Vox

How the Western drought is pushing the power grid to the brink

The megadrought is costing us megawatts.

By Umair Irfan | Aug 16, 2022, 8:00am EDT

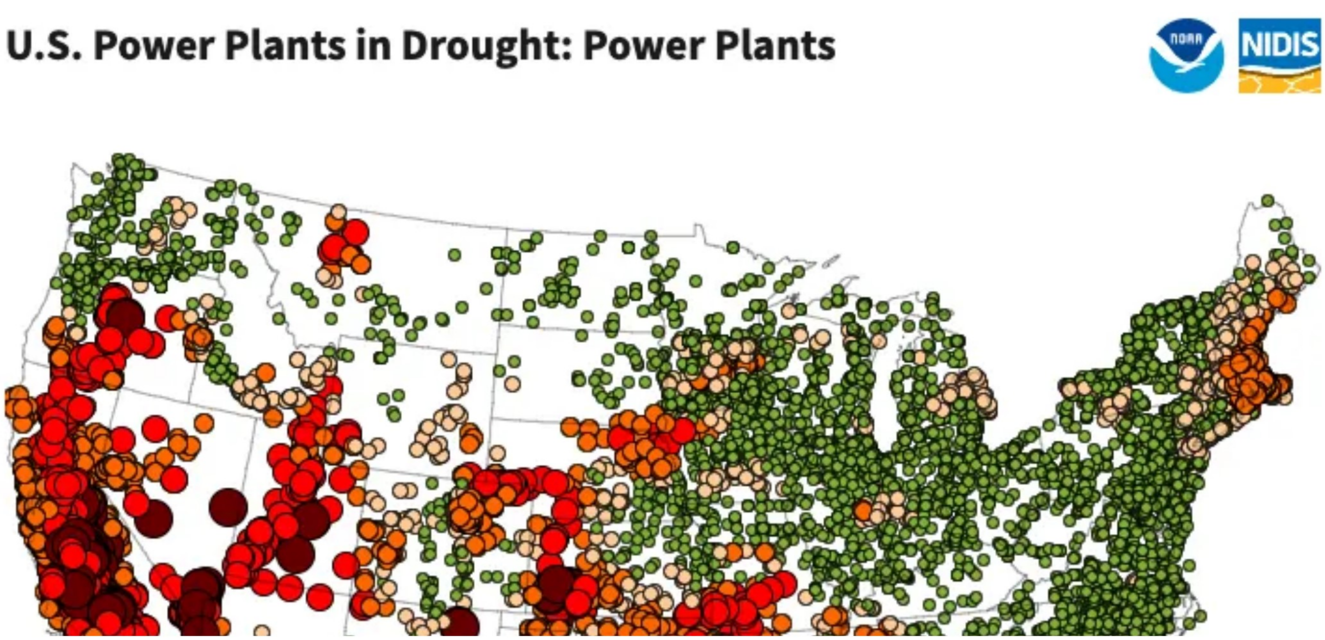
Lake Mead, impounded by the Hoover Dam, reached record lows this year, leading to cuts in electricity production. | George Rose/Getty Images

