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EMPOWERING RURAL AMERICA THROUGH INVESTMENT IN INNOVATION

HEARING

BEFORE THE

SUBCOMMITTEE ON RURAL DEVELOPMENT, ENERGY, AND SUPPLY CHAINS

OF THE

COMMITTEE ON SMALL BUSINESS UNITED STATES HOUSE OF REPRESENTATIVES

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EMPOWERING RURAL AMERICA THROUGH INVESTMENT IN INNOVATION

WEDNESDAY, JANUARY 21, 2026

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SMALL BUSINESS,
SUBCOMMITTEE ON RURAL DEVELOPMENT,
ENERGY, AND SUPPLY CHAINS,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:03 a.m., in Room 2360, Rayburn House Office Building, Hon. Jake Ellzey [chairman of the Subcommittee] presiding.

Present: Representatives Ellzey, Finstad, Wied, Schmidt, Williams, Morrison, Scholten, Olszewski, and Goodlander.

Chairman ELLZEY. Good morning. Welcome to the Committee on Small Business, Subcommittee on Rural Development, Energy, and Supply Chains.

I would like to recognize Chairman Roger Williams for the prayer and the pledge.

Mr. WILLIAMS. Please stand.

I pledge allegiance to the Flag of the United States of America and to the Republic for which it stands, one nation, under God, indivisible, with liberty and justice for all.

Would you please bow your head?

Heavenly Father, God of all people, thank you for allowing us to be here today to share wonderful ideas for the future of this great country and the people that care about it so much.

We also care about you, and that is why we strive every day to walk in your light and not in your shadow—in our shadow.

In your name we pray. Amen.

Chairman ELLZEY. Good morning. I will now call the Subcommittee on Rural Development, Energy, and Supply Chains to order.

Without objection, the Chair is authorized to declare a recess of the Committee at any time.

I now recognize myself for my opening statement.

So welcome to today's hearing, "Empowering Rural America Through Investment in Innovation."

I want to say thanks to our witnesses for showing up today, traveling here at their own expense to spend some time with us, and your expertise.

So, as the demand for AI accelerates, America's digital infrastructure is rapidly expanding into rural communities. This infrastructure consists of data centers being built far beyond traditional tech hubs, with many investments being made in rural areas, in-

cluding in my district, in Ellis County. Our rural communities and small businesses are at the center of America's AI-driven growth.

Texas is leading the charge in data-center development because of our pro-growth, pro-energy, and low-regulatory environment that has minimized the hindrance of red tape. We have placed a strong focus on developing the workforce for high-paying, new-collar jobs, and data companies have recognized those benefits.

The economic ripple effect from data centers can reinvigorate rural communities like mine by creating high-paying trade careers and supporting long-term economic activity in rural small businesses. For every direct job created at a data center, up to seven jobs are supported in the surrounding community.

Small businesses are supplying, maintaining, and supporting these facilities. From construction to infrastructure upgrades, data centers open doors for main street entrepreneurs and trade workers to be a part of the next generation of technical advances.

Meeting the workforce needs of data centers across the country will take a whole-of-community approach to attract and train the skilled workers needed to succeed. Many of our military veterans who return to civilian life already possess the skills required for this industry.

As a vet myself, I was proud to co-lead the bill that made the Boots to Business training program permanent, alongside Chairman Williams and Representatives McGarvey and Schneider. Through this effort, our returning service members can be trained to fully utilize their military skills in entrepreneurship opportunities, including those offered by the data-center industry. This bill was passed in the fiscal year 2025 NDAA and will continue to be a vital tool in meeting our workforce needs.

Building out this workforce is a crucial step in securing America's energy dominance and supporting our national security. At the same time, industry leaders, local partners, and educational institutions are already stepping up with investments in advanced energy solutions that not only strengthen local infrastructure but keep us competitive with the AI race with China.

I look forward to hearing from today's witnesses about how data centers can support local communities, strengthen the small-business ecosystem, and help build a new middle class in rural areas across the country.

And, with that, I now recognize the Ranking Member, Representative Morrison, for her opening remarks.

Ms. MORRISON. Thank you, Mr. Chairman.

And thank you to the witnesses for being here.

Emerging technologies like AI and blockchains are redefining how people around the world live and work. These technologies are run on computers, but most computers don't have the processing power or compute needed to run them quickly enough for mainstream use. For advanced AI models to be developed or operated at a suitable speed, they must be hosted by a massive group of computers that collectively pool their compute, found only in data centers.

The growth of AI, both in use and in development, has spurred an explosion in data-center construction, which has caused a huge

rise in demand for the electricity they need to function as well as for water used by some data centers' liquid cooling systems.

New data centers can bring benefits, like tax revenue and investment, to rural areas that sorely need them. But, as we point out in most hearings, it is important to think about the whole picture—the benefits, the costs, who receives those benefits, and who bears those costs.

The recent data-center boom presents numerous challenges.

First, data centers are causing residential customers' electric bills to rise by increasing electricity demand and straining the electric grid.

Second, data centers draw on supplies of clean, drinkable freshwater, stressing local water systems, sometimes in areas with already-limited water availability and infrastructure.

Third, computer-part-makers, responding to AI developers' vast capital, are shifting production from consumer parts to AI products, making computers and smartphones more expensive.

And last but not least, new data centers are directly and indirectly increasing pollution and carbon emissions, posing significant environmental health risks.

With all that said, these outcomes aren't foregone conclusions. It is possible to build more data centers in a way that doesn't hamper innovation but also benefits the communities that surround them. We should be thoughtful and purposeful about the way we are building data centers.

During the previous administration, Democratic congressional majorities enacted landmark laws to lower costs for consumers and small businesses. The Inflation Reduction Act created tax incentives to make energy cheaper and cleaner. The Bipartisan Infrastructure Law invested hundreds of billions of dollars in our clean water and broadband internet. And the CHIPS Act funds and incentivizes domestic computer manufacturing, stabilizing and lowering computer prices.

H.R. 1 slashed those IRA tax credits, and the Trump administration is doing everything in its power to halt the permitting of clean-energy products—the cheapest and fastest forms of energy to build. He has also diverted billions in broadband funding to Elon Musk's company Starlink for unreliable satellite connections in rural areas. And he proposed cutting rural water and wastewater grants by $154 million this year and repealing the CHIPS Act.

All together, President Trump is enabling data centers to make America's affordability crisis far worse.

Still, we can salvage the situation. We can follow through on the farsighted investments made by the previous administration and put in place commonsense guardrails that shield American consumers and small businesses from the excesses of the data-center boom.

