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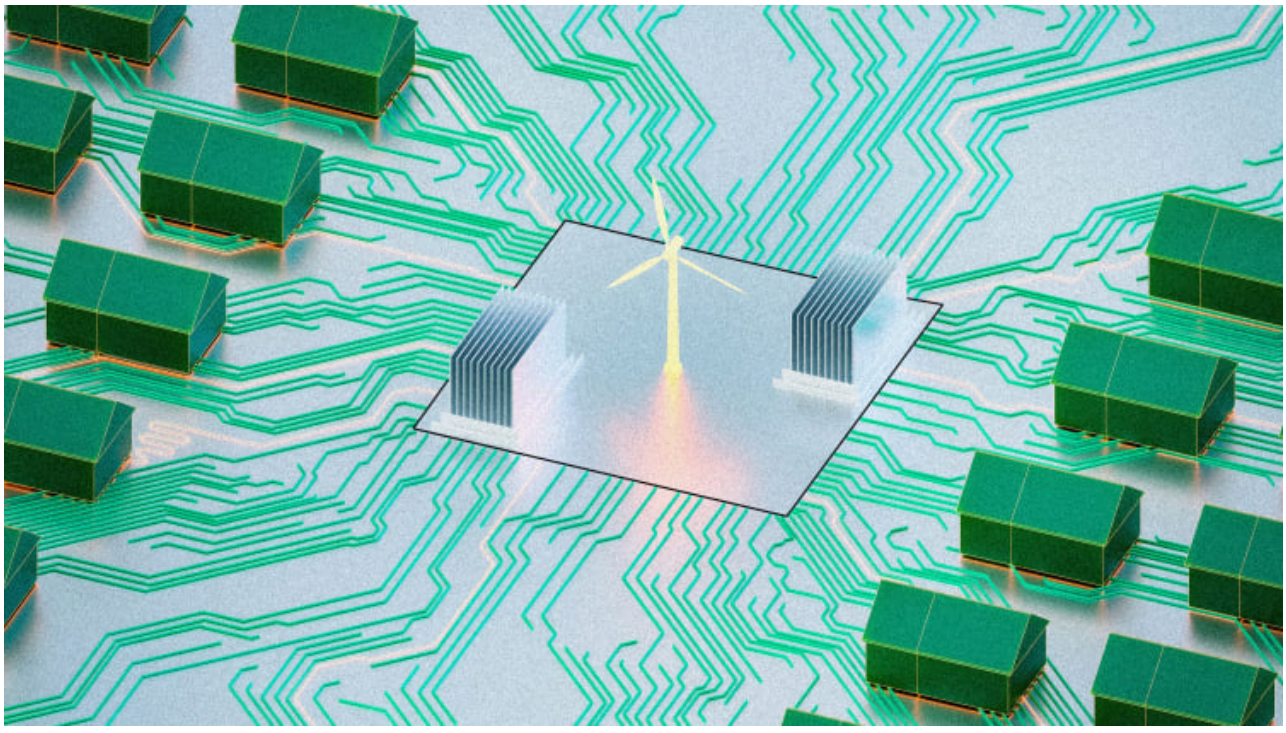
The outdated power grid is nearing a crisis point. Here's how to prevent it

New transmission lines take years to build, and that's slowing down renewable energy projects. But technology can help make better use of existing infrastructure now.



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BY ADELE PETERS 6 MINUTE READ

More than 10,000 proposed solar, wind, and battery projects are currently waiting in line to connect to the U.S. electric grid—more than enough to hit a target of 90% clean energy by 2035. But many of the projects won't get built, in part because the grid doesn't have enough capacity to handle the new power. Getting the permits to build a new transmission line can take as long as 15 years.

As electricity demand surges because of AI, cryptocurrency, and electric vehicles, the problem is getting even more urgent. Permitting reform will help make it easier to build new power lines. But there are also faster ways to boost the grid's capacity now.

NEW STATE-OF-THE-ART POWER LINES

One fix: Instead of building new transmission lines, just swapping out old power lines (and reusing old towers) can boost the grid. A recent report estimated that replacing existing power lines with advanced equipment could double the grid's capacity in many parts of the country. Instead of the five to 15 years it would take to build a new transmission line, changing an old line can take as little as 18 months, and cost half as much. If it happened broadly, it could help quadruple the projected transmission capacity in the U.S. by 2035.

"The transmission needs that we're seeing are pretty astronomical," says Michelle Solomon, senior policy analyst at Energy Innovation, one of the groups behind the report. "The thing that's exciting about this technology is that it can significantly increase transmission capacity in a really short period of time."

Standard power lines (or conductors, in industry-speak) are made with aluminum wrapped around a steel core. TS Conductor, one startup in the space, makes conductors with a carbon fiber core that can carry twice as much electricity. The equipment is both stronger and lighter than steel, so it doesn't sag dangerously when more power flows through.

