

Plug-in cars are the future. The grid isn't ready.





By 2035, the chief automakers will have turned away from the internal combustion engine. It'll be up to the grid to fuel all those new cars, trucks and buses.



Maple Ridge in Lewis County is New York's largest wind farm. (Kate Lovering for The Washington Post)

By [Will Englund](#)

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COPENHAGEN, N.Y. — On a good day, a fair wind blows off Lake Ontario, the long-distance transmission lines of New York state are not clogged up and yet another heat wave hasn't pushed the urban utilities to their limits. On such a day, power from the two big wind turbines in Vaughn Moser's hayfield in this little village join the great flow of electricity from upstate as it courses through the bottleneck west of Albany and then heads south, where some portion of it feeds what is currently the country's largest electric vehicle charging station, on the edge of Brooklyn's Bedford-Stuyvesant neighborhood.

There, at an installation opened earlier this year by a car-sharing company called Revel, on the site of the old Pfizer pharmaceutical headquarters, this carbon-free power can help juice up a whole fleet of sleek vehicles that aim to leave the internal combustion engine behind.

But that's on a good day. Even now — before this state and the country's grand ambitions for an electric future are fully in motion — there are too many bad ones.

Seventy-four times last year, the wind across Upstate New York dropped so low that for stretches of eight hours or more barely any electricity was produced. Nearly half the year, the main transmission line feeding the metropolitan area was at full capacity, so that no more power could be fed into it. Congestion struck other, smaller lines, too, and when that happened some of the wind turbine blades upstate fell still.

And in New York City this summer, the utility Con Edison appealed to customers to cut back on their electricity usage during the strain of five separate heat waves, while Tropical Storms Elsa, Henri and Ida cut power to thousands.

Converting the nation's fleet of automobiles and trucks to electric power is a critical piece of the battle against climate change. The Biden administration wants to see them account for half of all sales by 2030, and New York state has enacted a ban on the sale of internal combustion cars and trucks starting in 2035.

But making America's cars go electric is no longer primarily a story about building the cars. Against this ambitious backdrop, America's electric grid will be sorely challenged by the need to deliver clean power to those cars. Today, though, it barely functions in times of ordinary stress, and fails altogether too often for comfort, as widespread blackouts in California, Texas, Louisiana and elsewhere have shown.

"We got to talk about the grid," said Gil Quiniones, head of a state agency called the New York Power Authority. "Otherwise we'll be caught flat-footed."



By 2030, according to one study, the nation will need to invest as much as \$125 billion in the grid to allow it to handle electric vehicles. The current infrastructure bill before Congress puts about \$5 billion toward transmission line construction and upgrades.

Even in this progressive, wealthy state, where policymakers are spending billions on climate change initiatives and the governor has announced plans for two big new transmission lines feeding the New York metropolitan area, the challenge is enormous.

By 2050, the state projects, electric cars, trucks and buses will use 14 percent of New York's total output. That's equivalent to half of all the electricity used in New York City in 2019 — so it's like powering a new city of four million people. Overall demand could grow by as much as 50 percent.

Three places, hundreds of miles apart, tell the story of the grid in New York, and by extension in the country as a whole:

In the hard-hit dairy country of upstate Lewis County, wind power has been an economic lifeline, but its room for expansion is severely limited. Other renewables face similar limits.

In a control room in East Greenbush, outside Albany, the agency that oversees New York's grid must manage the flow of electricity through transmission lines that without significant rebuilding will be totally inadequate in connecting upstate to the big metropolitan area.

And in New York City, stressed utility equipment will need expensive upgrades — and perhaps a totally new model of energy production — if they are to handle an eventual 2 million electric vehicles.

All in all, it shows how the country’s 20th-century point-to-point grid, delivering energy over long distances, will not be adequate to serve this century’s needs.

“The grid of the future isn’t going to be a grid at all,” said Shuli Goodman, executive director of a Linux Foundation project called LF Energy. “It will be more like the Internet,” she said, with power generation happening all over the place.

“Something,” she said, “like a forest.”



It’s been 20 years since the first wind farm was built in Lewis County, and since then more have followed, bringing a steady income stream to the small dairy farmers whose land hosts the towering white turbines. Theirs has been a life of struggle, squeezed on price by their larger competitors, selling milk through a co-op to the big yellow Kraft Heinz factory in Lowville that goes through a reported 20 million pounds a month to make string cheese and cream cheese.