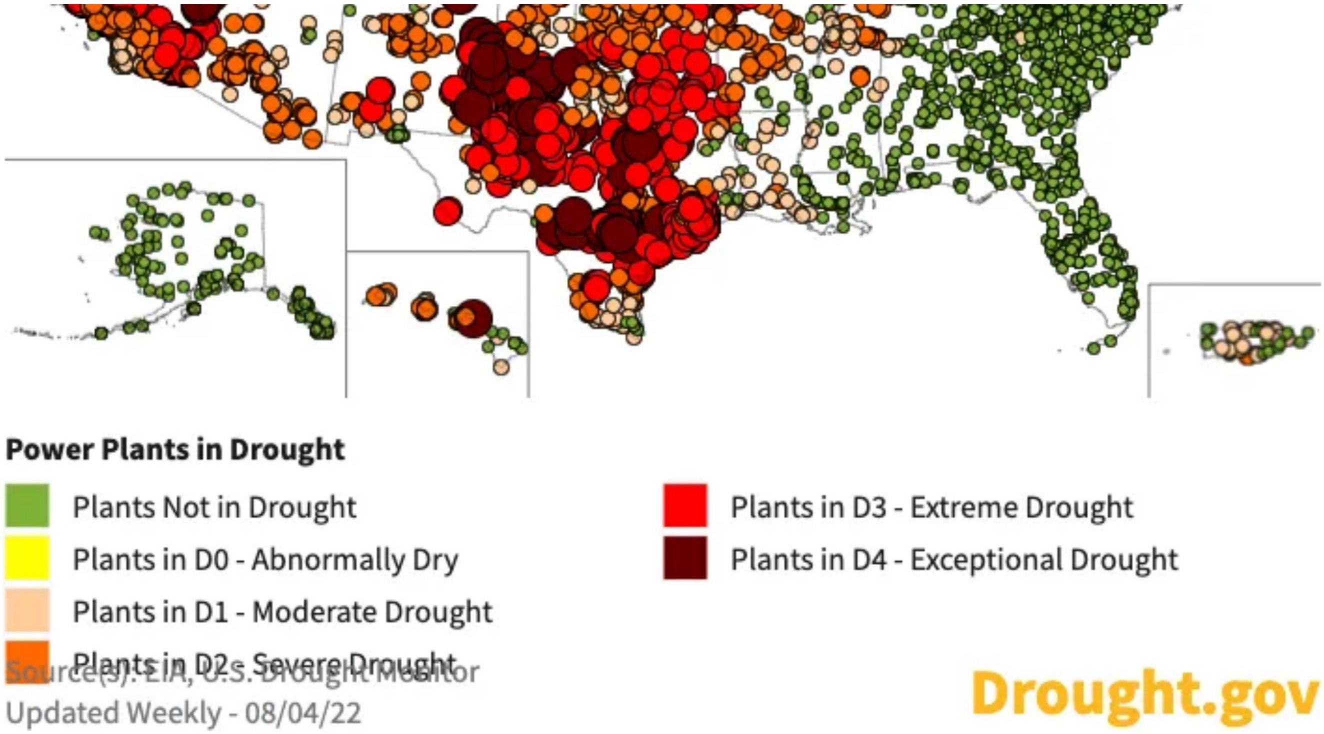
It takes a lot of water to make power.

From spinning turbines to hydraulic fracturing to refining fuel, the flow of water is critical to the flow of electrons and heat. About **40 percent of water withdrawals** — water taken out of **groundwater or surface sources** — in the United States go toward energy production. The large majority of that share is used to cool power plants. In turn, it requires energy to extract, purify, transport, and deliver water.

So when temperatures rise and water levels drop, the energy sector gets squeezed hard. The consequences of water shortages are playing out now in swaths of the American West, where an expansive, decades-long drought is forcing drastic **cuts in hydroelectric power generation**. At the same time, exceptional heat has pushed **energy demand to record highs**. As the climate changes, these stresses will mount.

The United Nations Environment Programme warned this month that if drought conditions persist, the two largest hydroelectric reservoirs in the US — Lake Mead and Lake Powell —could eventually reach “**dead pool status,**” where water levels fall too low to flow downstream. Lake Mead fuels the Hoover Dam, which has a power capacity topping 2,000 megawatts while Lake Powell drives generators that peak at 1,300 megawatts at the Glen Canyon Dam.





Power plants across huge swaths of the Western United States are under drought conditions. | National Integrated Drought Information System

“Water supplies for agriculture, fisheries, ecosystems, industry, cities, and energy are no longer stable given anthropogenic climate change,” Camille Calimlim Touton, commissioner of the Bureau of Reclamation, **told Congress in June**.

With hydropower production falling in recent months, **natural gas plants are filling the void** in the United States, leading to even more greenhouse gas emissions that heat up the planet.

This isn’t just a problem in the US. Extreme weather around the world, worsened by climate change, is causing all sorts of stresses to power grids. France has had to **curb output** from its nuclear power plants because the water they use for cooling warmed up too much. French nuclear plants have also received allowances to **discharge hotter water** back into rivers to meet energy demand. Low water levels in the **Rhine River are threatening to disrupt coal and gasoline shipments** in Germany.

