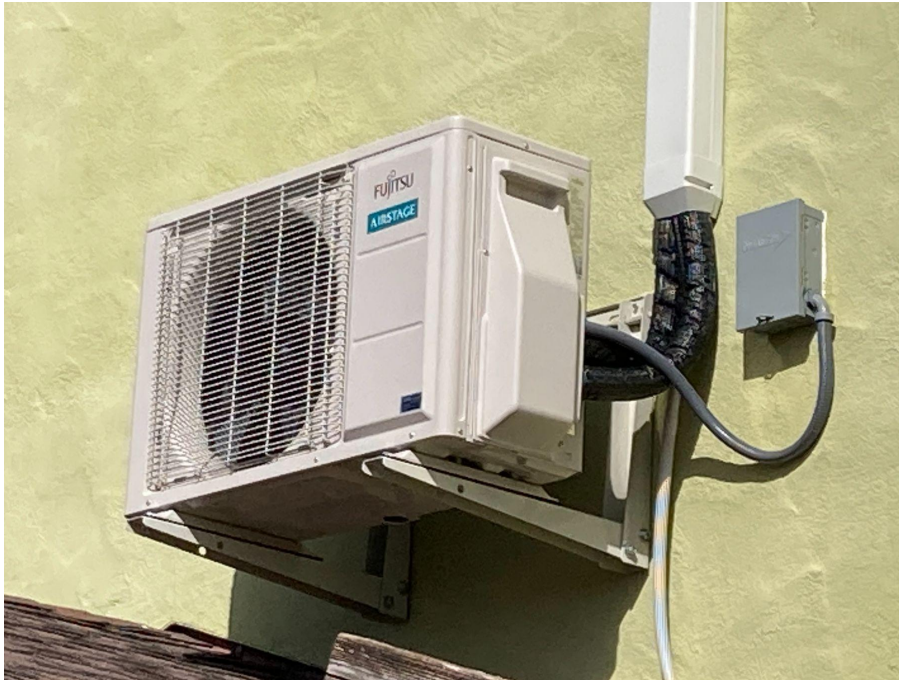
It previously had a gas furnace with ducting. It was still working but 23 yrs old. Now replaced with a heat pump.





Home heating pumps

For my upstairs 500 sq ft studio a small heat pump works fine.



Non-ducted mini split on 2 sides of an outside wall

Types of Heat Pump Systems

Mini split - split because the condenser is outside and the heat detector/mover is on the inside.
For a modest house a **ducted mini split** system uses the old ducting from your gas furnace and places the inside fan unit where your furnace used to be. The condenser is outside. The connecting lines are narrow and pretty easy to install.

Types of Heat Pump Systems Cont.

For a studio with no ducts the two units are just on opposite sides of an outside wall - **non ducted mini split.**
For bigger buildings several units might be installed controlling different areas.