Vaughn Moser’s parents were able to retire from farming when the turbines came. With four kids, ages 3 to 11, he keeps plenty busy making ends meet: tending about 250 head of cattle (beef and dairy), running 10,000 taps on maple trees to make syrup, operating a lumber mill and making furniture in his spare time.

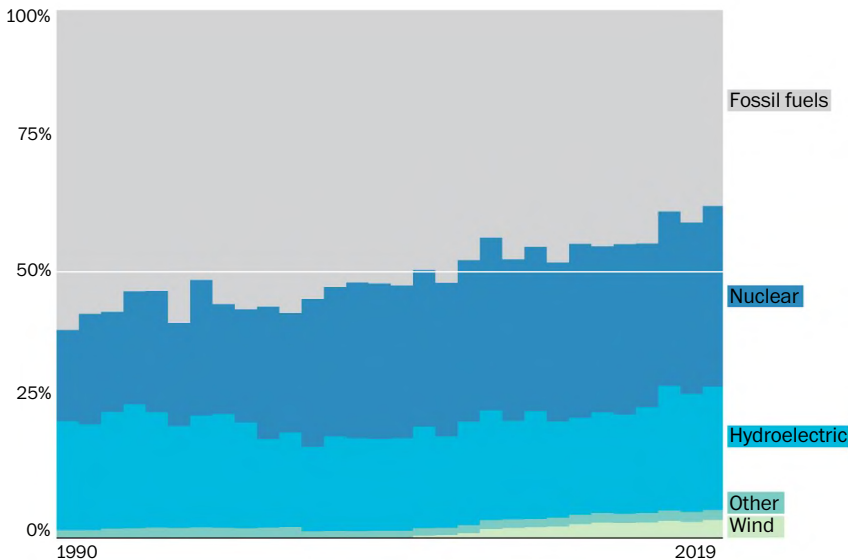
In a year when the dairy co-op is dumping milk because there’s too much for the market to use, he’s glad to see the turbine blades churning, grabbing electricity from the wind and sending it away down the wires. “It’s going where it’s needed, and that’s okay,” he said. “Everything gets bigger and needs more power.”

Government officials speak with similar confidence about the role of wind power and its renewable cousin, solar, in powering a low-emissions electric grid that could undergird an electric vehicle future. Without a renewable source of electricity, electric vehicles will still contribute to climate change — where fossil fuels are burned at power plants rather than in tailpipe emissions.

New York has adopted what it calls the 70-30 goal: 70 percent carbon-free power by 2030. The Biden administration has spelled out similar, longer-term goals for the nation as a whole. But a White House proposal to encourage the expansion of clean energy in the \$3.5 trillion reconciliation bill is facing intense opposition from Sen. Joe Manchin III (D-W.Va.) and is likely to be scaled back.