As average temperatures continue to rise, many parts of the world will see energy demands grow and supplies constrained, with water as the key factor on both sides of the equation.

The good news is that the energy sector is learning to do more with less water. In the US, the overall water use per unit of energy **has been declining in recent years**. But that trend will have to accelerate in order to keep people cool and slaked in a warmer world.

How drought is drying up energy production

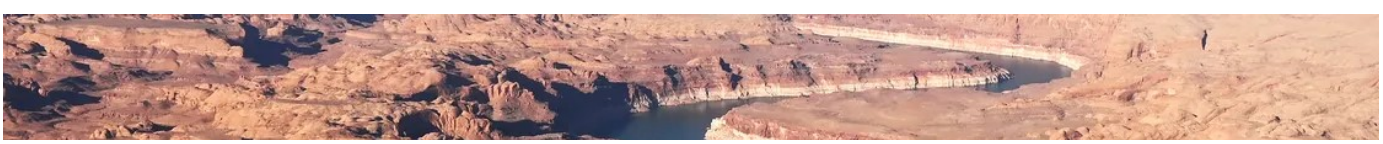
The energy sector uses water differently than households, farms, and factories, because while it requires a lot, much of that water isn’t used up but instead goes back into reservoirs, rivers, and lakes. A dam can release water to spin a turbine to generate electricity and that water can be used again by another dam downstream, for instance.

In the US, 90 percent of electricity comes from **thermal power plants**. They use a fuel — coal, gas, nuclear — to boil water into steam to spin a turbine that turns a generator. That water is contained in a closed loop. To condense the steam, however, these plants often draw on water sources to cool down. Most US power plants also use a closed loop for cooling, recirculating water with minimal loss, but 36 percent of plants use “**once-through**” cooling, taking in water from a source and then discharging it back into the lake, river, or ocean it came from.

“The [thermal] power plants may withdraw a lot of water, but they return 98 percent of it, at a higher temperature,” said **Bridget Scanlon**, a senior research scientist at the Bureau of Economic Geology at the University of Texas Austin. “They don’t ‘consume’ a lot.”

Coal, gas, and nuclear plants don’t necessarily require freshwater, either, and can draw on brackish water or other sources that aren’t fit for drinking. That way, they don’t have to compete with cities and farms for fresh water.

But drought still affects power generation directly in several ways. For hydroelectric plants, lower water levels in a reservoir means there’s less energy available to produce electricity. Reservoirs like Lake Powell, behind the Glen Canyon Dam, store so much water that they can continue providing steady power even through drought years. But the long-term drying across the Western US has managed to drink up these reserves.



Lake Powell, impounded by the Glen Canyon Dam on the Colorado River, sits at record low water levels. | RJ Sangosti/MediaNews Group/Denver Post via Getty Images

"Those are such large reservoirs that it does take multi-year droughts to put a significant dent in hydropower production, but that's starting to happen," said **Jordan Kern**, an assistant professor of forestry and environmental resources at North Carolina State University. "There is concern, not this summer, but potentially next summer and moving forward, that water levels could be so low that Hoover Dam might not be able to produce electricity."

For thermal plants, droughts mean there is less water overall, including the marginal water sources that they can use. That's compounded during **heat waves**, where water temperatures rise and lower water levels allow sources to heat up faster. Drawing on hotter water makes power plants operate less efficiently, reducing the amount of electricity they can make. Power plants heat up the water they use for cooling before it's returned to the source. Too much of this hot water pumped back into nature can harm wildlife, which is why the Environmental Protection Agency regulates this "**thermal pollution**." During heat waves, power plants face limits on how much water they can return to nature, or they must receive special permits to continue operating as normal.

Drought also hampers fuel production for power. **Hydraulic fracturing**, the technique that provides the most oil and gas in the US, requires enormous quantities of water pumped underground to fracture rock and release fossil fuels. On average, a fracking well uses about **4 million gallons of water**. Refining oil also uses a lot of water: it takes **1.5 barrels of water to process 1 barrel of crude oil**.

