

ANNALS OF A WARMING PLANET

# THE CLIMATE SOLUTIONS WE CAN'T LIVE WITHOUT

*The climate crisis is full of interconnected problems—but some are more connected than others.*

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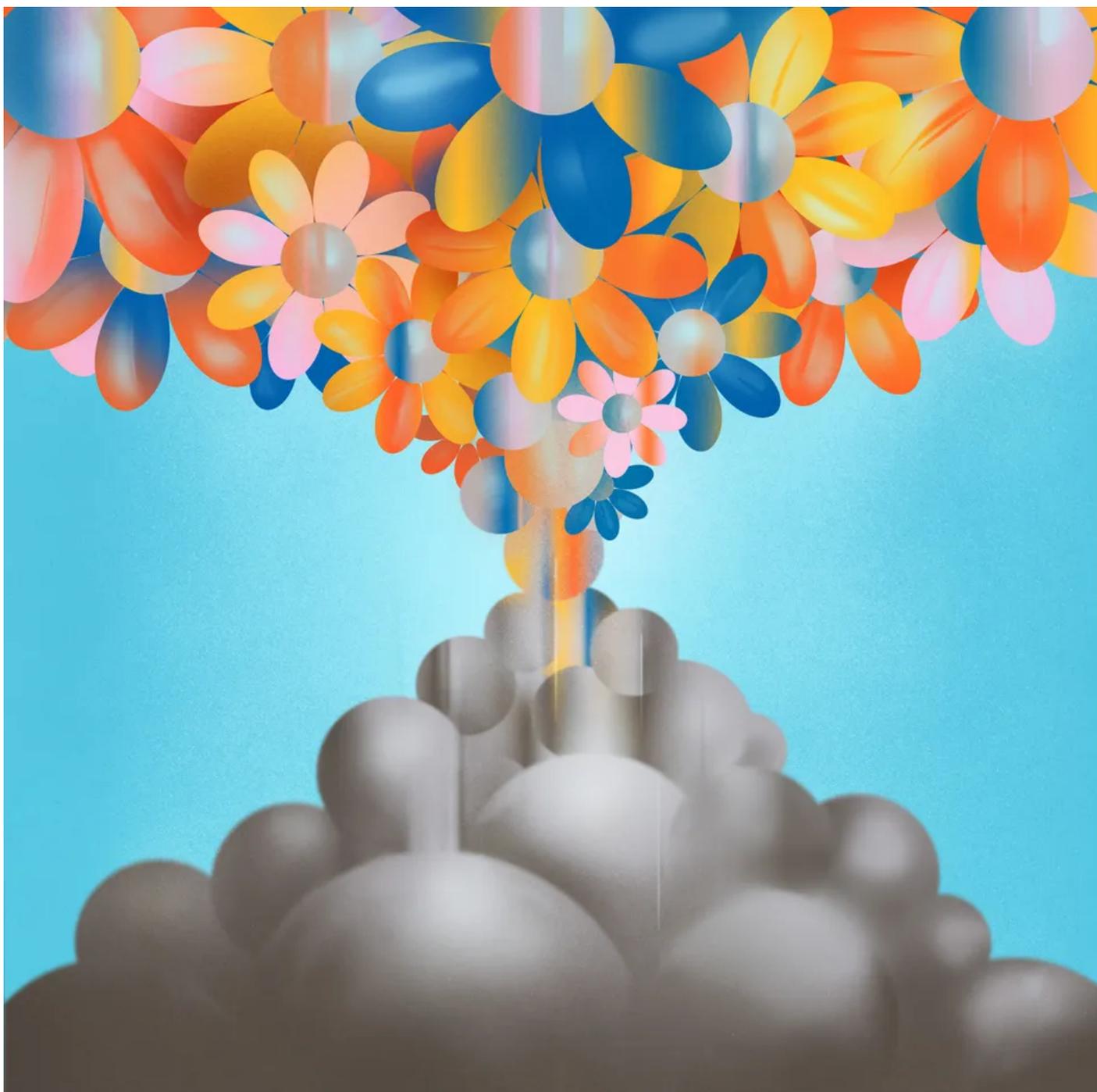


Illustration by Jose Berrio

**T**he biggest blackout in U.S. history began on a warm Thursday afternoon in August, 2003. In the span of seven minutes, it spread to at least eight states and the Canadian province of Ontario, an area in which some fifty million people lived. In New York City, elevators froze between floors. One woman in midtown walked down eighteen flights of stairs, collapsed, and could not be resuscitated. Transit workers hustled thousands of panicked passengers out of dark subway tunnels. That evening, the city's skyline was dark; in satellite photographs, a shadow appeared to have fallen

across swaths of the Northeast.