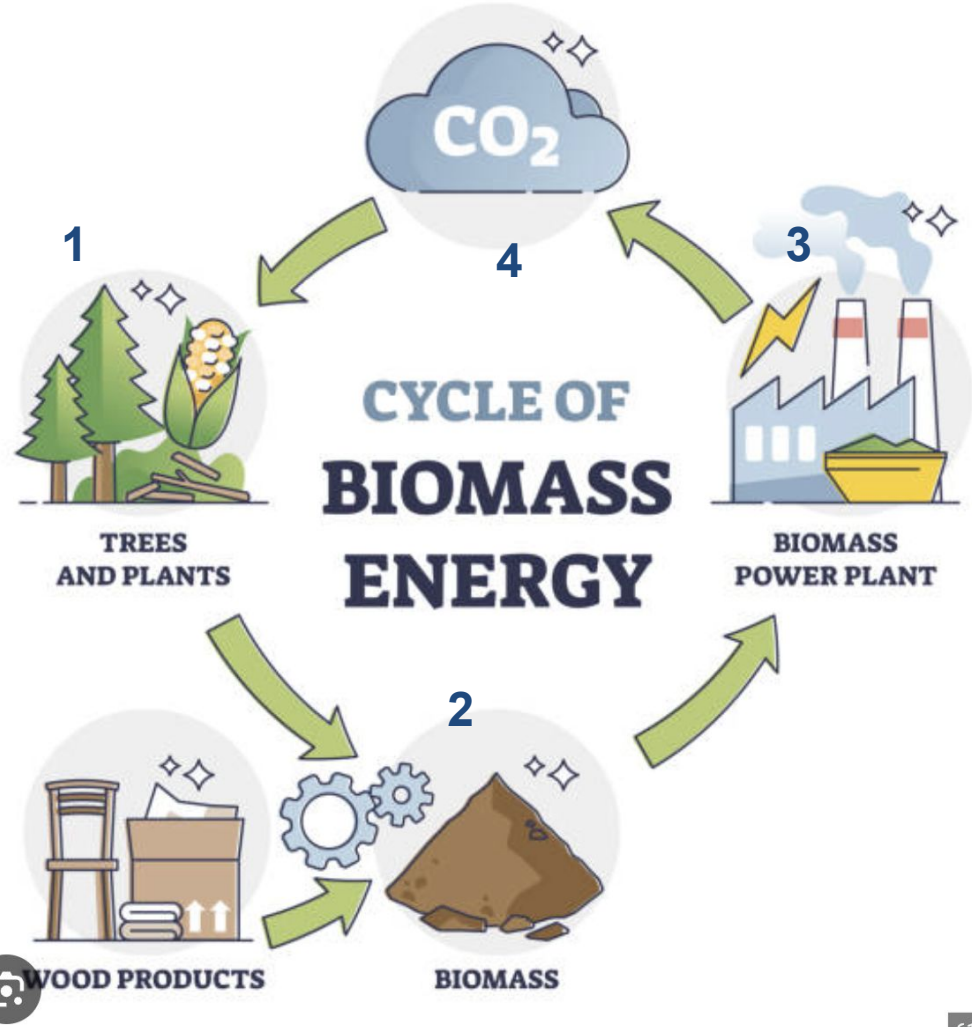
Biofuels

If plants could be harvested sustainably with REGROWTH and
Transformed into fuel without creating pollution that would be great!
BUT in many cases there are huge problems

Wood Pellet Proposals in Ca

GSNR plan includes cutting forests in Tuolumne and Lassen counties, setting up a shipping facility in Stockton and selling the pellets to the UK. All these Ca sites will suffer from air pollution and when burnt the pellets are worse than coal!

Wood Pellet problem article

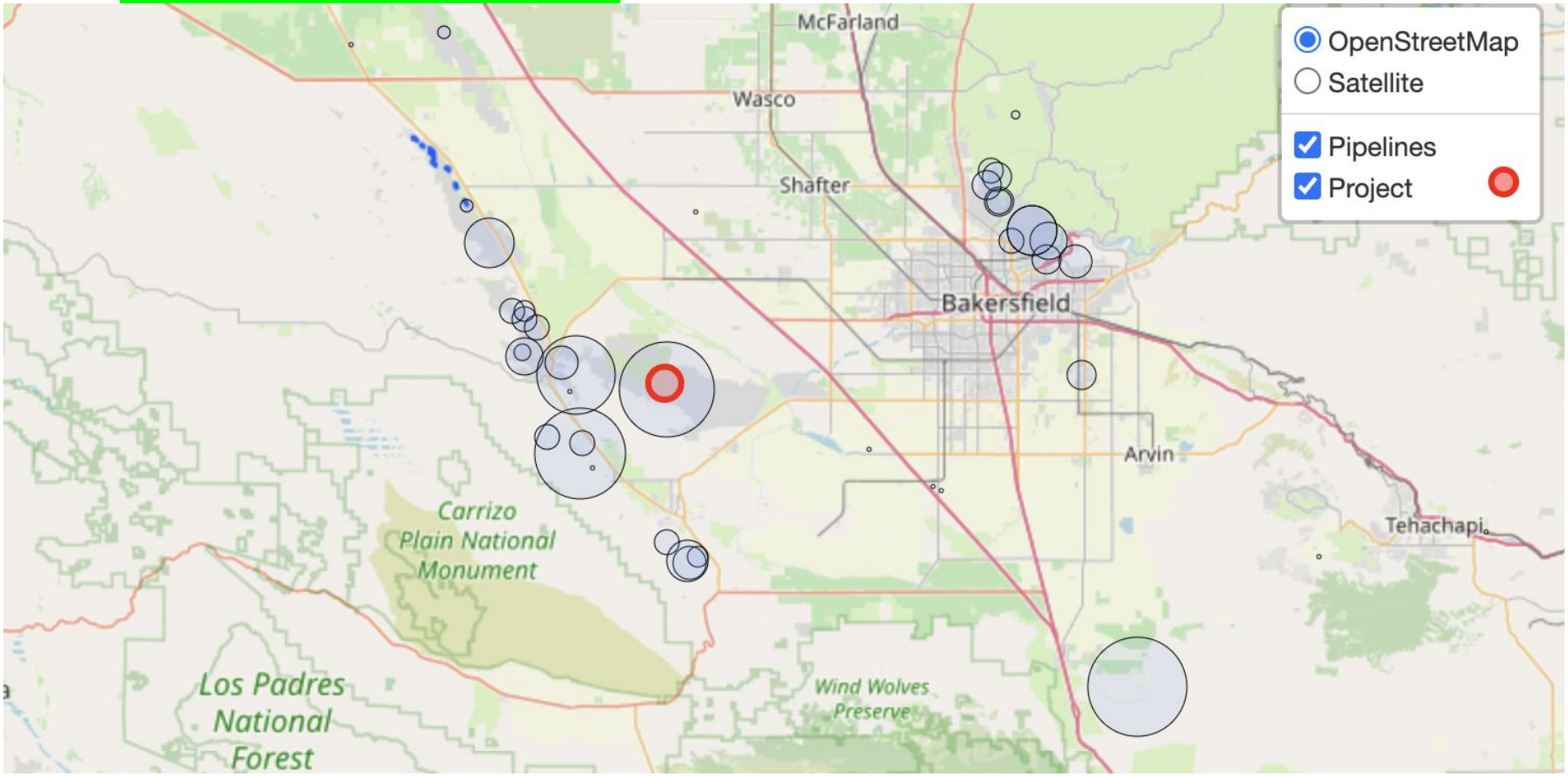


1. Replanting not shown and trees need 20-50 years to mature
2. Logging causes environmental damage and release of CO_2 .
3. Polluting energy is used.
4. Power plant produces lots of pollution including cancerous PM2.5 and other gases.
5. Not much of the CO2 will be absorbed by new trees

Carbon Capture and Storage CCS Problems - link

- At this point, **capture** technology is sadly inefficient.
- Currently, **oil refineries are planning CCS**. Even if they could capture the CO_2 at the facility, much **more is released when the fuel is used**.
- Underground **storage** in CA oil areas seems fraught with **danger of poisonous leakage** from corroded pipes.
  - Abandoned wells are prone to leak.
  - Past and future earthquakes increase the problems.

