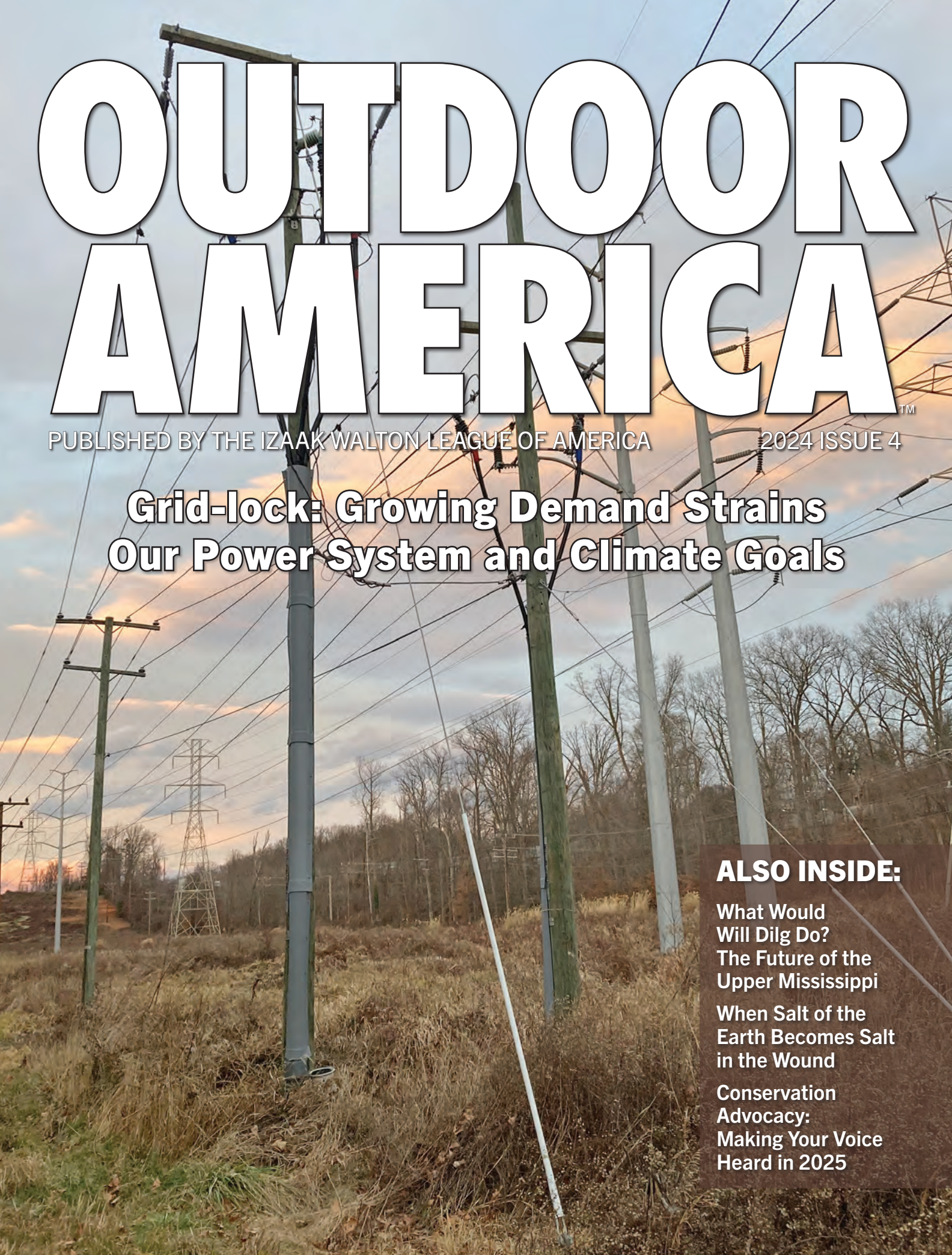

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Grid-lock: Growing Demand Strains Our Power System and Climate Goals

ALSO INSIDE:

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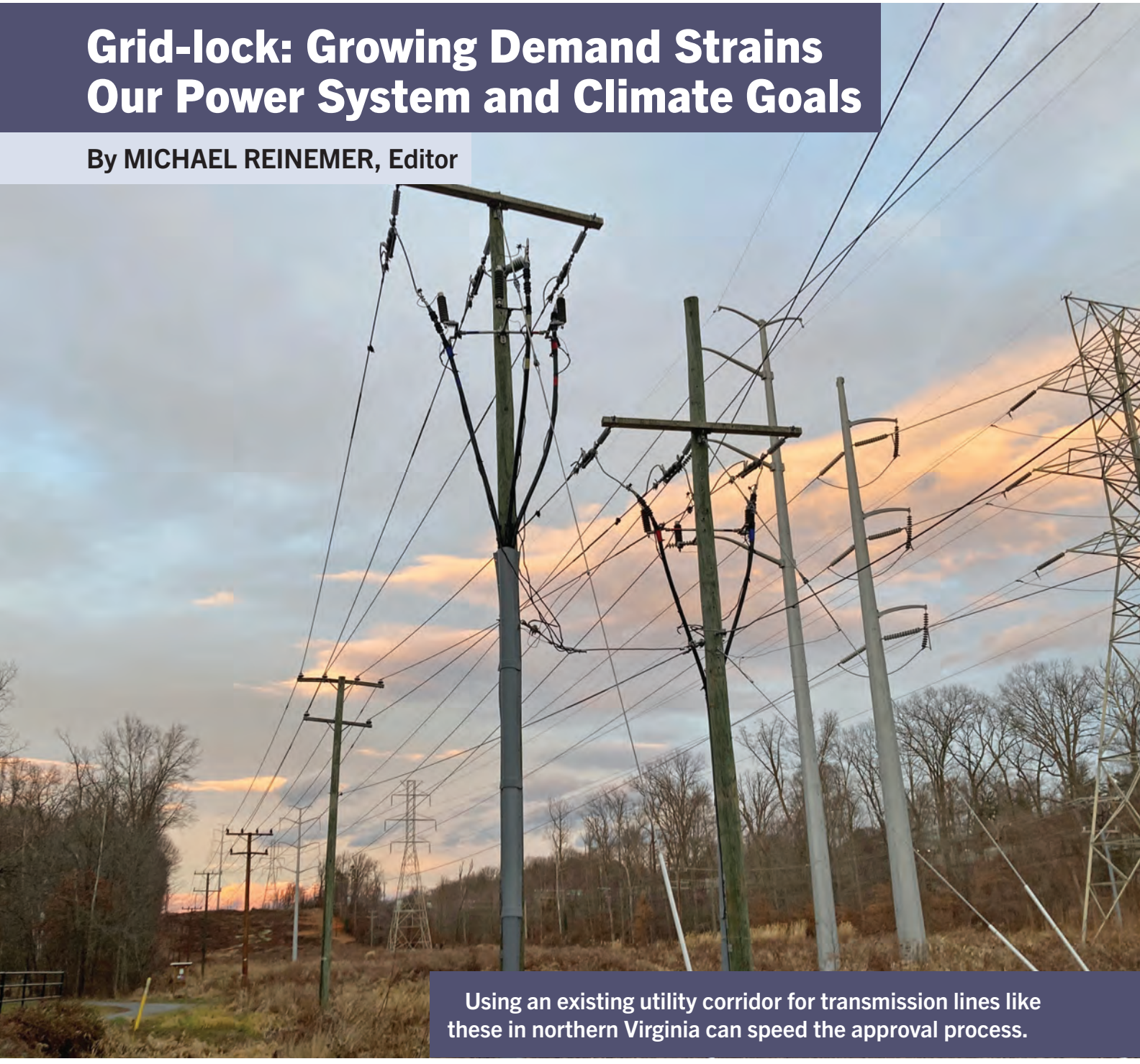
By MICHAEL REINEMER, Editor



Using an existing utility corridor for transmission lines like these in northern Virginia can speed the approval process.