New York moving toward less reliance on fossil fuel sources for electrical power

Annual share of electricity generated by source, 1990 to 2019



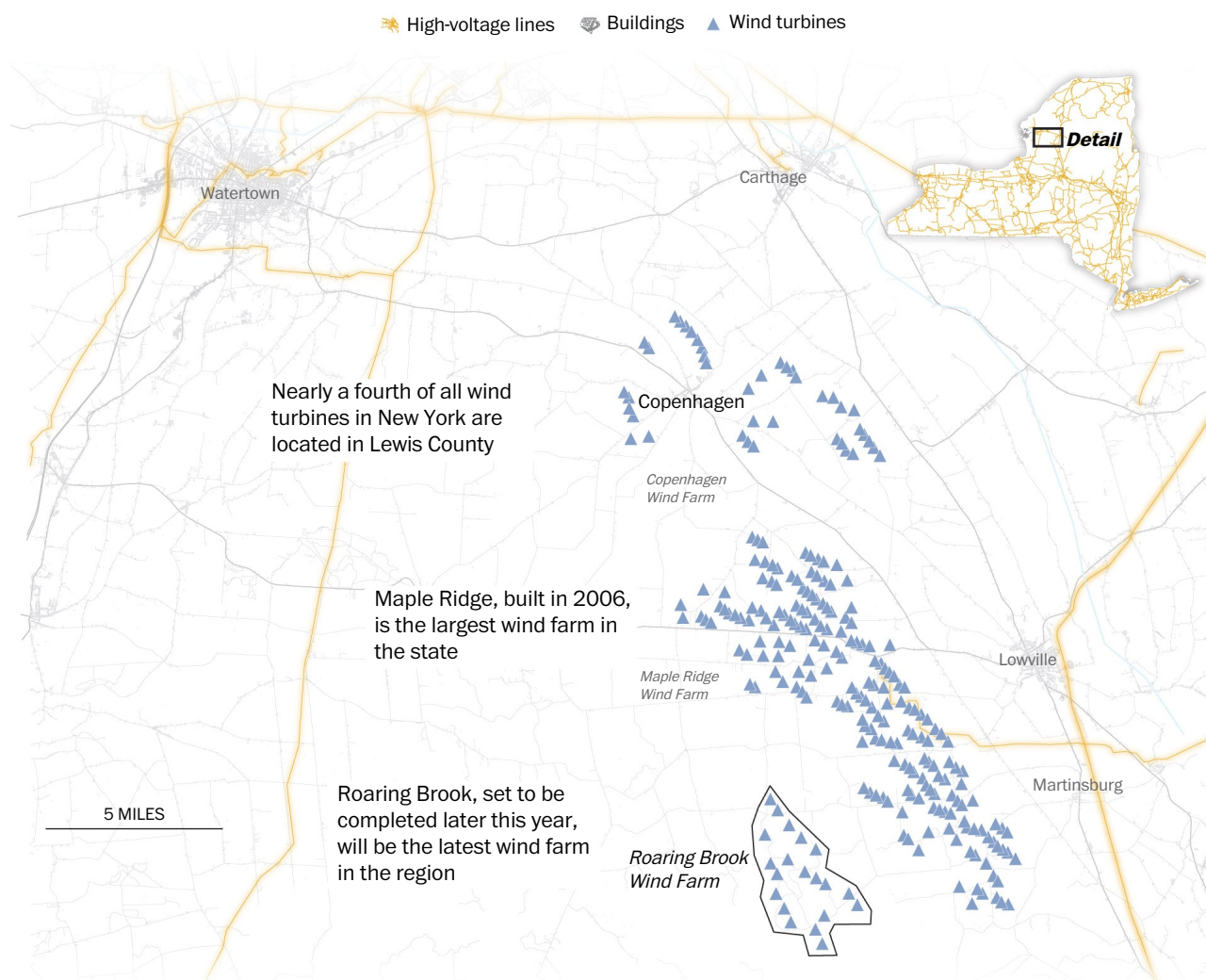
Officials have been depending on wind to be a big part of their clean energy plan. Earlier this year, then-Gov. Andrew M. Cuomo (D) boasted, "We are proposing the largest wind programs in the nation and advancing our green manufacturing capacity and the jobs that go with it."

In August, the Energy Department reported that 2020 had seen record-high levels of new land-based wind farm installations nationwide. "These reports contain such terrific news," Energy Secretary Jennifer Granholm said. "They underscore both the progress made and the capacity for much more affordable wind power to come."

But in New York and nationally, wind will have trouble meeting the expectations.

Lewis County and adjoining Jefferson County encompass the Tug Hill Plateau, a high forested region west of the Adirondacks. It's the best location for onshore wind farms in the entire state. Turbines stretch out along the eastern escarpment of the plateau, just where the winds off Lake Ontario pick up speed as they flow down into the fertile Black River Valley.

This fall, the Roaring Brook wind farm, with the latest in European turbine blades mounted to each of 20 250-foot-tall towers, goes into operation. It strides across 5,000 mostly forested acres on the eastern escarpment of the plateau.



Sources: United States Geological Survey; United States Energy Information Administration; Microsoft; Avangrid Renewables

All that power doesn't amount to much. Wind contributes about 3 percent of the output in New York.

Two proposed wind farms for Tug Hill could still get through the planning process and become operational.

"And that's probably about it for this region," said Jason Du Terroil, director of East Coast development for Avangrid, which will operate Roaring Brook. "The rest of New York, the topography doesn't really lend itself to wind. Up and down the East Coast, it's more difficult to site wind farms."

Nationally, wind accounts for about 8.4 percent of power production, and the U.S. Energy Information Administration expects some growth of onshore wind in the years ahead, especially in the Midwest.

Additional growth will occur offshore, at least for the East Coast. Stronger, steadier winds and more powerful turbines in the waters from Martha's Vineyard to Virginia could reach a capacity of 20 to 30 gigawatts by 2030, according to an American Wind Energy Association [report](#).

New York's share of that, probably nine gigawatts, would not be sufficient to replace all its fossil-fuel-powered generation plants, which in 2020 had a capacity of 26 gigawatts.

Solar energy is growing nationally, especially in the South and Southwest, but a combination of terrain and weather will limit its impact in the Northeast. It takes up too much room, for one thing.