I hope to have a clear-eyed and productive discussion about how communities, especially rural ones, can maximize the benefits and minimize the costs of the data-center projects popping up across the nation. Affordability for Americans depends on it.

With that, Mr. Chairman, I request unanimous consent to insert into the record the written statement of the Loudoun County Virginia Board of Supervisors Vice Chair, Mike Turner.

And I thank the witnesses for being here.

And I yield back.

Chairman ELLZEY. Without objection.

And I will now introduce our witnesses—hmm? Is she here?

I am going to pay for this later at the baseball field.

Thank you. I now recognize the Chairman of the full Committee, Chairman Williams, for an opening statement.

Mr. WILLIAMS. That is a good recovery, Chairman. Thank you.

Chairman ELLZEY. Thank you, sir.

Mr. WILLIAMS. Thank you, Chairman Ellzey, for holding this very timely hearing.

And thank you to all the witnesses for being here today and joining us with this discussion on the impact of the data-center industry on rural communities and small businesses.

The data-center industry is growing rapidly, and Texas is right in the center of the action. We are witnessing the economic and industrial revival, with these businesses driving high demand for tradeskill workers, and technical and trades jobs will be the backbone of the renewed American middle class.

As Chairman Ellzey has explained, veterans come ready with many high-demand skills that the data-center industry needs. By making the SBA's Boots to Business program permanent last Congress, Chairman Ellzey, myself, and other colleagues on both sides of the aisle are arming our veterans with the entrepreneurial skills and knowledge necessary to step into critical roles and leadership, not only in the data-center industry but across any industry.

One of my highest priorities is to encourage more young people to pursue a career in technical education, also known as CTE. And in pursuit of that goal, I have introduced two bipartisan bills in Congress—H.R. 1641, the Student Debt Alternative and CTE Awareness Act; and H.R. 1642, the Connecting Small Businesses with Career and Technical Education Graduates Act of 2025. These bills promote CTE programs and help graduates of these programs to find jobs with small businesses.

Now, career and technical education is critical to meeting the growing demand for tradeskills professionals and building the future of the American workforce. Ambitious and entrepreneurial electricians, HVAC technicians, and plumbers are finding an industry overflowing with opportunity in rural America. Data centers cannot operate without small businesses to build and maintain them.

And, of course, every opportunity comes with certain challenges. We look forward to discussing them with our witnesses today, as we continue exploring the impact of data centers across our communities.

I want to thank again our witnesses again for joining us today and for your investment in the rural communities of Texas.

With that, I yield back.

Chairman ELLZEY. Thank you, Mr. Chairman. Please, no wind sprints come March.

And I would like to add before we delve into our witnesses that, as we talk about our veterans—thanks for the kind words, Mr. Chairman—that our veterans have the discipline to be trained to

do anything, and they have the drive to do everything. So they are going to be an essential part of this.

Our first witness today is Mr. Chris Crosby, the chief executive officer of Compass Datacenters in Dallas, Texas.

Mr. Crosby founded the company in 2011 after years of working at the intersection of technology and real estate development, focusing on delivering scalable, customizable, and sustainable data-center infrastructure.

Since founding Compass, Mr. Crosby has led the company's growth, from completing its first 1.2-megawatt data center in 2012 to developing campus-scale facilities serving hyperscale customers worldwide.

Under his leadership, Compass has earned recognition as one of the fastest-growing companies in the country and has become a leader in sustainability and long-term infrastructure development within the data-center industry.

Mr. Crosby holds a Bachelor of Science in computer science from UTA—UT Austin, for those not in the Sixth District.

Thank you for joining us.

Our next witness is Mr. Kirk Offel. Mr. Offel is founder and chief executive officer of Overwatch Mission Critical, a strategic data-center consulting firm based in Austin, Texas.

Mr. Offel has had two decades of industry experience, having worked in executive roles with Fortune 1,000 companies and major data-center providers worldwide. His career includes work with Medtronic, Eaton Corporation, Hewlett-Packard's Technology Services Consulting practice, and others.

In addition to his executive pursuits, Mr. Offel is the founder of the Data Center Austin Conference and the host of the "Data Center Revolution Podcast."

He is a U.S. Navy veteran, having served aboard a nuclear fast-attack submarine, and was recognized as a Member of the class of 2010 "Military Top 40 Under 40."

And, if I might add, if you are on a fast-attack submarine, you have gone to Nuclear Power School and you are smarter than everybody else in the room.

And, clearly, because of that hair, you are a submariner, not a pilot.

I am looking forward to hearing your testimony.

I now recognize Ranking Member Morrison to briefly introduce our last witness.

Ms. MORRISON. Thank you, Mr. Chairman.

Dr. Nicol Turner Lee is a senior fellow in governance studies at the Brookings Institution and the director of its Center for Technology Innovation.

She is an accomplished tech-policy expert, focusing on equitable access to and impacts of technology, with three decades of experience in research and advocacy. Her recent work includes a 2024 book titled "Digitally Invisible: How the Internet is Creating the New Underclass" and a chapter in "The Oxford Handbook of AI Governance."

Before her time at Brookings, Dr. Turner Lee was the chief research and policy officer at the Multicultural Media, Telecom, and

Internet Council and the director of the Media and Technology Institute at the Joint Center for Political and Economic Studies.

She has also served on federal advisory commissions, such as the Commodity Futures Trading Commission's Technology Advisory Committee, the Department of Homeland Security's AI Safety Board, and the Federal Communications Commission's Communications Equity and Diversity Council.

Dr. Turner Lee holds a B.A. from Colgate University and an M.A. and Ph.D. from Northwestern University.

She might compete on the smart front here.

Welcome, Dr. Turner Lee.

Chairman ELLZEY. Thank you all for being here.

Before recognizing the witnesses, I want to remind you that you have 5 minutes. If you go over 5 minutes, I start tapping, and then I start screaming after that.

I now recognize Mr. Crosby for his 5-minute opening remarks.

STATEMENTS OF CHRIS CROSBY, CHIEF EXECUTIVE OFFICER, COMPASS DATACENTERS; KIRK OFFEL, FOUNDER AND CHIEF EXECUTIVE OFFICER, OVERWATCH MISSION CRITICAL; AND NICOL TURNER LEE, PH.D., SENIOR FELLOW IN GOVERNANCE STUDIES AND DIRECTOR OF THE CENTER FOR TECHNOLOGY INNOVATION, BROOKINGS INSTITUTION

STATEMENT OF CHRIS CROSBY

Mr. CROSBY. Thank you, Chairman Ellzey. Thank you, Ranking Member Morrison and Chairman Williams and distinguished Members of the Subcommittee. Thank you for inviting me today to testify on how investments in digital infrastructure is revitalizing rural America.