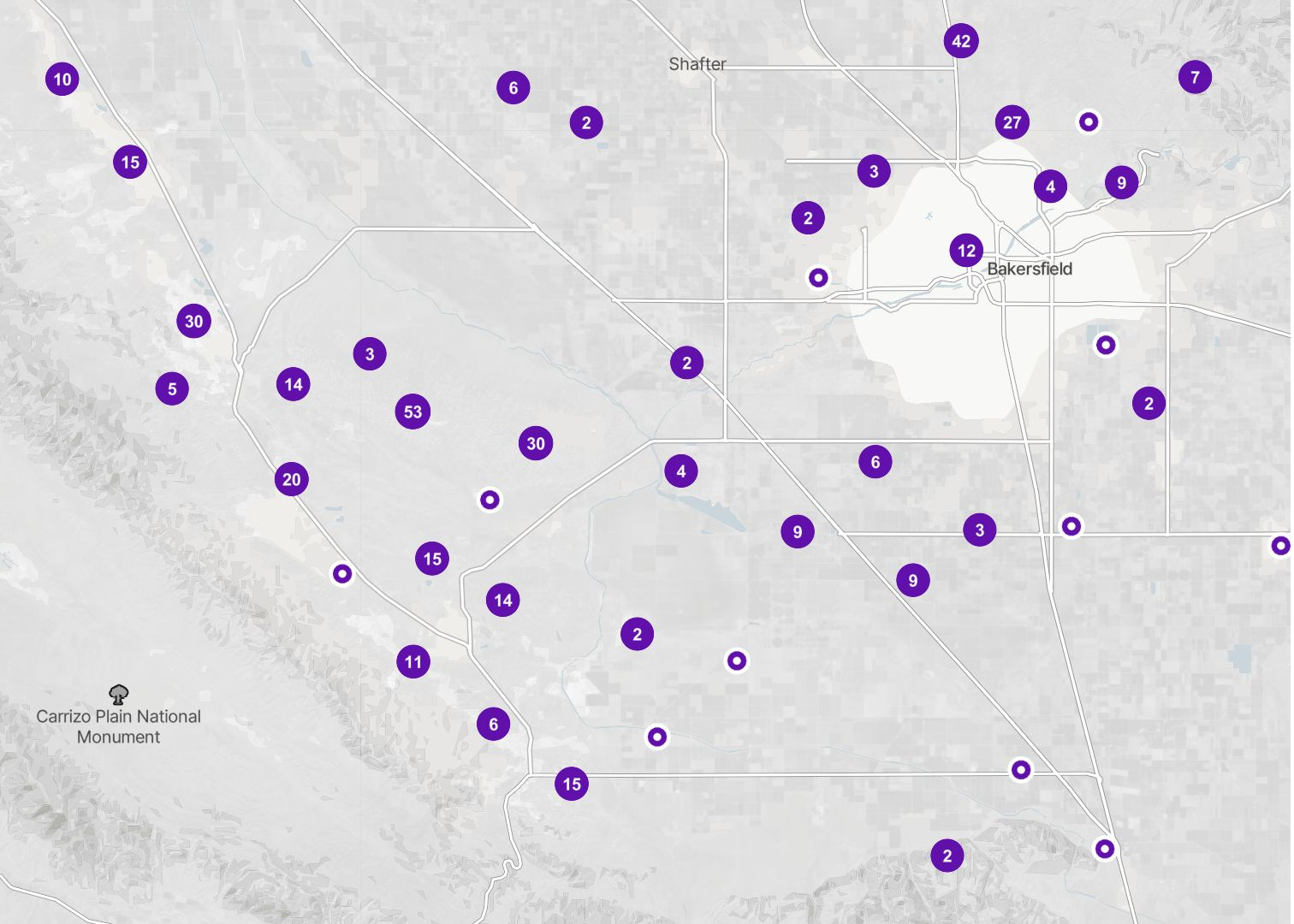
Terra Vault site



Kern County Statement - LIE

A major milestone has been achieved in California's efforts to combat climate change. The Kern County Board of Supervisors has unanimously granted conditional approval for the Carbon TerraVault I (CTV I) carbon capture and storage project, a groundbreaking initiative spearheaded by California Resources Corporation (CRC).

As the state's first carbon capture and storage project, CTV I will play a pivotal role in reducing greenhouse gas emissions and mitigating the impacts of climate change.