In an installation in Montana, one utility added TS Conductor's wires when it connected to a new wind farm. Without the technology, it would have had to also replace the towers holding up the power lines; because that didn't happen, the project was two years faster and cost 40% less. If the utility had needed to build a completely new transmission line, it would have taken even longer.

Veir, another startup, is developing superconducting power lines that can deliver 5 to 10 times as much electricity as a standard conductor and can be installed over long distances. The company has validated the tech in pilots and is now finalizing the design. "Right now we're focused on challenging transmission projects that face significant permitting, siting, or public opposition barriers," says CEO Tim Heidel. "These barriers can result in delays of many years. [We] can make better use of existing transmission rights of way for upgrades, and require much less land for new builds."

Advanced conductor technology faces some challenges in adoption, including the fact that utilities are traditionally slow to change. Their business model also gives them an incentive to invest in expensive projects, like building new transmission

lines, and then pass the cost on to consumers. But as electricity demand quickly grows, utilities are realizing that they need faster options.

Some utilities, like National Grid, now invest in startups like TS Conductor and Veir. “I think the electric grid is viewed almost as a potential Achilles’ heel of net zero achievement,” says Kristian Bodek, director at National Grid’s investment arm. “So there is an increased scrutiny and focus on what we can do as utilities to help facilitate the growth in renewables, as well as all of the increase in demand.” Policies can also help, Solomon says, including state laws that require utilities to consider using tech like advanced conductors or give utilities better incentives to adopt it.

SENSORS AND SOFTWARE

Some utilities are beginning to use sensors on electric towers to track how much power is flowing through lines. There’s usually much more capacity than is being used, but utilities rely on very conservative estimates. “Utilities currently operate with ‘static ratings’ for their transmission lines, which essentially act like a speed limit for how much power they can flow over the lines,” says Jon Marmillo, cofounder of LineVision, a company that offers “dynamic line ratings” instead. It makes sensors that use lasers to track movement in power lines and understand if they’re sagging or overheating. The company also tracks weather, since the temperature or amount of wind blowing on a power line makes a difference. By using sensors to track data and adjust in real time, the capacity can increase by as much as 40%.

The equipment is easy to add; installing a sensor takes only half an hour. (There's typically one sensor every three miles.) It takes another 90 days for machine learning to create accurate line ratings, and another three months to integrate the technology into system operations. LineVision now has more than 50 installations in the U.S. "We've plugged the data feeds from their sensors directly into our control room," says National Grid's Bodek. Other companies are taking different approaches to monitoring power lines, like Prisma Photonics, which uses fiber optics instead of the laser system used by LineVision.

Using dynamic line rating technology costs a fraction of what it would cost to replace a power line. But again, since utilities make money by charging ratepayers for expensive equipment, they don't have as much incentive to use it. Some utilities have been hesitant because they thought they wouldn't be able to build as many new transmission lines if they were getting more value out of the existing ones. But that attitude has changed as power demand surges, says Julia Selker, executive director of the nonprofit WATT Coalition. "Now, utilities are not worried because there's just so much transmission to build that there's no way they can build it all," she says. "They wouldn't be able to ask the ratepayers to pay for it all, and they can't build it all fast enough." Here, too, policies can help incentivize utilities to consider the tech in their planning. (In

the U.K., policy lets utilities share savings with customers when they make improvements like this; the same thing could happen in the U.S.)

Other software can also help increase capacity on existing power lines. At power substations, software can help redirect extra energy onto different circuits when needed. Another type of software tracks power generation and power lines and and also helps power flow differently; in the past, engineers did this manually. In the U.K., National Grid used this type of technology, from a company called Smart Wire, to unlock an extra 1.5 gigawatts of capacity on the grid.

YOUR HOUSE AND ELECTRIC CAR

Adding energy storage can also help avoid the need to build as many new transmission lines. That includes both batteries that are strategically placed on the grid and home batteries that are connected to solar panels.

First, people can use the energy generated on their own roof. “You don’t have to add all that upstream capacity,” says Chris Rauscher, head of grid services at Sunrun. Home batteries can also help store excess renewable energy from the grid, filling up when solar or wind farms produce too much and releasing it only when the grid needs it. Sunrun now has the country’s largest “virtual power plant,” a network of more than 16,000 homes with solar and battery storage that can work together to help relieve strain on the grid in California in the summer, as air conditioning use surges.

Electric vehicles that connect to the grid can also help. Electric school buses, for example, are beginning to use their batteries to store extra solar power and later send it back to the grid

when there's more demand. Electric vehicles and other electric equipment can also use data to charge when there's less demand on the grid (at night, for example), helping reduce the total amount of electricity that has to flow at peak times.

As utilities adopt some of these solutions—from advanced power lines to partnering with school bus companies—the grid will also need to keep adding new transmission lines. But a lot of the short-term needs can be tackled without them—and that could give a huge boost to renewable energy projects that are stuck waiting now.

ABOUT THE AUTHOR

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