My name is Chris Crosby, and I am the founder and CEO of Compass Datacenters. After 25 years of working at the intersection of technology and real estate development, I founded Compass in 2011. We design, build, and operate the customizable, scalable, and sustainable foundations of the global hyperscale market.

It is vital to distinguish our work from crypto farms or transient AI factories. We build hyperscale campuses, enduring civic infrastructure that supports the banking, cloud-computing, AI, and social connectivity services Americans use every day.

We are in the middle of the most significant economic transformation since electrification. Data centers are the 21st-century equivalent of the railroads coming. They are now moving beyond traditional tech corridors into rural communities. They are bringing substantial capital, jobs, and infrastructure investment.

There is an outdated myth that data centers only provide temporary construction jobs. In reality, our campuses are 100-year assets. They are part of the communities that they sit in, and they are in a state of constant evolution.

In Red Oak, Texas, the Chairman's district, our investment has triggered a significant butterfly effect. We provide stable work for roughly 1,500 construction workers during the decade-long build-out and anticipate over 400 permanent, high-paying jobs—operations, maintenance careers, technology careers—on the campus.

We anchored a new industrial hub by partnering with Schneider Electric to build a 105,000-square-foot manufacturing facility on our campus, in the middle of our campus, creating an additional 350 jobs on the campus.

Before our 2021 investment in Red Oak, new sales tax business permits in the municipality grew at a meager 12 percent annually, which for north Texas is not doing very good. Since we began construction, that growth rate has surged to 43 percent, compounding.

Data-center campuses function as sustained economic engines, creating a butterfly effect of new restaurants, retail, housing, and other developments within the communities. And if you have driven through Red Oak, Texas, you see the bridges and the construction, the new schools, and everything else that is coming along with it.

On energy, large data centers serve as anchor tenants for the grid. Our national grid averages just about 50-percent utilization throughout the year, so by utilizing this underused capacity, we help take those fixed costs across more electricity sales and actually do put pressure down on the rates for families and not small—and small businesses to pay less.

Let me be very clear on this point: Data centers pay more so that families and small businesses can pay less. There are scenarios where we are regulated to not be able to do that, but that is not for want.

At Compass, we go even further with our "co-serve" model. To quote John Knight, the assistant director of economic development in Red Oak, Texas, "Compass builds redundancy into our grid, supports our infrastructure. I love what data centers are doing to improve our community's qualify of life," end quote.

We fund transmission lines, substations, and interconnects through up-front contributions in aid of construction, also known as CIAC payments, strengthening the local grid for everybody.

However, outdated regulations still limit our ability to contribute even more.

We need emissions standards that distinguish the cleaner hydrotreated vegetable oil, or HVO, that we use—we pay more for than diesel—from traditional diesel so that we can stabilize the grid during emergencies without penalty. We don't want black soot going in the air for our communities.

We need the EPA to formally classify mandatory grid curtailments as emergencies, allowing us to support the grid, be grid resources during extreme weather events like this coming week, without risking compliance violations.

And we need regulatory flexibility to allow more proactive private funding for long-term grid infrastructure—that is, private funding for grid infrastructure.

Compass is built to last, which is why we invest deeply in our people and our communities. We partner with Texas State Technical College to create a scholarship pathway into high-tech, high-paying roles that don't require 4-year degrees. The program is now scaling nationally. We are in our second cohort.

We also work with veteran-focused organizations like Overwatch and Salute to place skilled military talent in data-center careers close to home.

Environmentally, we preserve local resources by mandating water-free cooling since 2012 to protect our agricultural water supplies.

In conclusion, Compass does not seek a free ride. We come with a multigenerational commitment to prosperity in each of our communities, ensuring that the AI revolution empowers every corner of our nation.

I thank the Committee for the opportunity to testify and for your leadership on this important topic, and I look forward to answering your questions.

Chairman ELLZEY. Thank you, Chris.

Now I recognize Mr. Offel for his 5-minute opening remarks.

STATEMENT OF KIRK OFFEL

Mr. OFFEL. Good morning, Mr. Chairman. Thank you. Ranking Member, Members of the Committee, thank you for the opportunity to testify today.

As an industry, we did not communicate early enough or often enough about our data-center plans, and that created avoidable concerns. We didn't clearly explain what we were building, why it mattered, or how communities would benefit, and we relied on the trust we hadn't yet earned.

We are fixing it by increasing transparency, tightening our outreach, and making sure every community and stakeholder understands the mission, the safeguards, and the benefits. We know trust is earned, and you will see that reflected in how we engage moving forward.

My name is Kirk Offel. I am the CEO of Overwatch, and I am proud to be a Service-Disabled, Veterans-Owned Small Business (SDVOSB). Before I ever set foot in a data center, I spent five (5) years in the U.S. Navy, serving aboard the nuclear fast-attack submarine USS Memphis.

That experience taught me something simple: You don't accomplish big missions with big slogans; you accomplish them with small, highly capable teams who know how to execute.

And that is exactly what is happening in the AI boom today. Let me be blunt: Small businesses are the backbone of this entire industry. I am saying the AI boom does not happen without us, period.

Today, more than 75 percent of the whole AI infrastructure ecosystem is driven by small businesses. We are the ones building the AI factories. We are the ones pulling fiber, erecting steel, trenching conduit, fabricating components, hauling equipment, running logistics, and delivering professional services that keep projects moving.

As our grid gets pushed harder than ever before, it won't be a big company flying in from out of State fixing that. It will be a local electrician, local line crews, local engineering firms, and local contractors—small businesses that actually understand the communities that they serve.

We are going to see new small businesses pop up in manufacturing—equipment rental, transportation, environmental services, permitting, legal, security, cleaning, maintenance, you name it. And all the indirect jobs—housing, food, retail, childcare—all grow because of this work.

And we have seen this before. Every major leap in American infrastructure has had the same outcome: Small businesses become the biggest winners. They grew with the railroad era. They scaled during the electrification of America. They expanded through the construction of the interstate system. And they absolutely exploded during the automobile revolution. Each of those moments didn't just change the country; they created millions of small businesses that reshaped the American workforce.

And, today, we are living through what I believe is the fifth industrial revolution—a revolution powered by data, intelligence, and people who build and sustain the infrastructure behind it. AI factories are no different. They are simply the 21st-century version of those earlier transformations, and they will become the next great engine of American small-business growth.