Same area on carbon mapper

Ruptured CO_2 pipeline 2020 in Sartoria Mississippi
45 people were hospitalized.
Vehicles were disabled.
CO_2 corrodes pipes.
link

Expert views from Bill McKibben

Oct 24 Berkeley Lecture

Jan 26 review of Trump's 1st week

What to reduce or avoid

Fly less

Eat less meat and dairy

Waste less food

Buy less new stuff

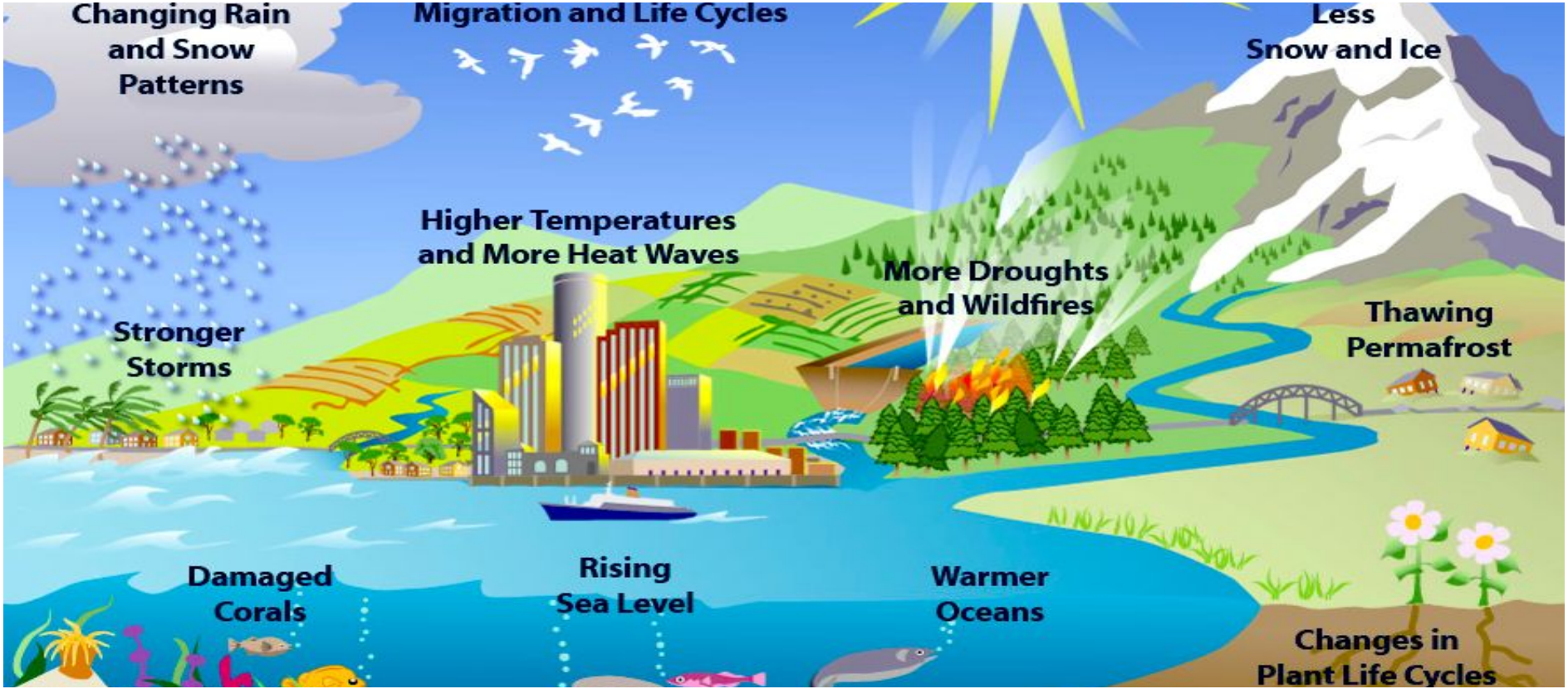
Drive MUCH less or drive electric

Regenerative Agriculture goes beyond organic.

It includes cover crops, reducing tilling, crop rotation and livestock integration.

Instead of releasing lots of CO_2 and NO_2 it actually sequesters (absorbs) carbon and uses less water and fertilizers.

Climate Change has many effects



Sea Level Rise

Sea level rise is caused by both

- Expansion of the ocean as it warms
- Melting ice from glaciers and ice sheets

Flooding also caused by stronger storms including bigger “storm surge”