With less water to go around, all of these energy operations become more difficult and expensive.

That said, the Western US so far hasn’t seen major power cuts or plant shutdowns like those in Europe this summer. A big reason is that the region is vast, with hundreds of power plants connected through a massive power grid, including more than 600 hydroelectric dams. While many power plants face production shortfalls as a result of the drought, there are enough other generators that can fill the gap, and it’s much easier to shunt electricity around the country than water.

“The loss of those projects doesn’t mean lights out for ordinary people,” said **Sean Turner**, a water resources modeler at the Pacific Northwest National Laboratory.

And while some basins like the Colorado River are running low, other regions like the Pacific Northwest have had a surfeit of water this year, bolstered by robust snowfall this past winter. That has helped boost hydropower from the region to above-average levels. “If you take an overall picture of hydro over the whole West, the story is different to what you would consider if you just look at those isolated cases where drought is really making its impact,” Turner said.

A well is drilled to supply water to a fracking site in San Joaquin Valley, California. | Citizens of the Planet/Education Images/Universal Images Group via Getty Images

However, the situation has been dicier in Texas. Much of the state is covered by its own power grid **that largely doesn’t integrate** into the wider network across the West. As a result, Texas can’t easily buy power from elsewhere and has to meet its own demand within its borders. Drought coupled with record demand this summer led ERCOT, the state’s grid operator, to issue requests to Texans to **conserve electricity** and **water**.

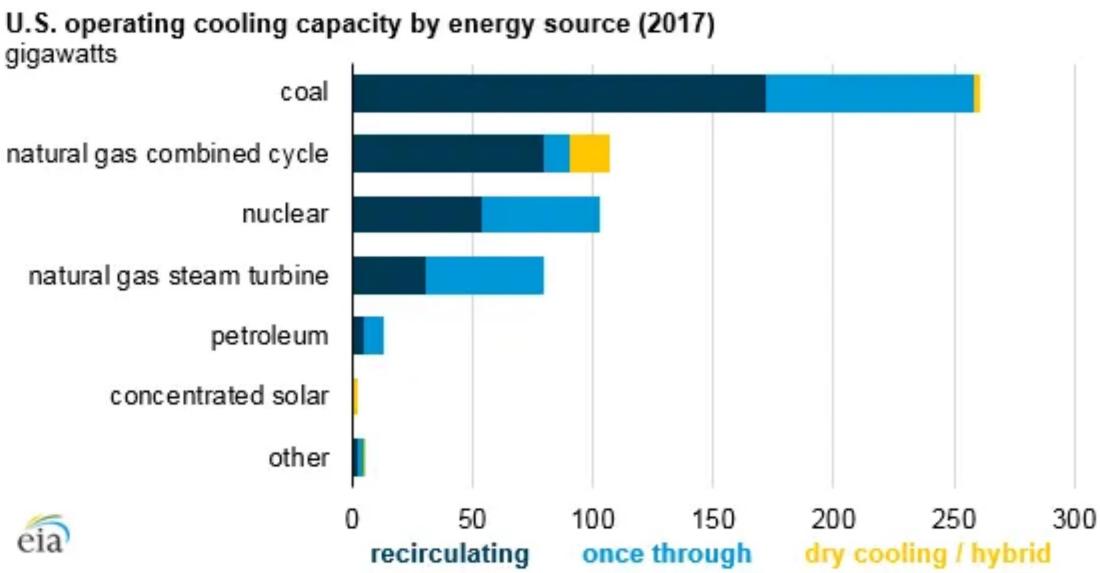
While the grid has so far held up, the threat from drought to energy production is only growing, exacerbated by climate change.

“In the future, drought and severe heat waves will continue to pressure electricity generators, particularly hydropower and large thermal facilities,” said **Kelly Twomey Sanders**, an associate professor of civil and environmental engineering at the University of Southern California, in an email.

The long, dusty road to making energy less thirsty

Fortunately, there are ways to use less water to produce energy. In the US, the amount of **water needed for power** has fallen from 14,928 gallons per megawatt-hour in 2015 to 11,857 per MWh in 2020. That’s due largely to shifting toward natural gas-fired plants that generate electricity more efficiently and require less water for cooling. The proliferation of wind and solar power, both of which require minimal water, has also reduced water demands.