Let me put some numbers behind that. For every $100 billion we invest in building digital infrastructure, we get $800 million in local tax revenue; 500,000 new jobs; $40 billion in labor income; and that is a $140 billion boost to the U.S. GDP.

Now I want to address the concerns we all hear: energy, water, environmental impact, and job creation—all valid concerns. They deserve our attention, and they are beginning to get monitored very closely. But the answer is not to hit the brakes. The answer is the same answer we used when we built the railroads, electricity, cars, and the roads: We govern it, we guide it, and we build it more responsibly.

People forget this, but the first cars were horribly inefficient, wildly polluting, incredibly dangerous, and brutal on city infrastructure. So, what did we do? We built smarter, we built safer, we set standards, and we improved efficiency.

Progress doesn't happen because we avoid the challenge; it happens because we take it head-on. That is the American way.

Today, we have 5,400 data centers in the U.S. That is the most in the world. Hyperscale capacity has doubled in the last 5 years, and we are staring down the barrel of $5 trillion in construction over the next 5 years. The industry is on track to triple by the end of the decade.

And for the first time ever, we have the ability to retrofit the past, to take older facilities and make them just as efficient as the new data centers we build today. AI factories are the most transformational infrastructure America has ever attempted to build.

Henry Ford enabled the movement of people and goods. AI factories enable the movement of data, intelligence, and services. And once again they are going to create millions of small-business opportunities, just like cars did, just like the railroads did, just like electricity did.

But here is the part that matters the most, and this is where my Navy background speaks up: If we don't build this infrastructure here, if we don't scale it and if we don't support it with American labor and American small businesses, those jobs and that technology are going overseas. And they will go to countries who have worse environmental standards, less transparency, and strategic interests directly opposing our own. This is not just an economic issue; this is a national security issue.

So, to the Committee, I will leave you with a piece of history. Energy has never been a reason for us to stop; it is a reason for America to lead. Growth isn't a threat; it is an opportunity. And small businesses, they are not just part of the story; we are the story. Empower us, and we will build the next generation of American infrastructure. Fail to empower small businesses, and we will fall behind nations that would love nothing more than to take our place.

Thank you, and I look forward to your questions.

Chairman ELLZEY. Thank you, Kirk.

Now I recognize Dr. Turner Lee for her 5-minute statement.

STATEMENT OF NICOL TURNER LEE, PH.D.

Ms. TURNER LEE. Chairman Ellzey, Ranking Member Morrison, and distinguished Members of the Subcommittee, thank you for the invitation to testify today.

AI is changing the way we work, how we learn, get well, and interact online, as well as emboldening other transformative cases, like speeding up the development of scientific discoveries and better evaluating climate impacts.

But not all consumers have full access to AI, especially those with limited internet access or who lack the digital skills to utilize it in their lives.

Rural communities, especially small businesses and farms, have been historically left behind when it comes to technological innovation and can benefit from what AI offers. With vast topography, rural areas tend to have the land needed to support physical data centers. Technology can create avenues for economic development in rural areas that have experienced declines in population and farming assets as well as insufficient access to high-speed broadband.

Data centers have gotten increased visibility as economic drivers, but this will only be the case if they are built in ways that are additive to the local community and bring limited harm to residents and local businesses.

In my testimony, I want to discuss the increasing explosion of data centers but talk about how they require a national framework for resources, security, permitting, and community benefit.

State and local leaders, business owners, employees, and residents should participate in planning and implementation together with technology companies, big or small.

Communities must be actively involved at the onset of data-center development and have transparency to assess the impacts of electricity, water, noise and light pollution, jobs, land use, tax revenues—all of which I detail in my written statement.

With the various types of facilities, including enterprise, hyperscale, co-location, and edge, technology companies are investing in larger facilities for greater computing power. More compute requires more space, equipment, electricity, and water, resulting in a set of unknown environmental hazards that we have yet to realize.

Some tech companies are greatly benefiting from the explicit support of the President right now, whose favorable stance towards more data centers to compete with China has expedited permitting

and bypassed environmental remediations as part of the tenets of the AI Action Plan.

However, the current administration has also threatened to rescind federal funding to States if they stand in the way of AI deployments. And just in December, the White House issued an order making States ineligible for BEAD non-deployment funds if they threaten such.

Threats to States through moratoriums and lawsuits are counterintuitive to the ultimate goal for having data centers in the first place, leaving communities without agency in conversations involving not just data centers but broadband in their community.

More importantly, we must listen to communities. Data centers have been the central focus of some gubernatorial and state legislature campaigns during recent elections in New Jersey, in Virginia, and other places, where consumers saw rising electricity rates coincide with unprecedented demand for new data centers.

A middle ground must be met to balance the needs of advanced technologies with the demands of residents who just seek clarity, buy-in, and oversight in these data centers that are being built in their backyard.

Further, communities should not feel the drain of data centers on their natural and generated resources. And with the environmental impact still largely unknown, we need to make sure that the rollbacks that we made in the Biden-Harris administration in terms of clean and renewable energy sources do not have disproportional impacts in the future.

What I will also say about job creation: Though we know that the rate of jobs is temporary and, in some cases, will not scale to the size of the data center itself, it is important for the rural workforce to be involved.

Right now, rural workers are lacking in areas of trade as well as construction. These challenges offer opportunities for government agencies, businesses, and local governments to collaborate on solving those workforce shortages and rooting training in ways that those people stay in the community and become the pipeline for rural communities going forward.

Data centers cannot be selective, as well, when it comes to who works within the facility itself. Small businesses should have the opportunity to bid on contracts for food services, security, and maintenance.

And if these jobs are primarily remote, we need to ensure that broadband is available so that people who live in rural communities do not have to go to, as I found in my book, local hotels and 50 miles away to just access their jobs.

There must be some foresight, my friends, about the long-term impact on surrounding communities, the environment, and overall resilience.

This is especially important as fears over a potential AI bubble escalate and feed the possibility of stranded assets in communities that essentially have given the green light to data centers along with millions of dollars in tax incentives.

Communities should be asking about the plans for stranded or deserted buildings, how they can be repurposed and better inte-

grated into the community, or else we are going to find ourselves, like China, with a lot of idle buildings.

I envelope my remarks around this idea that data centers should be responsibly and ethically designed and built, and I leave this Committee with my closing thoughts:

Ensure early collaboration among all the utilities—energy, water, and telecom, and even real estate.

Develop community benefit agreements that resolve and make major public concerns around data centers transparent.

Focus on job creation.