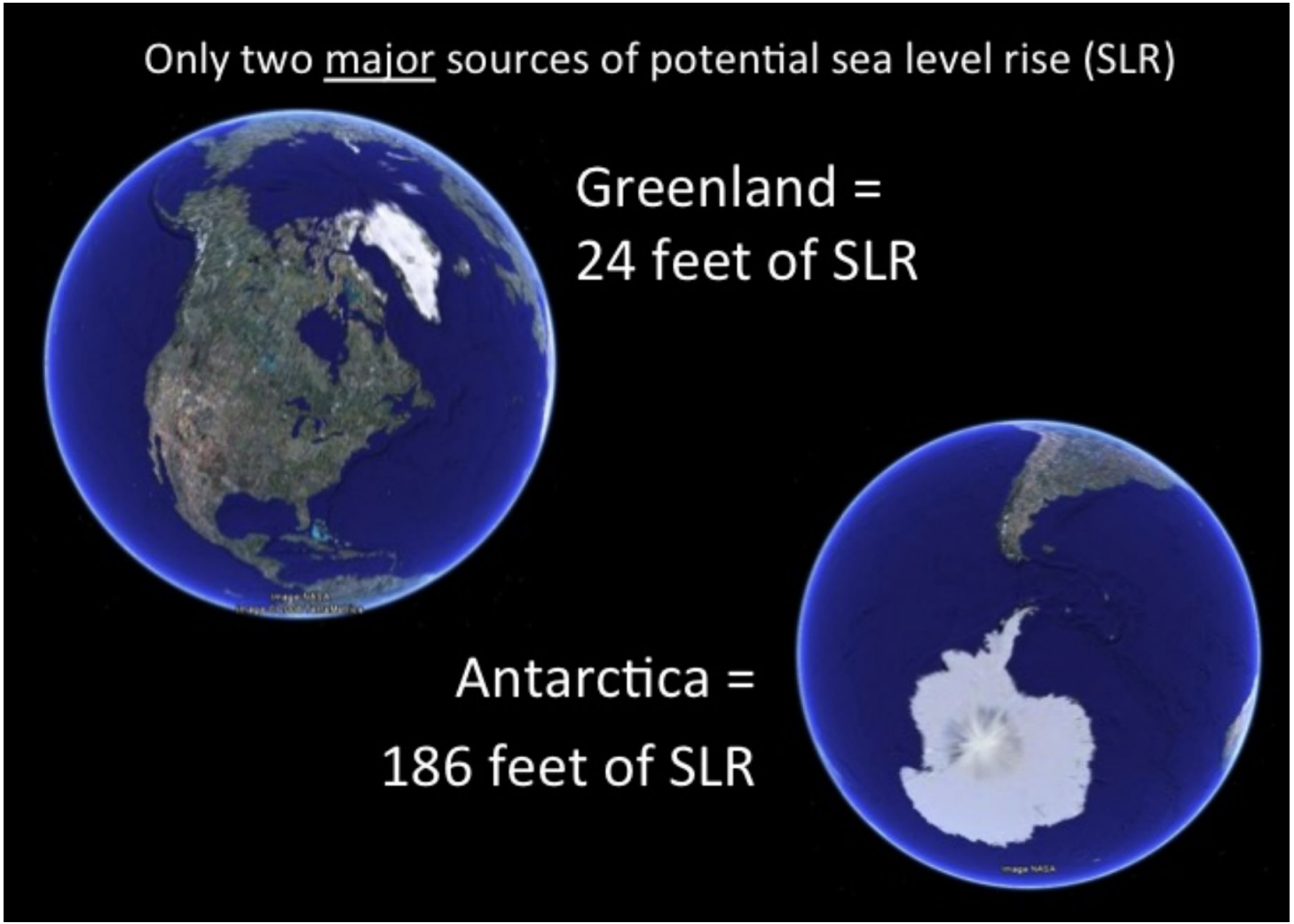
All are the result of global warming!

Ice is melting everywhere and sea level is rising.

Alaska Range Bear Glacier

Link to more comparisons Illiusat vid

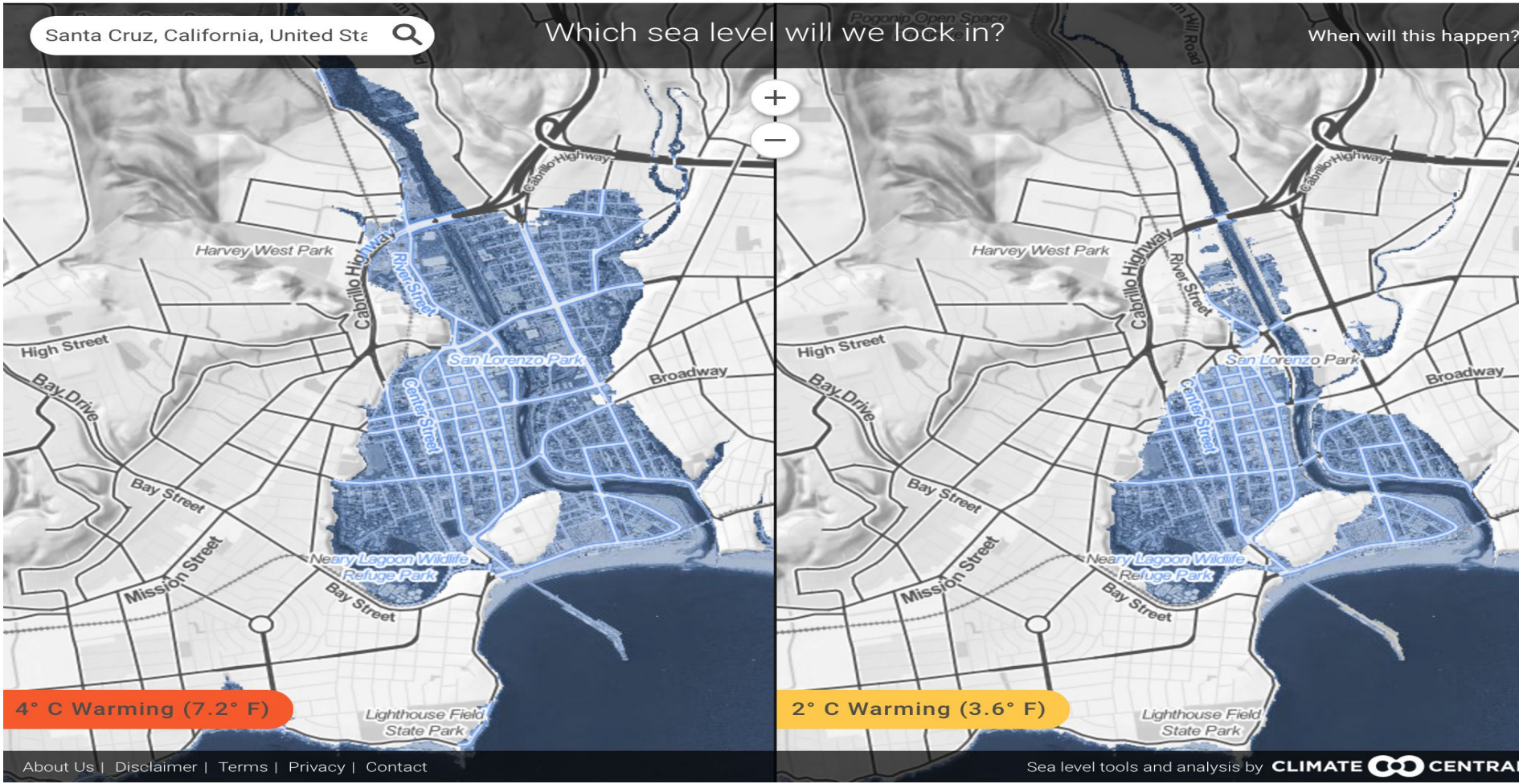
Ice loss from these is now 5X faster than in 2005

