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Wind and Solar Energy Projects Risk Overwhelming America's Antiquated Electrical Grids

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12-15 minutes

The U.S. Has Billions for Wind and Solar Projects. Good Luck Plugging Them In.

An explosion in proposed clean energy ventures has overwhelmed the system for connecting new power sources to homes and businesses.



Pouring concrete for a wind turbine in Nebraska. More than 8,100 energy projects were waiting for permission to connect to electric grids at the end of 2021. Credit...Walker Pickering for The New York Times



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Plans to install 3,000 acres of solar panels in Kentucky and Virginia are delayed for years. Wind farms in Minnesota and North Dakota have been abruptly canceled. And programs to encourage Massachusetts and Maine residents to adopt solar power are faltering.

The energy transition poised for takeoff in the United States amid

record investment in wind, solar and other low-carbon technologies is facing a serious obstacle: The volume of projects has overwhelmed the nation's antiquated systems to connect new sources of electricity to homes and businesses.

So many projects are trying to squeeze through the approval process that delays can drag on for years, leaving some developers to throw up their hands and walk away.

More than [8,100 energy projects](#) — the vast majority of them wind, solar and batteries — were waiting for permission to connect to electric grids at the end of 2021, up from 5,600 the year before, jamming the system known as interconnection.

That's the process by which electricity generated by wind turbines or solar arrays is added to the grid — the network of power lines and transformers that moves electricity from the spot where it is created to cities and factories. There is no single grid; the United States has [dozens of electric networks](#), each overseen by a different authority.

PJM Interconnection, which operates the nation's largest regional grid, stretching from Illinois to New Jersey, has been so inundated by connection requests that last year it [announced a freeze on new applications](#) until 2026, so that it can work through a backlog of thousands of proposals, mostly for renewable energy.

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It now takes roughly four years, on average, for developers to get approval, double the time it took a decade ago.

And when companies finally get their projects reviewed, they often

face another hurdle: the local grid is at capacity, and they are required to spend much more than they planned for new transmission lines and other upgrades.

Many give up. Fewer than one-fifth of solar and wind proposals actually make it through the so-called interconnection queue, [according to research](#) from Lawrence Berkeley National Laboratory.

“From our perspective, the interconnection process has become the No. 1 project killer,” said Piper Miller, vice president of market development at Pine Gate Renewables, a major solar power and battery developer.

Image



A building that formerly housed transformers at the Brayton Point Power Station, a decommissioned coal plant that is being repurposed to link a wind farm to the Massachusetts power grid. Credit...Simon Simard for The New York Times



After years of breakneck growth, large-scale solar, wind and battery installations in the United States [fell 16 percent](#) in 2022, according to the American Clean Power Association, a trade group. It blamed supply chain problems but also lengthy delays connecting projects to the grid.

Electricity production generates roughly one-quarter of the greenhouse gases produced by the United States; cleaning it up is key to President Biden's plan to fight global warming. The landmark climate bill he signed last year [provides \\$370 billion in subsidies](#) to help make low-carbon energy technologies — like wind, solar, nuclear or batteries — cheaper than fossil fuels.

But the law does little to address many practical barriers to building clean energy projects, such as [permitting holdups](#), [local opposition](#) or transmission constraints. Unless those obstacles get resolved, experts say, there's a risk that billions in federal subsidies won't translate into the deep emissions cuts envisioned

by lawmakers.

“It doesn’t matter how cheap the clean energy is,” said Spencer Nelson, managing director of research at ClearPath Foundation, an energy-focused nonprofit. “If developers can’t get through the interconnection process quickly enough and get enough steel in the ground, we won’t hit our climate change goals.”

Waiting in line for years

In the largest grids, such as those in the Midwest or Mid-Atlantic, a regional operator manages the byzantine flow of electricity from hundreds of different power plants through thousands of miles of transmission lines and into millions of homes.

Before a developer can build a power plant, the local grid operator must make sure the project won’t cause disruptions — if, for instance, existing power lines get more electricity than they can handle, they could overheat and fail. After conducting a detailed study, the grid operator might require upgrades, such as a line connecting the new plant to a nearby substation. The developer usually bears this cost. Then the operator moves on to study the next project in the queue.

This process was fairly routine when energy companies were building a few large coal or gas plants each year. But it has broken down as the number of wind, solar and battery projects has risen sharply over the past decade, driven by falling costs, state clean-energy mandates and, now, hefty federal subsidies.

“The biggest challenge is just the sheer volume of projects,” said Ken Seiler, who leads system planning at PJM Interconnection.

“There are only so many power engineers out there who can do

the sophisticated studies we need to do to ensure the system stays reliable, and everyone else is trying to hire them, too.”

Image



The climate bill President Biden signed last year provides \$370 billion in subsidies for low-carbon technologies like wind, solar, nuclear and batteries. Credit...Kenny Holston for The New York Times



PJM, the grid operator, now has 2,700 energy projects under study — mostly wind, solar and batteries — a number that has tripled in just three years. Wait times can now reach four years or more, which prompted PJM last year to [pause new reviews and overhaul its processes](#).

Delays can upend the business models of renewable energy developers. As time ticks by, rising materials costs can erode a project's viability. Options to buy land expire. Potential customers lose interest.