Moser points out that he can plant his crops right up to the bases of the wind turbines standing in his fields. "To see good farmland covered with solar, it's disappointing," he said.

But wind farms aren't welcome everywhere. Wind has meant money for Lewis County, though it still has the second-lowest median household income of New York's 62 counties after the Bronx. Elsewhere — up near the Thousand Islands along the St. Lawrence River, for instance — wealthy part-time residents have had the means to fight off proposed wind farms.

And even in Lewis County, Roaring Brook met opposition. The Tug Hill Land Trust, a private nonprofit, objected to its placement on forest land, instead of farmers' fields, said Linda Garrett, the executive director of the group. She cited concerns about water pollution and the loss of a wilderness feeling in the state's third-largest forest. Avangrid has cut more than 10 miles of roads through the tract to connect the turbines.

"If you're cutting down trees to put up windmills to fight climate change, it doesn't make sense to me," she said. "It would be a lot easier to swallow if it was a community project, with community benefits."

Currently, 57 proposed wind projects in New York — on land and at sea — are awaiting a green light. Approval depends on there being enough transmission capacity to handle their output. Some have been in the queue since 2012.

If every project eventually won approval, and moved toward operation over the next decade, the capacity would be about 30 gigawatts, enough in theory to replace the fossil fuel plants.

But every project won't win approval. A new study of selected U.S. regions by the Lawrence Berkeley National Laboratory found that fewer than a quarter of all proposed projects actually make it to commercial operation.

Nuclear power is expected to decline from 20 percent of national output in 2019 to 12 percent in 2050, according to a [projection](#) by the U.S. Energy Information Administration. There are no nuclear proposals in New York's plans. Earlier this year, the state shut down an old nuclear plant at Indian Point, on the Hudson. Its capacity was picked up by two new gas-fired plants.

"Getting to 70 percent in nine years is going to be a big push," said Cullen Howe, a grid specialist with the Natural Resources Defense Council. "It's going to be a heavy lift. There's no question about it. Is it technically feasible? Yeah, I think it is."

But generating all that power will be one thing. Even assuming the goal can be met, that clean power still has to make its way to where the electric cars will be.



The electricity generated in Moser's hayfield heads about nine miles to the northwest, where it joins the New York grid at a substation in East Watertown. There it falls under the control of the state's Independent System Operator and enters a transmission line that shows up as a thin yellow connector on a dauntingly complicated and huge schematic screen that dominates the ISO control room in a tightly secured building in East Greenbush, just across the Hudson from Albany. The line interconnects with other lines in magenta, blue, red, green and orange, each representing a different level of voltage.

The ISO operators like to talk about what they call the state's Tale of Two Grids: on one side, the rural north and Rust Belt west, and on the other, the Hudson Valley, New York City metropolitan area and Long Island. Both produce nearly the same amount of electricity — about 65,000 gigawatt-hours in 2020 — but one has plenty of renewable power and the other does not. One has vast rural stretches; the other does not. They operate like two nearly separate systems.

"When the system's running well, there's not a lot to do," said Richard Dewey, president of the New York ISO. "It's, like, 95 percent boredom and 5 percent hysteria."

One main transmission line connects the two grids, carrying power from the north and west to where it's needed downstate, which uses about two-thirds of the state's overall energy. Running roughly between Utica and Albany, that line is called the Central East Constraint, and it is congested about half the year, meaning no more power can flow along it.

And at least 11 pockets within the two regions have their own local constraints: high-tension lines that don't have enough capacity even today.

It is not a problem specific to New York state. Similar constraints exist in Texas, California, Maryland, Illinois and elsewhere. Across the country, long-distance transmission lines can only carry so much electricity, just the way a pipe can only carry so much water. When they're at full capacity, they can't carry any more, even if a downstream customer — a local utility, for instance — is trying to obtain some.

The limits of these constraints will become even more significant as the nation moves to send more clean energy across long distances. It's much easier to cut back on wind and solar generation in what are called curtailments than it is to dial down a traditional power plant or hydroelectric dam, and easier to bring them back on again, so renewables always take the brunt of curtailment orders.

By 2030, a study suggests, the potential output of renewables in some of the smaller pockets in New York could face curtailments of as much as 63 percent without improvements in transmission. This would make it virtually impossible for the state to meet the 2030 goal.

Keeping energy flowing from upstate to downstate is critical to the state's goals. Last year, 90 percent of the electricity produced upstate was zero-emission, a little bit of it from the Moser farm but the bulk from nuclear plants and the Niagara Hydroelectric Power Station. Downstate, by contrast, 77 percent of the electricity was from fossil fuels.