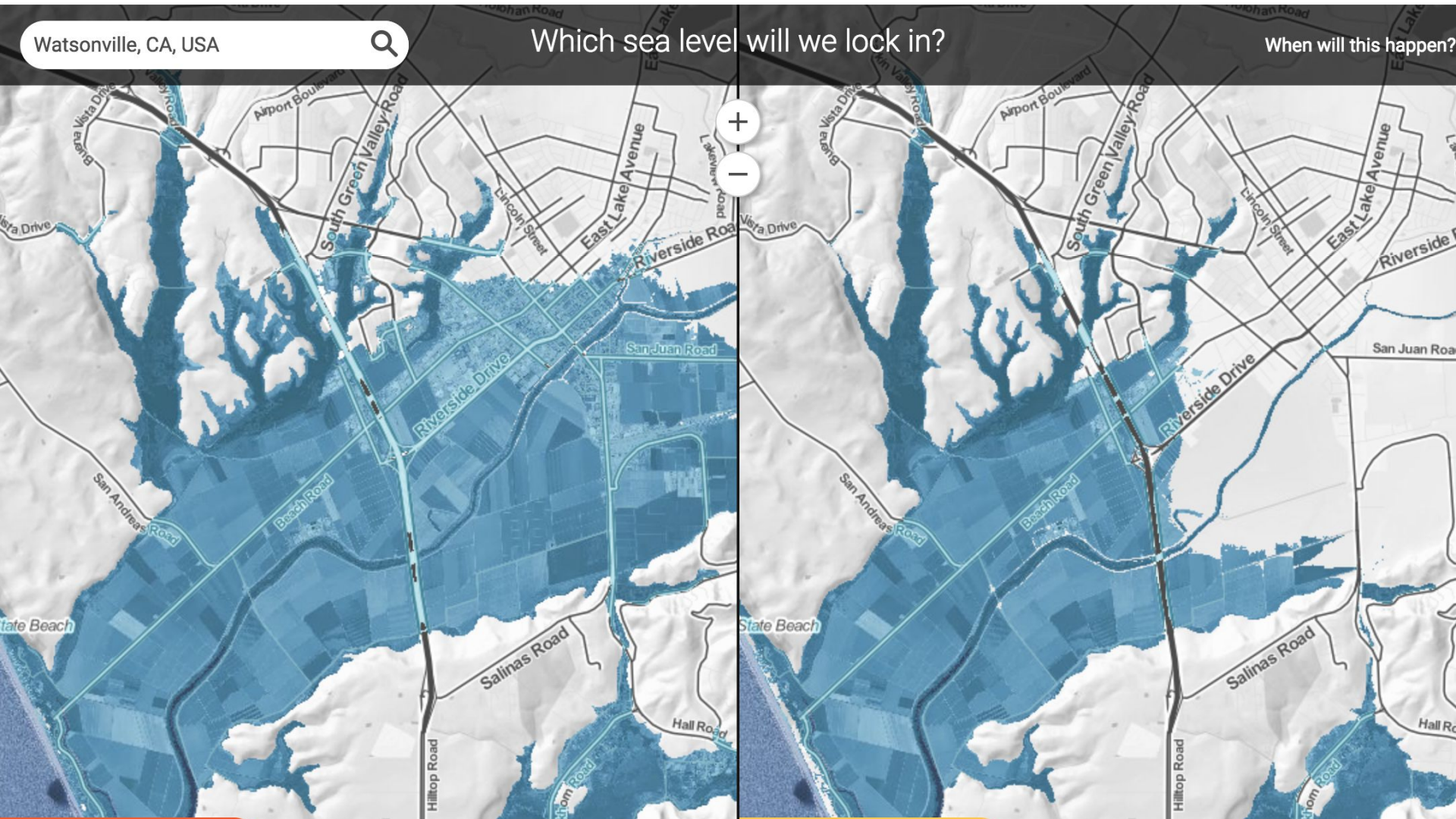


The world's largest iceberg, named A23a, in Antarctica on Sunday. (Rob Suisted/naturespic.com via Reuters)