Two years ago, Silicon Ranch, a solar power developer, applied to PJM for permission to connect three 100-megawatt solar projects in Kentucky and Virginia, enough to power tens of thousands of homes. The company, which often [pairs its solar arrays with sheep grazing](#), had negotiated purchase options with local landowners for thousands of acres of farmland.

Today, that land is sitting empty. Silicon Ranch hasn't received

feedback from PJM and now estimates it may not be able to bring those solar farms online until 2028 or 2029. That creates headaches: The company may have to decide whether to buy the land before it even knows whether its solar arrays will be approved.

“It’s frustrating,” said Reagan Farr, the chief executive of Silicon Ranch. “We always talk about how important it is for our industry to establish trust and credibility with local communities. But if you come in and say you’re going to invest, and then nothing happens for years, it’s not an optimal situation.”

PJM soon plans to [speed up its queues](#) — for instance, by studying projects in clusters rather than one at a time — but needs to clear its backlog first.

‘Imagine if we paid for highways this way’

A potentially bigger problem for solar and wind is that, in many places around the country, the local grid is clogged, unable to absorb more power.

That means if a developer wants to build a new wind farm, it might have to pay not just for a simple connecting line, but also for deeper grid upgrades elsewhere. One planned wind farm in North Dakota, for example, was [asked to pay for multimillion-dollar upgrades](#) to transmission lines hundreds of miles away in Nebraska and Missouri.

These costs can be unpredictable. In 2018, EDP North America, a renewable energy developer, proposed a 100-megawatt wind farm in southwestern Minnesota, estimating it would have to spend \$10 million connecting to the grid. But after the grid operator completed

its analysis, EDP learned the upgrades would cost \$80 million. It canceled the project.

Image



A solar battery energy storage site in the Bronx, part of a test program to support New York's transition to renewable energy sources. Credit...Hiroko Masuike/The New York Times



That creates a new problem: When a proposed energy project drops out of the queue, the grid operator often has to redo studies for other pending projects and shift costs to other developers, which can trigger more cancellations and delays.

It also creates perverse incentives, experts said. Some developers will submit multiple proposals for wind and solar farms at different locations without intending to build them all. Instead, they hope that one of their proposals will come after another developer who has to pay for major network upgrades. The rise of this sort of speculative bidding has further jammed up the queue.

“Imagine if we paid for highways this way,” said Rob Gramlich, president of the consulting group Grid Strategies. “If a highway is fully congested, the next car that gets on has to pay for a whole lane expansion. When that driver sees the bill, they drop off. Or, if they do pay for it themselves, everyone else gets to use that infrastructure. It doesn’t make any sense.”

A better approach, Mr. Gramlich said, would be for grid operators to plan transmission upgrades that are broadly beneficial and spread the costs among a wider set of energy providers and users, rather than having individual developers fix the grid bit by bit, through a chaotic process.

There is precedent for that idea. In the 2000s, Texas officials saw that existing power lines wouldn't be able to handle the growing number of wind turbines being built in the blustery plains of West Texas and [planned billions of dollars in upgrades](#). Texas now leads the nation in wind power. Similarly, MISO, a grid spanning 15 states in the Midwest, recently [approved \\$10.3 billion in new power lines](#), partly because officials could see that many of its states had set ambitious renewable energy goals and would need more transmission.

But this sort of proactive planning is rare, since utilities, state officials and businesses often argue fiercely over whether new lines are necessary — and who should bear the cost.

“The hardest part isn't the engineering, it's figuring out who's going to pay for it,” said Aubrey Johnson, vice president of system planning at MISO.

Image





Wind turbines in North Dakota, where some developers have canceled projects after facing rising costs to connect to the grid.Credit...Brandon Thibodeaux for The New York Times



Climate goals at risk

As grid delays pile up, regulators have taken notice. Last year, the Federal Energy Regulatory Commission proposed two major reforms to [streamline interconnection queues](#) and encourage grid operators to [do more long-term planning](#).

The fate of these rules is unclear, however. In December, Richard Glick, the former regulatory commission chairman who

spearheaded both reforms, stepped down after clashing with Senator Joe Manchin III, Democrat of West Virginia, [over unrelated policies](#) around natural gas pipelines. The commission is now split between two Democrats and two Republicans; any new reforms need majority approval.

If the United States can't fix its grid problems, it could struggle to tackle climate change. Researchers at the Princeton-led REPEAT project [recently estimated](#) that new federal subsidies for clean energy could cut electricity emissions in half by 2030. But that assumes transmission capacity expands twice as fast over the next decade. If that doesn't happen, the researchers found, emissions could actually increase as solar and wind get stymied and existing gas and coal plants run more often to power electric cars.

Massachusetts and Maine offer a warning, said David Gahl, executive director of the Solar and Storage Industries Institute. In both states, lawmakers offered hefty incentives for small-scale solar installations. Investors poured money in, but within months, grid managers [were overwhelmed](#), delaying hundreds of projects.

"There's a lesson there," Mr. Gahl said. "You can pass big, ambitious climate laws, but if you don't pay attention to details like interconnection rules, you can quickly run into trouble."

Audio produced by Kate Winslett.

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