MICHAEL REINEMER

As demand for electricity soars and suppliers of renewable sources seek connections to consumers, the transmission system—the grid—is in trouble. It's old and hasn't kept up with new technologies. Its vast network of power plants and transmission lines represents 100 years of building out the electrical infrastructure in the U.S. This grid connects generating capacity—traditionally large power plants, hydro-electric dams and heavily concentrated wind and solar development—with cities and towns.

Planning, siting, financing and building new transmission lines can take up to 10 years to complete and involves authorization from both state

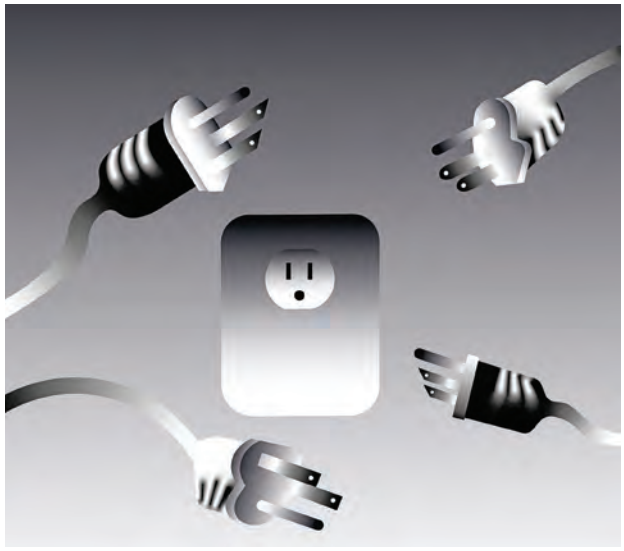
and federal regulatory authorities. So even as we develop new ways to generate and store electricity —including with utility scale battery systems—the network that moves this energy from the source to the consumer needs help.

"The grid is worn down, it's patched up, and every hoped for improvement is expensive and bureaucratically bemired," writes Gretchen Bakke in her book, *The Grid*.

We will need a combination of better transmission technology, grid capacity and energy storage to meet growing demand and integrate a greater share of renewable sources into a modern grid.

Limited transmission capacity in the existing system

The grid is actually a collection of several independent networks throughout the U.S. that operate transmission and interconnection—getting electricity onto a grid. There is a backlog of renewable energy projects—solar, wind and batteries—waiting to get on the grid. The abundance of renewable energy sources and the limited capacity for transmission slows the ability to get new and renewable energy to users.



Organizations that operate grids, called regional transmission operators, do not own electric generating plants or transmission lines and are independent of their members—the utilities that generate electricity. The largest grid management authority, PJM Interconnection, manages the grid in 14 states stretching from New Jersey to Illinois. Separate grids operate in the West. Texas has its own grid system, which suffered large power outages due to frigid weather in February 2021. At least 200 deaths were attributed to the loss of heat to millions of households for several days.

All of these systems are coping with the challenges of providing reliable electricity through their existing infrastructure. But throughout the industry, across the states and in Washington's own brand of power corridors, some solutions are creating sparks of optimism.

Demand skyrockets

Americans' dependence on abundant electricity is growing. For instance, the data centers that run artificial intelligence (AI) programs like ChatGPT and the AI applications popping up everywhere consume an enormous amount of electricity. That puts a strain on energy supply.

In Virginia, Dominion Energy estimates that demand for electricity will increase 100 percent over the next 15 years due in large part to energy-hogging data centers, which are abundant in the commonwealth.

PJM, the regional transmission operator, also expects increases in load growth related to data centers. The share of total load attributable to data centers, which is currently 4 percent, is expected to rise to 12 percent by 2030 and 16 percent by 2039. Further complicating the picture, PJM expects significant retirements of existing plants that use fossil fuel to generate electricity, which represent about 21 percent of PJM's current installed capacity.

There are no simple solutions to what will be expensive challenges for generating and transmitting enough electricity to meet demand. In addition to more electricity from renewable sources, it will likely require more power generated by natural-gas—even as companies, like Microsoft, aim to achieve "carbon negative" power sources by 2030.