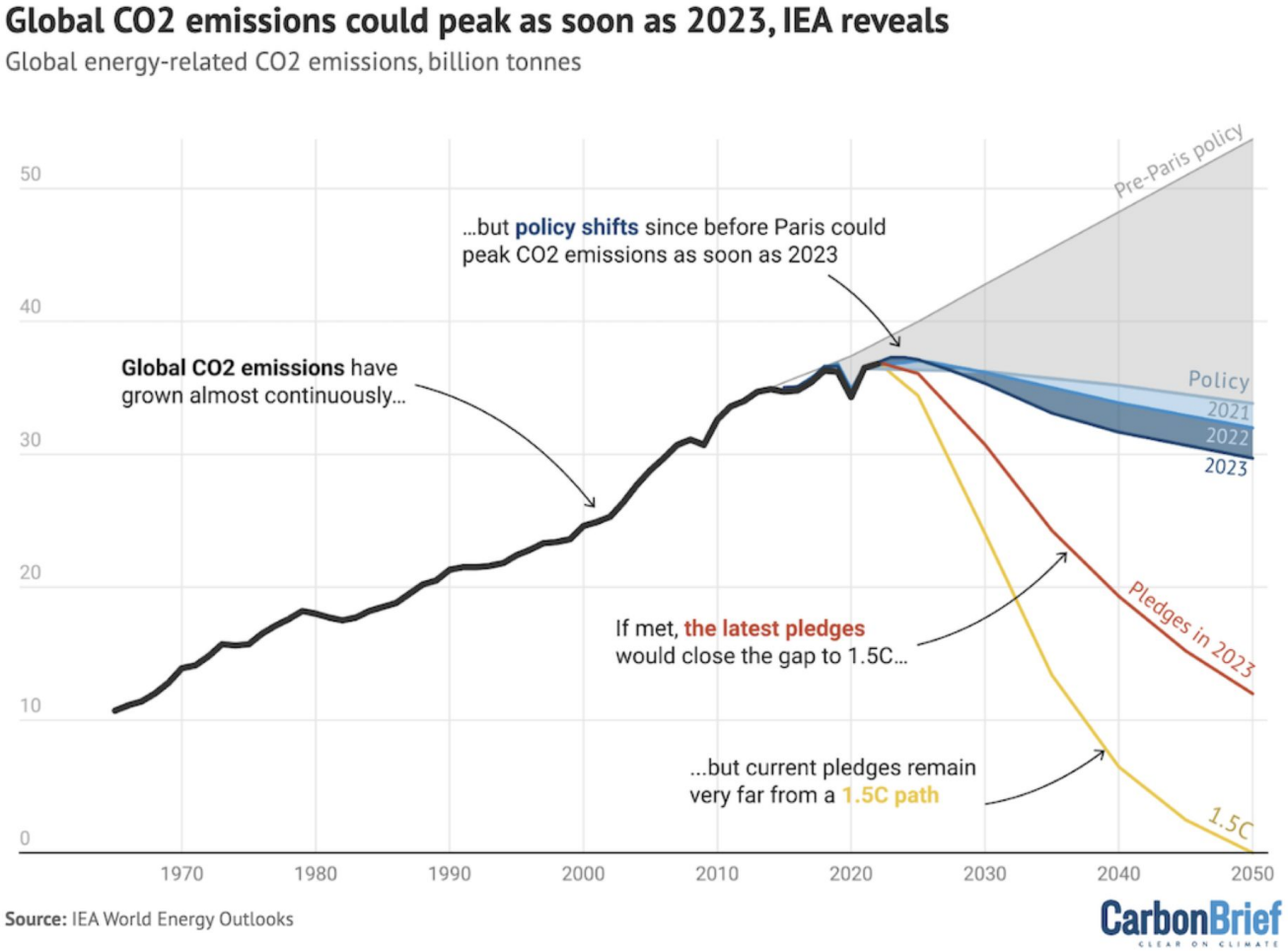
Warmer ocean waters around Antarctica are melting the ice sheets from underneath