Immediately, people theorized about the origins of the breakdown. Canadian officials blamed power plants in New York State; New York officials argued that the blackout had begun somewhere west of the Ontario power system. But neither of these hypotheses could fully explain why thousands of miles of electrical wires had suddenly gone dark. “We are a major superpower with a third-world electrical grid,” Governor Bill Richardson of New Mexico, a former energy secretary, complained at the time. Representatives for utility companies pointed specifically to overtaxed transmission lines, which carried power between different parts of North America. “If there had been more lines available at the time that this event occurred, it’s possible they could have absorbed the load and kept the failure from spreading,” one observed. “We’ve got excess power in upstate New York, but there’s no way to get it to New York City because of the bottlenecks,” another said.

A joint U.S.-Canada report ultimately concluded that the outage had likely originated with some overgrown trees in northern Ohio. On warm days, the metal in wires tends to heat up and expand, and, that afternoon, a warm line sagged into a tree branch. This tripped the line and caused a short circuit to ground; the local utility company wasn’t alerted because its alarm system was broken. So many other power lines were close enough to capacity that the rerouted electricity overloaded and tripped them, and, by 4:06 p.m., power could no longer flow to the south of the state. Instead, it went northwest, to Michigan, where it overloaded more lines; to the east, a cascade of failures extended all the way to Massachusetts and New York. By 4:13 p.m., hundreds of power plants were shutting down. The blackout inflicted billions of dollars in economic damage, and a study later found that it contributed to about a hundred excess deaths.

In any complex system, there are points of special weakness. Problems in those places cause many more problems. Those weaknesses, however, can also present opportunities: strengthen the right spots, and everything gets

easier. More than a year before the blackout, a Department of Energy report addressed to President George W. Bush had identified fifty places in the eastern U.S. where a power surge could overwhelm overtaxed lines. “These bottlenecks,” the authors wrote, “increase the risk of blackouts.” The upside was that power companies and government agencies could focus their efforts on the weakest links. But the report also described the obstacles to this rational course. A decade earlier, utilities had proposed adding a power line between West Virginia and Virginia—a connection that could make a “cascading outage” across the eastern U.S. less likely. At the time, the project was still waiting for final approval from state regulators and the U.S. Forest Service. (It was approved several months later, and then it took an additional three years to construct.)

The 2003 Northeast Blackout has something to teach us about the challenge of climate change. Right now, the planet is getting warmer, and unprecedented heat waves, floods, and fires are claiming lives and livelihoods. There’s hardly any time left to pivot away from fossil fuels and toward clean power sources like wind and solar. And, in this effort, there are weak points—problems that are causing many more problems.

One such area is the grid itself. There still aren’t enough lines connecting windy, sunny places to locales that need the most electricity; meanwhile, the grid is so delicately balanced that many clean-energy projects now wait about four years, in an “interconnection queue,” simply to be plugged in. The grid has become a bottleneck in the fight to protect the climate. Other bottlenecks can be found in our daily lives and our global economy. We will need to swap out our dirty stoves and heaters for cleaner ones—but we can’t make these kinds of upgrades without training more electricians and plumbers. We will need to drive more electric cars—but we can’t power them until we can responsibly mine and recycle enough lithium for the batteries. We need to get our methane emissions under control—but it’s difficult to plug the leaks without new tools to show us where the gas is coming from. There’s a general principle at work here: if we’re quick to find and fix the

bottlenecks, progress is possible. If we can't fix them, we face a breakdown.

A few years ago, a report funded by the U.S. Department of Transportation investigated the prototypical bottleneck: the traffic jam. Historically, Americans have blamed traffic on a lack of capacity—"not enough lanes" or "too many cars." As a result, the authors argued, we have often tried to "build our way out" by widening entire highways at enormous expense. But bad traffic often starts with a local logjam—for example, at a single place where three lanes narrow into two—and then cascades across the system. This means that the government doesn't need to spend hundreds of millions of dollars on major highway projects. Instead, it can spend, perhaps, a million dollars to widen a bottleneck with an additional lane. Better yet, it can do what the Texas Department of Transportation did to a bottleneck on U.S. Route 183, in North Austin: spend fifty-five thousand dollars to restripe the road, so that two lanes become three. "If it was this easy and this cheap, what took you so long?" one local asked, when the traffic dissipated.