Consider smaller data centers when appropriate. They don't need to be big.

Create safeguards for communities and allow communities the opportunity to say no when they want to say no, and they do not feel that they are involved.

Thank you again to the Members of the Subcommittee, and I look forward to your questions.

Chairman ELLZEY. Thank you, Doctor.

We will now move to the Member questions under the 5-minute rule. I will recognize myself for 5 minutes.

Chris, Texas has emerged as a leading State for data-center development because it has affordable land, it has plenty of energy, and it has an understandable and relatively easy regulatory climate.

What else makes Texas attractive to data centers?

Mr. CROSBY. The growable workforce that comes with it. You know, as we continue to bring new people into the data-center space, we call it the new-collar workforce.

The ability to attract employment in Texas is fantastic. And when we launched our vocational school in conjunction with Texas State Technical College—I went through the first cohort. You know, immediately the first class is all hired. The second class is already pre-hired. That is going on right now. We just—we have a workforce where we have youth, we have new people coming in.

And in these communities like Red Oak, the commitment and the partnership with the local community really helps with that front. You know, that can-do attitude in Texas has been fantastic.

Chairman ELLZEY. Well, if it is predictable, does that reduce uncertainty for you long-term for these data centers and their success?

Mr. CROSBY. That is a great question.

We look at things as—we don't exit. There is a big difference if you build to exit versus build to last. You make a lot better decisions, just like if you are going to remodel your home and you build it to flip it—or, you remodel to flip it versus you remodel to stay in that home. And that is where a lot of great sustainability decisions get made.

And we view ourselves as 100-year campuses. These facilities will have multiple refreshes over that timeframe, both from an IT/technology as well as from a mechanical and electrical plan, and they are going to be long-term parts of those communities. They are living, breathing, active machines in those communities.

So it is that—when you have certainty and you know that you can have that, you can make the multibillion-dollar type of invest-

ments that we make and look at it in the 40-plus-year horizons that we look at it from an investment perspective.

Chairman ELLZEY. And you mentioned John Knight. So you built this data center with the encouragement and the cooperation and the oversight of the local government, correct?

Mr. CROSBY. That is correct.

Chairman ELLZEY. So they are fully on board with everything you are doing. This didn't need to come from Congress; this didn't need to come from Austin. They did it themselves, and they know you are going to be an integral part of the community already, right?

Mr. CROSBY. That is a huge part of our selection criteria. We want to go to the places where people are.

I can't speak for all developers. There is Class A development, and there is not. But when you are doing the right thing, you want to put long-term—you don't want to have people picketing a site that you are planning to try to get somebody to stay in for 30 years. Who wants to go work in a community like that? We go to the places where they welcome the investment, they welcome the transformation of their communities.

And, like I said, I think it is akin to having—you know, the railroad was probably pretty loud back in the 1800s, and, you know, the communities that passed on that, it didn't work out so well for them. Those that passed on the Federal Highway System, those that passed on the international airports in the 1970s, you know, it did not work out long-term for those communities.

And data centers are that now. We are—AI is like electricity. We don't know all the applications that it is going to be used for. It is a foundational tool, and it is going to continue to create opportunities.

Chairman ELLZEY. Speaking of opportunities, Kirk, tell me about how veterans meet the threshold for what you are looking for in these data centers.

Mr. OFFEL. I appreciate the question, Mr. Chairman.

You know, we talk about data centers because it is measured in mission-critical. Mission-critical means that you could quantify the downtime in dollars or death behind one (1) second of lost infrastructure. I would argue that everyone that has put on the uniform and took the oath has once entered into a mission-critical environment that isn't measured in downtime, but it is measured in their own mortality.

The State of Texas and what Chris was saying and why it is such a robust State—the sky for the cloud is northern Virginia, but the home for AI will be Texas. It has more than 200 high-educational [https://ballotpedia.org/Higher—education—in—Texas—1993-2016] platforms, 15 military bases, and 4 of the most populous cities in the United States, not to mention it has more natural resources than any other State in the Union, including Alaska and Montana.

So, we have the best access to the biggest workforce. There is a massive amount of veterans coming out of the military that have been exposed to the most advanced weapons, machines, and technology ever built, and the military is best known for being one of the largest leadership incubators ever built.

So, we are not only—this industry does not—it is not lacking genius or intelligence. It does lack leadership. It lacks courage. And veterans are trained and conditioned and pressure-tested in all three.

So, I think that veterans have the highest likelihood—I have three kids that are in college right now, and I tell them that that college degree is about as useful as a taxi medallion in a few years. Because you could spend four (4) years in the military and find yourself with a higher demand of opportunity that has the highest overall total earning potential versus something that you could find today going to college.

Chairman ELLZEY. Nailed it. Nailed it.

Mr. OFFEL. Thank you.

Chairman ELLZEY. Okay.

I now recognize Dr. Morrison for 5 minutes of questions.

Ms. MORRISON. Thank you, Mr. Chairman.

Dr. Turner Lee, are data centers being constructed to meet current demand or anticipated demand? And if the tech bubble does pop, will these data centers still be necessary?

Ms. TURNER LEE. Thank you for that question, Ranking Member.

I do think that data centers are necessary. I mean, the current compute demand of AI is out of the box, right, in terms of everything that we are doing in everyday as well as what we are trying to do with future scientific discovery.

I also think that it is still unclear whether we are going to be able to grow these functions in the future into the current data-center assets that we are building in the present.

I think we need to have the type of assessments that are done to sort of have some predictability in the marketplace of how we are going to foresee that growth. But I also think that, you know, there are other types of data centers that can be built to accommodate what we are talking about with AI.

Ms. MORRISON. Thank you for that.

And what would happen to these data centers and the associated jobs if the tech bubble does pop?

Ms. TURNER LEE. One of my fears and we have written about this at the Brookings Institution, myself and Darrell West, my colleague—is that we do need to have programs that leave workforce opportunities within rural communities after the life of the data center.

So it is particularly important that we have programs that sustain themselves, where those carpenters and electricians and welders are receiving training as well as recertification, using AI, and they are able to bring that asset back into their communities post—the life of this one infrastructure asset.

Ms. MORRISON. Thank you.

The Environmental Protection Agency has announced that it will no longer consider the health benefits of reducing air pollution in regulations—it is still shocking to say those words—cutting human health protections in favor of the fossil-fuel industry.

I am a physician by trade, and I am deeply concerned about the health impacts of air pollution. Given these rollbacks, how could air

pollution from fossil fuels and backup diesel generators, spurred by data centers, affect public health in rural areas?