In October, Google and Microsoft announced plans to build small modular nuclear reactors (SMRs) to provide electricity for data centers. Today, no commercial SMRs are operating, and as Amazon executive Matt Garman told *The Wall Street Journal,* SMRs won't solve anything during this decade. Nuclear power presents a host of vexing problems,

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including storage of highly radioactive waste for thousands of years. But this proposal illustrates one of the long-term options data companies are considering.

At the same time, local resistance to data centers has emerged in many places, including Fort Worth, Texas, Fayette County, Georgia and Burns Harbor, Indiana. The centers bring tax revenue but also increase the cost of electricity and, as detailed in Issue 2, 2024 of *Outdoor America,* data centers consume an immense amount of clean water to cool the centers' computers.

Data centers often require upgrades to existing transmission lines to deliver electricity. Or they may require entirely new "greenfield" transmission lines across undeveloped land. Greenfield refers to construction on land that is undeveloped or natural. That contrasts with "brownfield," defined as development in places that have already been used for industrial or commercial purposes.

Existing brownfield corridors across land, or rights-of-way, already used for highways, railroads or pipelines could help smooth the approval of new transmission lines.

Promising technology

During the summer of 2024, the Biden administration announced a federal grant program to improve the grid using the existing transmission corridors. Called "Smart Wires," the program uses new technology to optimize the efficiency and flexibility of the existing grid.

The nation's competing goals of emission reduction and energy production are clearly at odds.

The Wall Street Journal reported improvements reaped from a pilot program at Great River Energy in Minnesota increased energy transmission capacity by about 40 percent by using sensors to track weather and other factors that affect the efficiency of power lines.

Another tactic is replacing existing transmission lines with high-performance wires, which is relatively easy and inexpensive. Adopted broadly, that could increase transmission capacity fourfold, say researchers at the University of California-Berkeley and the consulting firm GridLab.

Rethinking energy rules

During 2024, several attempts to improve the grid have been introduced. In April, the Energy Department introduced a plan to upgrade 100,000 miles of transmission lines over the next five years. The department proposed that it will take the lead in coordinating the process to fast-track improvements in transmission infrastructure. The regulatory process historically has required approvals from several agencies. And aiming for better long-term

Energy-hogging data centers increase demand for electricity from fossil fuels as well as renewable energy sources, both shown operating near Casper, Wyoming.

MICHAEL REINEMER

planning for the grid, the Federal Energy Regulatory Commission (FERC) announced a rule in May that requires energy companies to plan for and consider supply and demand for electricity at least two decades into the future, and also focus on places where transmission infrastructure is lacking.

In Congress, members have also been looking at ways to speed up the approval process for energy projects. One process energy projects go through is a review required by the National Environmental Policy Act (NEPA), one of the nation's vital, bedrock laws that requires environmental assessments of projects proposed by the federal government.

A setback for climate goals?

While governments that recently gathered at the U.N. Climate Conference discussed the urgent need to reduce greenhouse gas emissions, the reality is energy demand will make carbon reduction goals harder to reach.

In the U.S., the new, extra energy needed by data centers alone, according to a report from Bloomberg Intelligence, is the equivalent of 10 to 30 percent of the current demand for electricity derived from natural gas-fired plants. More than 200 new natural gas power plants are now under development. Although burning natural gas emits less carbon pollution compared to burning coal or oil, the scale of new development will only add more carbon to the atmosphere when scientists overwhelmingly agree net emissions need to be reduced immediately.

So, the nation's competing goals of emission reduction and energy production are clearly at odds.

Neil Chatterjee, who chaired FERC during President Trump's first term in office, recently told the *Washington Post,* "There are real moral questions that will be brought to bear. Is the benefit society is deriving from AI worth the energy intensity needed to power it and the carbon emissions associated with that energy intensity?"

UTILITY-SCALE BATTERIES BOOST STORAGE CAPACITY

Utility-scale battery systems offer important, growing capacity for storing electricity. These systems help to balance supply and demand and store electricity from renewable sources until needed.

In the first half of 2024, energy operators added five gigawatts of storage capacity to the nation's grid, according to the U.S. Energy Information Administration. One gigawatt equals 1,000 megawatts, which is enough to power a medium-sized city. New York City typically uses about 5.5 gigawatts of electricity annually.