To meet its needs, New York state is planning to spend \$1.2 billion on upgrades, and Gov. Kathy Hochul (D) announced on Sept. 20 a plan to spend \$11 billion on a new transmission line skirting the Catskills, as well as another line that would bring hydropower straight down from Quebec. At the national level, the federal infrastructure bill includes \$5 billion to address congestion.

Even with the improvements, Dewey said, meeting the state's emissions target by getting cleaner power downstate "is going to be a stretch."

In New York and across the country, engineers also expect to enhance lines on existing rights of way. A technology called dynamic line rating, which uses sensors to provide much greater visibility into conditions on transmission lines, could allow them to carry significantly more power, without new construction.

A different workaround to the transmission problem involves numerous new small but local power generators. Hochul announced a plan in September to build vast numbers of rooftop installations.

The panels would be installed where the demand is — predominantly in and around New York City.



The main transmission line from upstate to New York City comes right down the Hudson Valley, with secondary lines providing some backup. Electricity imported from Connecticut, Massachusetts and New Jersey can also feed the metropolitan area.

At substations around the region, the voltage is stepped down and the power is distributed on local lines — strung on familiar poles in parts of the outer boroughs and Westchester County, but underground in Manhattan.

Moshe Cohen, the CEO of a start-up called Gravity, hoped this year that at the end of one of these lines would be what he needed to get his electric taxi vehicle company up and running — quickly, and at scale.

He approached major parking garage operators about setting up 50 fast chargers, which can replenish a car in as little as 20 minutes but gulp huge amounts of electricity.

Building out the equipment for such a site would be possible. "This is what we do for a living," said Patrick McHugh, vice president of engineering and planning for Con Edison. "It's nothing that we haven't done."

But it would take years. If you plugged in 50 cars at once to 50 chargers, it would draw as much electricity as a high-rise office building for as long as the cars were being refueled.

"We face some very tight constraints," Cohen said.

The plan didn't work out. Instead Gravity is going with reduced, scattered charging sites around the city.

But that was a plan for only 50 cars. As the country turns toward electric vehicles, New York City is expected to have 2 million of them on the streets by 2040, according to the New York Power Authority.

Con Ed does not intend to be the obstacle to the electric vehicle future. "This is coming," McHugh said. "We're working to be ahead of that."

But Gil Quiniones, head of the New York Power Authority, has a less optimistic view. He lives in the West Village of Manhattan, and there's a big UPS depot just around the corner on Greenwich Street.

“What if Amazon and FedEx and UPS say, ‘We’re going to go electric,’ ” he said. “Con Ed is going to be scrambling.”

As CEO of the Power Authority — a state agency established by Gov. Franklin D. Roosevelt in 1931 — Quiniones has had an up-close look at what ails the power grid.

The heat is a big headache for Con Ed and the utilities nationwide that distribute electricity up and down every street. Block by block, transformers and substations can overheat, from both the air temperature and the heavy burdens placed upon them by the demand from air conditioning. Heat pushes the system on a grand scale to its limits, but also neighborhood by neighborhood, even house by house.

In June, July, August and September, Con Ed urged customers to conserve power so the system wouldn’t crash.

As recently as the summer of 2019, Con Ed had to sever power to 50,000 customers in Brooklyn and Queens to keep its system from crashing in the face of 100-degree heat.

A crucial component as electric vehicles become more prevalent will be the ability to spread demand over 24 hours.

“You don’t want everybody charging when it’s 96 degrees at 2 p.m. That’ll crash the system,” Quiniones said.

McHugh said that Con Ed expects the move to electric cars to be gradual, much the way the adoption of home air conditioners was in the 1970s and 1980s. “It will slowly build up,” he said, “and we’ll monitor that accordingly.”

To power a city’s worth of electric vehicles, New York by the 2030s will have to call on a wide array of resources. New or enhanced transmission lines, for instance, will carry more juice from the renewable producers of western New York down to the metropolis — likely even some from Moser’s hayfield, unless it’s needed closer to home.

But at the same time, a dramatic transformation of the grid will be necessary, experts say. Rooftop solar panels will need to be sprouting everywhere. Enthusiasts believe that microgrids could one day be powered by long-elusive hydrogen fuel, or small, next-generation nuclear reactors. All these sources would be local but deeply interconnected, supporting each other.

“We have the technology to do it,” Howe said. “The question is, do we have the will?”

Graphics by [Chris Alcantara](#).

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