Ms. TURNER LEE. I definitely think the use of the word "public health" is meaningful in this conversation, I think, given the community response to environmental concerns.

With that being the case, as you have mentioned, the rollback on the $11 billion of Biden-Harris investment towards clean and renewable energies is a setback, and we want to make sure that we are not setting back the progress. Because I think most tech companies, including my colleagues here, want as much electricity as possible and want it to happen to every electron.

With that being the case, when workers are sick in rural communities because of these environmental impacts, small businesses suffer. When young people are sick due to asthma and other related environmental illnesses, they don't go to school. And so, we want to make sure that we are not having a bigger impact, I think, on the community, given the fact that we know very little about the environmental impacts.

Ms. MORRISON. Thank you for that.

How much electricity and water does the smallest hyperscale data center consume?

Ms. TURNER LEE. Well, I will say this because I am not a scientist by trade; I am a sociologist. But we do know hyperscalers exceed and my colleagues can correct me if I am wrong about 100 megawatts, in terms of electricity.

We also have to consider the offsite electricity used. Some tech companies are being responsible—we have seen that with Microsoft in terms of trying to figure out ways to build substations or take advantage of other electricity outlets. But, again, it is not just the building where the electricity is being consumed; it could be other buildings across the community that have to power and generate the same amount of power generate and consume the same amount of energy.

Ms. MORRISON. And what about water? How much water is used?

Ms. TURNER LEE. Yeah, the water issue is tricky as well. Based on the data center's size, we still see continuous water flow. Again, given the fact that there have been advancements in science when it comes to closed loop systems or using recycled water, I am excited about these opportunities.

Again, water consumption is critical. Data centers must be cooled. And if they are not cooled, it takes the whole investment and throws it out in the wayside.

Ms. MORRISON. I am glad you referenced that. So, depending on what cooling systems a data centers uses—because they use different ones—it may consume even more water or more electricity.

Can you just briefly walk us through the tradeoffs of each type of cooling system?

Ms. TURNER LEE. Well, we already know that we have an outdated and archaic national water and irrigation system, so that is a cause of concern.

I also think what is interesting, too, is that we probably need to use, Ranking Member, more AI to help us to monitor the type of water that is going into these units, as well as ways in which we

can save residential households money, you know, by the consumption.

Communities adjacent to data centers are not getting the best of AI when it comes to these water and energy consumption measures.

Ms. MORRISON. Thank you very much.

And I yield back, Mr. Chair.

Chairman ELLZEY. Thank you, Doctor.

I now recognize Mr. Finstad from Minnesota for 5 minutes.

Mr. FINSTAD. Thank you, Chairman Ellzey. Thanks for holding this important hearing today.

And thank you to our witnesses for being here.

As the Representative from the First District of Minnesota, a district that is founded on farming, healthcare, manufacturing, and small businesses which have helped sustain our rural areas, innovation is more than just a slogan to us; it is a way of life.

With the rising demand for artificial intelligence, data centers are moving to rural areas, like the ones I represent in southern Minnesota, because of the availability of land, our climate—we are nice and cold, especially right now in Minnesota—and our access to power.

For my district, data centers can be economic anchors in their regions, improving local supply chains and providing job opportunities for skilled tradespeople.

At the same time, I want to acknowledge the concerns that I am hearing from my constituents regarding energy and water consumption, affordability, grid reliability, particularly from farmers and small-business owners and families. People want assurances that new, energy-intensive developments won't increase their utility bills or put a strain on local power and water systems.

This hearing today is about ensuring that rural districts like mine are ready to take advantage of innovation while solving real problems like labor shortages and energy security. I look forward to the discussion today and learning more about ways we can empower rural America to lead on this next wave of innovation.

So, with that, just a couple questions.

Mr. Crosby, many of my constituents in southern Minnesota are concerned, have questions, maybe just don't know for sure, in regards to—I guess the question I hear is really, you know, the big, energy-intensive facilities like data centers, they are new to us. They may increase electricity prices or put stress on our local grids. We just heard a little bit about the water discussion.

You have made the case that data centers can serve as an anchor tenant that reduces costs by spreading out fixed infrastructure costs and making up-front grid upgrade payments through contributions in aid of construction.

So what is your company doing to ensure that data centers and development in rural areas does not increase energy costs for community members and small businesses?

Mr. CROSBY. Thank you for your question.

We do not go to these environments and look for the environments to pay us on these. So we build infrastructure. We have bought land and transferred it to the utility company for easements. We have bought—we pay for transmission. We have paid

for switching stations, substations, and the like. That is our infrastructure that we are utilizing.

Almost every single time, that involves additional infrastructure, such as in Red Oak, that other parts of the community can use that we pay for in order to bring it there—so additional switches on a switching station, as a for-example.

The other aspect to this is that we are trying to work, as well, with the regulatory bodies on trying to get data centers to become grid resources.

So we are going through this cold snap right now. During Storm Uri, if data centers had been allowed by law, and not threatened with criminal penalties, to operate, 12 people would not have died during Storm Uri in the State of Texas.

We can be stabilizing, distributed, islanded bodies. I will tell you, not 100 percent of my colleagues would say the same thing, but all of the Class A folks will absolutely look at that as, "We can be the stabilizing factor for the grid."

When we do that, we utilize infrastructure that is not being used right now, because it is, you know, 50-percent utilization when it is not during those peak timeframes.

So you have a very small amount of hours per year where, if we could be utilized by grid operators, we could actually reduce down-costs for consumers and stabilize the grid, with it being our nickel.

Mr. FINSTAD. Thank you for that.

Mr. Offel, in your opening comments, I think you hit the nail on the head when you talked about, we probably haven't done a good enough job explaining what the opportunities are, what the real economics look like, what the risk and reward is in this new emerging industry.

I like to say, around the halls in this town, you know, you start talking about data centers, AI, cryptocurrency, cybersecurity, and you get a glazed look over a lot of people's eyes. And these are policymakers that are hopefully in a position to educate themselves and make decisions on the very issue that we are talking about.

So, if we have a problem here in the halls of Congress understanding some of the details of what we are trying to do in this next generation of opportunities, it is easy to assume that our neighbors are having that same issue of understanding.

So maybe do you have some thoughts about how we as policymakers but how the industry is taking strides to make sure that we can talk to our neighbors about what does this mean in our backyard in regards to energy and water and the value that it adds to communities?

Mr. OFFEL. Yeah. Thank you, sir. And I appreciate the question.