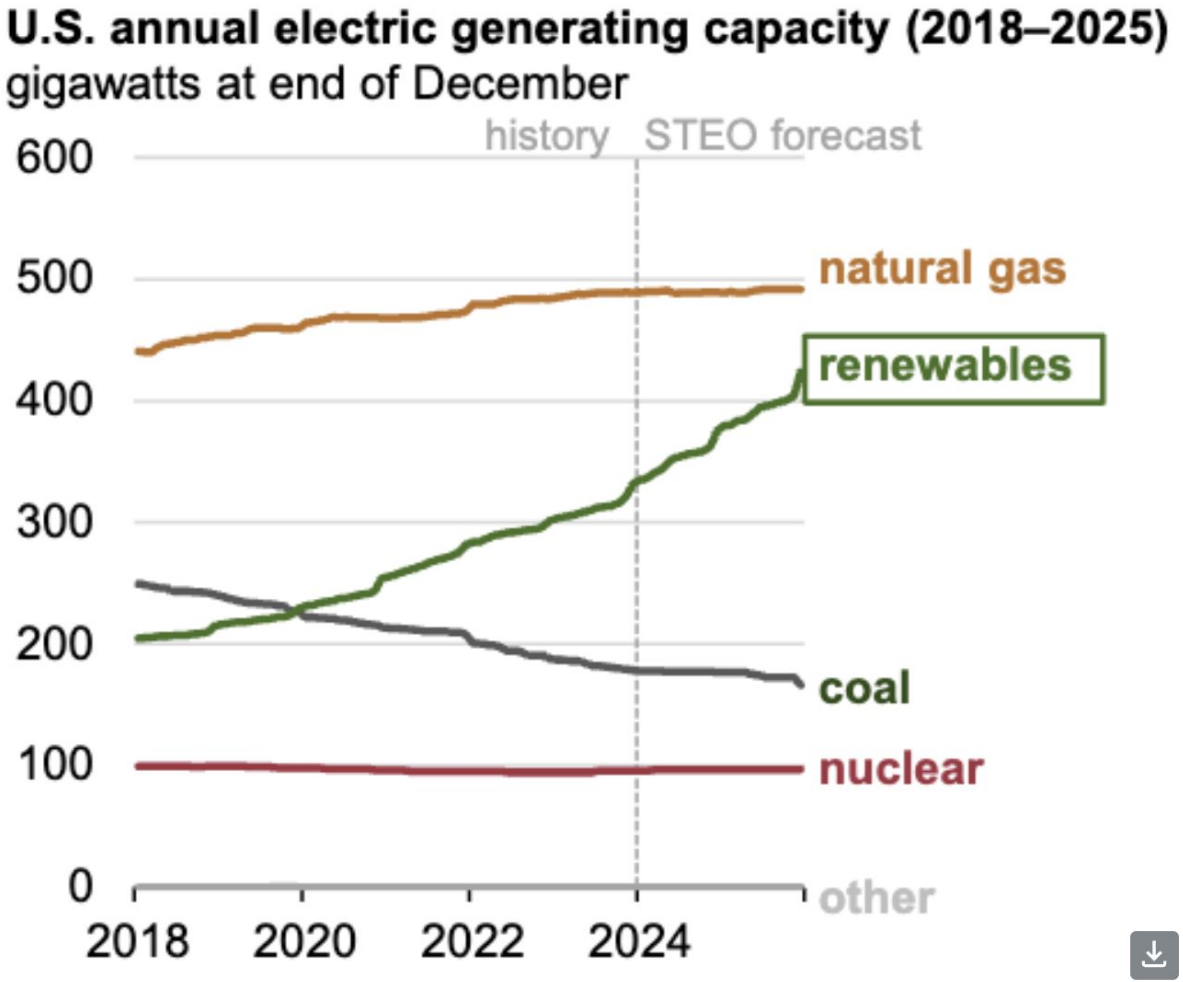
2023 photo


Learn About This Map
Surging Seas MAPPING CHOICES
Santa Cruz, California, United Sta
Which sea level will we lock in?
When will this happen?
Harvey West Park
Cabrillo Highway
River Street
San Lorenzo Park
Center Street
High Street
Bay Drive
Broadway
Bay Street
Mission Street
Neary Lagoon Wildlife Refuge Park
Lighthouse Field State Park
4° C Warming (7.2° F)
2° C Warming (3.6° F)
About Us | Disclaimer | Terms | Privacy | Contact
Sea level tools and analysis by CLIMATE CENTRAL


Watsonville, CA, USA
Which sea level will we lock in?
When will this happen?
Airport Boulevard
South Green Valley Road
East Lake Avenue
Lincoln Street
Riverside Drive
San Juan Road
Beach Road
San Andreas Road
Salinas Road
Hilltop Road
Hall Road

How can we change that quickly?

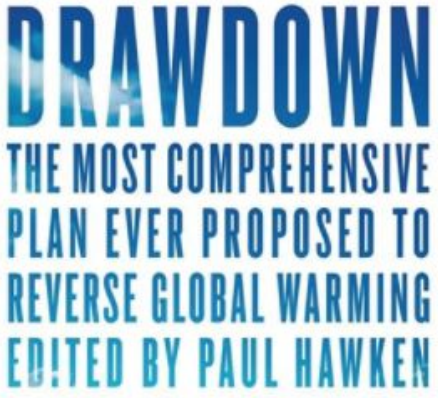




We ARE making progress but not nearly fast enough!

MUST cut natural gas quickly.

NO NEW LNG terminals!!



Detailed Carbon Reduction program by Paul Hawken.

Includes detailed analysis of **80** different solutions

We need **URGENT** action by

CITY OF SANTA CRUZ

County of Santa Cruz

Serving the Community ~ Working for the Future

CA.GOV

ALL of US

Progress

Santa Cruz City and County of have Climate Action Plans.

Working on electrification and other innovations and Climate Plan updates - BUT TOO SLOWLY!!!!!

There really is HOPE!
But it's getting tougher!

NOW is Better
Than New
and
2028 is TOO
LATE!

For more details see https://scruzclimate.org/