Bottlenecks, according to the report, are often the places where targeted efforts can make the most difference. Turn this lens onto the energy system and new insights may come into view. In many parts of the U.S., it's clear from the line to join the grid that there's an abundance of wind and solar and battery projects. For that reason, a million dollars might be better spent on electrical-system upgrades than on new subsidies to incentivize clean-energy projects. A subsidy primarily benefits the project that receives it, but even a small improvement in the interconnection queue could benefit all the projects that are waiting in line. Likewise, if you're in the mood to badger your lawmakers about something, consider badgering them about whichever government agencies are standing in the way of new transmission lines. On a national level, the Biden Administration could staff up federal agencies that review permits, such as the Bureau of Indian Affairs and the U.S. Forest Service; the Federal Energy Regulatory Commission, which already approves regional natural-gas pipelines, could be empowered to approve regional

transmission lines. It's also possible to find routes around the bottlenecks: it's sometimes argued that clean-energy projects shouldn't pool their electricity on a rickety grid in the first place, and should instead power local microgrids, such as university campuses or apartment complexes.

The theory of bottlenecks could amount to a hopeful strategy for supercharging the fight against climate change. The basic principle is to look for the sources of gridlock in the system, and to focus on restoring flow before worrying about individual cars. A functional citywide composting system is worth far more than a few isolated piles of food scraps; similarly, a new car-charging station, in a neighborhood where it's hard to find one, could cut emissions more than any one person's pledge to drive less. These structural changes will not come easily, but they can help us focus our efforts. A city or state that wants to spur rooftop solar should look for where the longest lines are forming: if solar panels are piling up in warehouses because customers can't afford them, subsidies might help; if those who've bought panels are waiting months for someone to hook them up, the government could consider launching a free certification program for solar installers, or a clean-energy vocational scholarship through a local trade school. And, if the longest lines are for permits at city hall, then maybe it's time to hire more office workers. "An hour lost at a bottleneck is an hour lost for the entire system," Eliyahu M. Goldratt, a business consultant and process theorist who authored several novels about management—among them "It's Not Luck," "Necessary but Not Sufficient," and "Isn't It Obvious?"—once wrote.

Over time, if clean-energy investments are successful, the bottlenecks will move. After America has trained a million new tradespeople, we might find ourselves waiting on solar companies to build new factories. When the interconnection queue shrinks to one year, it might be time to badger your legislators about wind and solar projects, not wires. The same logic can also be applied to fossil-fuel infrastructure, but in the opposite direction. One argument for protesting against oil and gas pipelines is that they're bottlenecks. This is also why climate activists were so disappointed when the

Biden Administration approved ConocoPhillips's sprawling Willow oil project, in Alaska: red tape might have been enough to keep that oil in the ground.

Other breakthroughs have the potential to cascade across large sectors of the economy. If shipping companies succeed in decarbonizing cargo ships, some of the dirtiest vehicles on earth will get a little less dirty, and the carbon footprint of virtually every consumer will go down. A small advance in cooling technology, like a cheaper heat pump or a superefficient air-conditioner, will be multiplied by the billions of people who will need one as the planet warms. And, given that many machines, from heat pumps to cars, will be in service for decades to come, a dollar spent on research and development is probably worth a lot more today than years from now. Of course, pessimistic scenarios flow from these same principles, too: even a step in the right direction may be meaningless if a bottleneck later stops you in your tracks. “An hour saved at a non-bottleneck is a mirage,” Goldratt warns.

**N**ot so long ago, coverage of the climate focussed on the small signs that big changes were coming. The trees were blooming a few weeks early; the butterflies had moved north; the sand on the beach was washing away. These stories were necessary but not sufficient. Nowadays, we are more likely to report that the trees are burning and the butterflies are dead. When the crisis is in the present tense, as it is now, and the window for halting it is slamming shut, all we can aim for is action. If this decade is our last best chance to avert the worst consequences of climate change, how should we spend it?

In this week's digital issue, inventive and passionate people try to solve a hard problem—maybe the hardest problem—in surprising ways. They look for bottlenecks and try to alleviate them. Because the fight against climate pollution is hamstrung by the difficulty of detecting emissions, they set out to launch a satellite that can essentially catch polluters red-handed. Because

enormous solar farms often can't be constructed without the buy-in of local people, they imagine new models that can win community support. Because the melting of certain ice sheets will have outsized consequences, they try to figure out if it's possible to save some. These stories don't aim to bear witness or raise awareness. They start from the premise that the planet does not care whether we care—only whether we act, and act quickly, in useful places.

The interventions considered in these stories reveal something about the architecture of our global problem. Here's how the pipes and walls and wires fit together; here are the doorways you can walk through; here are the places that can catch fire, and the extinguishers that can put those fires out—and the exits, when all else fails. If a building's weakest link is its single exit, it's unwise to begin by widening the upstairs hallway. We can build a second exit. We can look for better ways to wire, and for materials that will not burn, and for walls that could become doorways. We can find the fixes that make other fixes possible. ♦