I think this is a great opportunity for us to reshape the mindset and the way that we view this. So, I would ask you, as this Committee, to flip the binoculars around and open up the aperture and let us revisit this.

I think this is something that people tend to be very scared of, because some of these things that they have been introduced to, like some of the technologies you talked about, are very faddish, where what we are talking about today is a data center which will have—it is a transformational infrastructure that will have a

greater impact on humanity since we have seen in powered flight. This is something that is coming, and it is coming to stay.

So, I think that if we can pause, I think that we can help people become more educated, and as we do that, they are going to become less fearful of what these data centers are.

And we shouldn't see them as a building. Data centers aren't a building. Look at them as a career field and an opportunity to build back the middle class with high-paying jobs that don't require college degrees.

Thank you for your question.

Mr. FINSTAD. Yeah. Thank you.

And, Mr. Chair, I yield back.

Chairman ELLZEY. Thank you.

I now recognize Ms. Goodlander from New Hampshire for 5 minutes.

Ms. GOODLANDER. Thank you, Mr. Chairman, thank you, Ranking Member Morrison, for convening this important hearing.

To our witnesses, thank you so much for being here today.

We are on a really good streak with this Committee, because yesterday we passed two commonsense, bipartisan bills that go to the core issues around small businesses and artificial intelligence.

And I couldn't agree more with my colleague from Minnesota; the Congress should be spending way—as much time as possible on this important issue. This is a transformational issue. We have never seen a revolution quite like this AI revolution.

You know, when we talk about data centers and other innovation-driven investments in rural areas—and I represent the most beautiful district in the nation, a very rural district, where I hear every day about the pain people are feeling from high costs across the board—my priority is to make sure that these projects, that these innovations, aren't going to shift new burdens and new unbearable costs onto hardworking people who are already feeling a whole lot of pain right now.

When we talk about energy costs and data centers, you know, I start from the premise that New Hampshire has some of the highest energy costs in our country. You know, this week, we are on track to have some of the coldest days of winter to date, and the people I represent cannot bear higher electricity bills, higher energy costs.

I appreciate the testimony of our witnesses so far.

Dr. Turner Lee, I wanted to ask you how you would advise Congress to think about the real ways in which data centers—what actions we can take to make sure that no costs are shifted in an inappropriate way onto people who just cannot bear the pain of higher costs right now.

Ms. TURNER LEE. Thank you very much for that, Representative. And I agree, affordability is a huge concern for many consumers that are resisting data centers to date.

It is important for Congress to continue to have the dialogues that we are having around updating and modernizing the energy grid. Clearly, this is a conversation of 20, 25 years ago, and we are putting on top of an outdated energy grid more resources that I think will continue to strain those communities.

It is important for public utility commissions to be at the table in these conversations because they set the rates for ratepayers.

And it is also important for tech companies, who are coming in and draining some of those assets, to talk with PUCs, local governments, and consumers, to figure out ways in which they can set clear standards and rates for what electricity should look like.

I mentioned earlier what Microsoft has done, for example, recently in their announcement about a community AI first, is to have set in certain rates that they pay, whether or not there is a variable increase or decrease in energy consumption. And we need to see more of that so that they are footing the bill as opposed to everyday Americans.

Ms. GOODLANDER. Well, I want to ask also about water security and water costs. Because when we look at utility bills in New Hampshire, what we have seen in so many of the towns I represent, particularly in the southern part of my State, big, foreign corporations have come into New Hampshire, polluted our water, eliminated our wells. The costs of clean water have never been higher in our State.

In your testimony, Dr. Turner Lee, you speak about water impacts as one that are—as impacts that aren't often fully understood until after a project has become underway. I hope you might be able to speak a little bit more about that, to your really important point that we need to be clear about the costs up front.

What can and should Congress be doing to make sure that we have clarity and that we are putting all of our tools to use to make sure that these important developments don't actually undermine a core function of government, which is to make sure we have clean water for our citizens?

Ms. TURNER LEE. I appreciate that question.

And as I have said in my oral statement as well as written, it is important that Congress support States and allow them to be part of the negotiating table. You know, when we put barriers for State leaders to actively think about how these data centers are positioned in their community, we burden them, as well, and we remove them from the table.

I think Congress should really move away from moratoriums and restrictions on the States to be actually involved.

I think community benefit agreements might be another way for us to negotiate these speculative opportunities that are being promoted to communities. Lancaster, Pennsylvania, for example, just did a $20 million community benefits agreement that also includes quality-of-life factors—air quality, water consumption, other educational assets, jobs.

We need to see Congress promote and support States actually engaging in those community benefit agreements, because I think it will get to the broader question that you are asking, Representative, which is, how do you just put everything in the bucket and make sure communities come out safe when this is all said and done?

Ms. GOODLANDER. Well, thank you so much.

I yield back, Mr. Chairman.

Chairman ELLZEY. Thank you.

I now recognize Chairman Williams for 5 minutes.

Mr. WILLIAMS. Thank you, Chairman.

Thanks again to the group for being here today.

Mr. Crosby, the data-center boom has led to some growing pains, especially in meeting the workforce demand. However, the industry is already taking steps to address this challenge.

Now, what steps have Compass Datacenters taken to build partnerships, including public-private partnerships, in career and technical education programs to address workforce needs?

Mr. CROSBY. Thank you for your question.

The Texas State Technical College and ourselves—we were looking for a partner to start a school. We scholarship the school. And then we brought in all of our partners, all of our suppliers, our customers, and our competitors that now all sponsor this program. It is called MEI. It is based in Red Oak.

We are now also donating a facility, a little later this year, on the campus to allow the students to have a place to practice it, in which our—not only our client but also our equipment suppliers are donating equipment for them to be able to work on it.

We plan to replicate this model in multiple markets where we have these levels of investment. These are, you know—when "all-in"-type investments are north of $20 billion, you need a long-term workforce.

This is something that we work very closely with—we have had great work with Ellis County, and Red Oak officials have been super-supportive of it as well. I think the private-public partnership is a very easy way to do this.

Mr. WILLIAMS. Okay.

How do you interact with local communities before beginning to build data centers to ensure they are an equal partner and valued stakeholder?

We have talked about communications. You can't have any—you can never be too short on communications. So——

Mr. CROSBY. That is right. The challenges that have been brought up by the doctor are not—I would say they are not very common today, but they are still—I mean, they still come up. And when you do not engage with these communities properly—so, for example, when we walk into a community, a lot of people have a myth that these are going to use a lot of water. It is not true. We don't use water at our facilities for those purposes.