Some power plants are now using **dry cooling**, a technology that requires 95 percent less water than conventional methods. The trade-offs are that dry cooling systems are more expensive to install and require more energy to operate, which makes power plants less efficient. So a dry cooling system on a coal or gas power plant could end up saving water but lead to more greenhouse gas emissions.

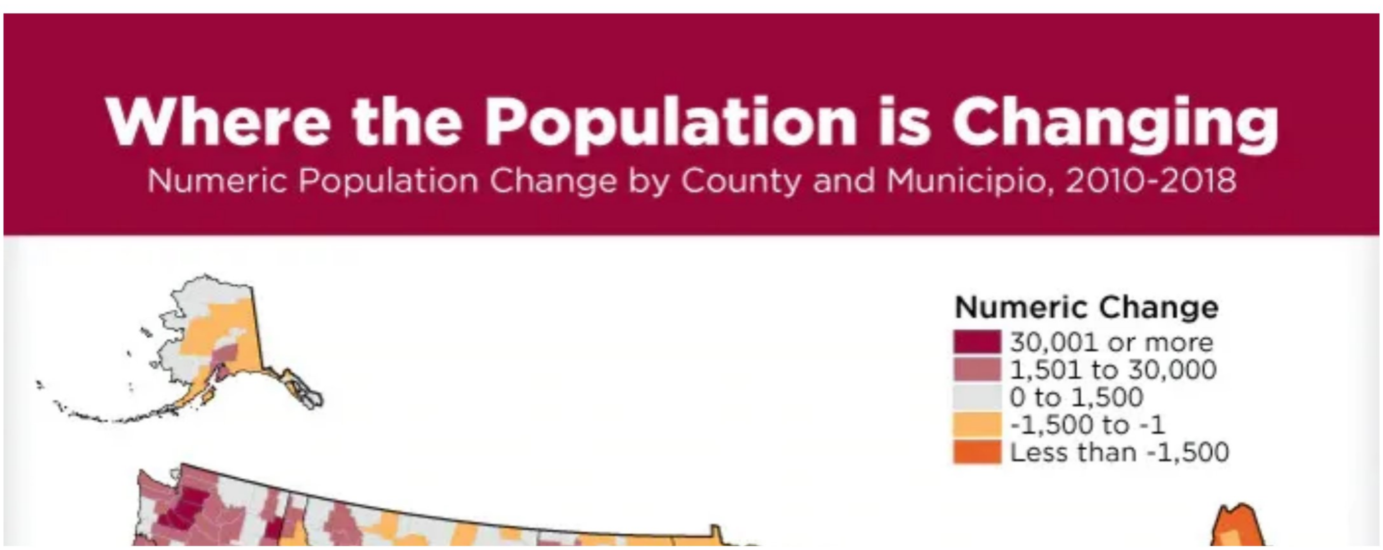


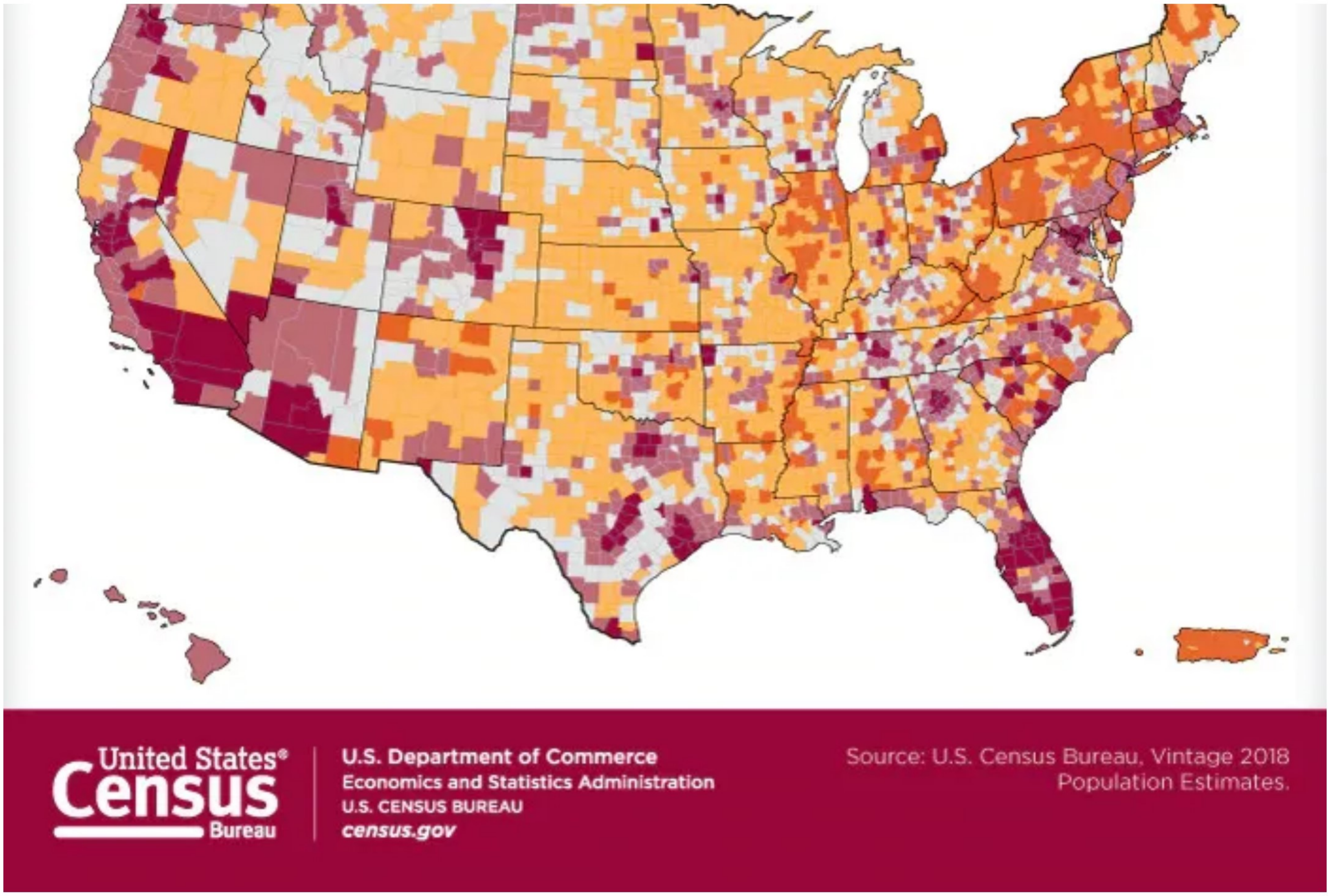
Most US power plants use a closed loop of water for cooling, but a growing number are using dry cooling technology. | US Energy Information Administration

However, to truly prepare for a hotter, drier future, planners will have to think and act beyond individual power plants. The West needs a diverse mix of energy sources to ensure that the strengths of one can compensate for the weaknesses of another.

Preparing the energy sector for future water shortages also requires rethinking some of the policies that helped create the situation. Water in the Colorado River basin is **infamously overallocated**, with more water claims than there is water to go around, creating a system that could lead to faster water depletion.

On the demand side, many of the fastest growing regions in the US are in places facing extreme water stress and higher temperatures.





Populations are growing rapidly in the Southwestern US, a region also facing water stress. | US Census Bureau

Mitigating this demand spike will require more efficient cooling systems, urban planning designed to reduce heat, and stricter water conservation.

Otherwise, the West is poised for even more energy supply shortages worsened by water constraints and surging power demand from the hottest regions, especially along the drought-parched Colorado River.

“Without significant change to water management and demand from the basin, it’s likely that this type of situation is going to continue to reemerge,” Turner said.

Our goal this month

Now is not the time for paywalls. Now is the time to point out what’s hidden in plain sight (for instance, the hundreds of election deniers on ballots across the country), clearly explain the answers to voters’ questions, and give people the tools they need to be