So we will end up in these meetings. We engage with the community. We sit in the meetings with the hearings, the public hearings, answer their questions. Our most recent one we had in Statesville, North Carolina, we had people that had "No" stickers that took their "No" stickers off at the end of it as they learned more facts.

The key is education, and the key is doing the right thing for that community. That means you have to be built to last. You cannot be built to exit in this business.

Mr. WILLIAMS. Yeah. Sometimes you get one crack at it, and you have to get it right.

Mr. CROSBY. Yes, sir.

Mr. WILLIAMS. Mr. Offel, the growth of the data-center industry has brought massive demand for tradeskills. We have been talking about that all day here. However, the demand for elec-

tricians, HVAC technicians, and plumbers has outpaced supply. And I know, in Texas, we are short of welders; we always are short of welders.

Now, your business, Overwatch Mission Critical, is actively working to address this problem. What methods have you found most effective in developing the necessary workforce to grow this economy and your industry?

Mr. OFFEL. Thank you for the question, Mr. Chairman.

It is simple. We have tried to approach this from multiple dimensions.

One was with a bunch of Band-Aids. We tried to figure out how we can transfer people that were in adjacent verticals of industry into this industry. And we realized that the adoption rate of emerging technology, specifically driven because of the surge of AI, has allowed us to discover that that strategy is no longer tenable.

I am at a point right now where we need to create another apprentice program. This is the fifth utility. This is the fifth utility. We need to have an apprenticeship and journeyman program associated just to this. We needed our own, dedicated apprenticeship program.

And we have partnered with a group, a small business—veteran-owned small business in Dallas, Texas, and we have partnered with them to create an incubator that could put 1,200 people through that program a year that will be certified in data centers. They could join the workforce immediately and be a data-center apprentice.

Mr. WILLIAMS. There are 10,000 kids a year dropping out of—or, 100,000 kids a year dropping out of school in Texas in the ninth grade. They are losing hope. And we have to be able to show them that it is not about being architects, businesspeople, whatever. Plumbers, welders, carpenters, technicians. It is important you do this because we can save a lot of kids who are now dropping out of school and we are losing them.

So thank you for——

Mr. OFFEL. The largest demand for labor is in this vertical. This industry grows faster than every other industry on this planet because of the growth of every other industry on this planet.

And there is no sense sending our kids to college for data centers. Whatever they would be exposed to or learn their freshman year would be obsolete by the time they graduated.

There are 6-week, 12-week, and 18-week programs that are designed for high-school kids, as well as the 17,000 people leaving the military on Active Duty every month. There is a large, massive workforce of trained people coming out of military that we are looking to adopt. And those people will help us lay out a roadmap to where we could support people transitioning right out of high school.

They just don't know the industry yet. And, right now, everybody is telling them that they need to be scared about it. We need to fix it.

Mr. WILLIAMS. Well, in the time remaining, take it to them. Because there are these 100,000 kids who need to have an opportunity, and they will hire their friend too.

Mr. OFFEL. Yes, sir.

Mr. WILLIAMS. Mr. Chairman, I yield back.

Chairman ELLZEY. Thank you.

I now recognize Mr. Olszewski from Maryland for 5 minutes.

Mr. OLSZEWSKI. Thank you very much, Chairman Ellzey, to Ranking Member Morrison, and to all of our witnesses today. I appreciate your time and your presence.

My district in Maryland is home to many beautiful rural communities in both Baltimore and Carroll Counties, which affords our State flourishing farmland and engaged small businesses.

Agricultural preservation is a top priority for our district. Since 1980, Carroll County alone has preserved nearly 81,000 acres, with over $200 million invested. Prior to coming to Congress, as Baltimore County executive, I helped push our number to over 71,000 acres of farmland preserved.

In Maryland, our farms account for billions of dollars of economic activity. They are a critical part of our history and our economy.

Although we do not currently have a data center in Maryland, there are plans to have one under development in Frederick County, and others are being considered across our State.

For more than a year now, Baltimore, Frederick, and Carroll Counties have been contending—frankly, fighting—a proposed 67-mile high-voltage transmission line, known as the Maryland Piedmont Reliability Project, or MPRP, needed to fuel power in data centers in northern Virginia—power that we worry, frankly, is simply being transferred from Peach Bottom, Pennsylvania, to northern Virginia.

Sadly, our questions to clarify this have gone completely unanswered, both by PJM and by the project's developer. Worse, eminent domain has been proposed. So, unfortunately, that "reliability" doesn't seem to cover the Maryland rural communities who are facing the project's burden.

Even worse, to Ms. Goodlander's point, the cost of this project, $424 million, would fall on Maryland ratepayers—ratepayers who are already crushed under a cost-of-living crisis and increasingly high utility costs in our State.

I understand that transmission lines play a role in modernizing the electrical grid. However, my constituents and I have been very vocal in expressing these concerns.

Our communities have worked for decades, with millions of local and State dollars invested, to conserve this land for future generations, to preserve the economic activity on these lands. Now they are being told it must be sacrificed and their livelihoods disrupted for a transmission line that won't even offer them benefits, and yet these constituents are being asked to pay for it.

I guess I would just open with a question for all: Is that fair? Does that make sense?

Ms. TURNER LEE. Well, I will start, Representative. And I want to also say to you, Maryland does have beautiful farmland. I spend a lot of time in Garrett County, Maryland, as part of my book with farmers as well as small businesses, entrepreneurs, and residents.

The transmission line project I do write about in my written statement, and I think it is one of those examples where we do see a lack of coordination between all the actors and—I do agree with

my colleagues—a lack of transparency when it comes to information about what is being done and what is being built.

The revenue should come on the side of the companies, not the taxpayers.

Mr. OLSZEWSKI. Yep.

Ms. TURNER LEE. Because the revenue that comes from the companies can take those communities, even though they don't have a data center—but they can possibly build, you know, a better school, a better firehouse, better broadband for that matter.

I do say to you, I do not think it is fair that the community is left in the dark and is going through several challenges to understand why, when, how this project is going to pan out for them.

I appreciate that and you including it in your written testimony.

Gentlemen?

Mr. CROSBY. Yes. Thank you.

Look, I agree with a lot of your points. I don't think it is fair for us to come to communities and just say, it is on—you know, it is on you as a community. Those days were decades ago.

Mr. OLSZEWSKI. Yeah.

Mr. CROSBY. There are a lot of new players that are doing that sort of technique. And check their capitalization and check their track record—that is what I would say—if you are a community looking at these groups.

The other thing I would state is, this should be a very bipartisan issue. Transmission upgrade is absolutely necessary. When we transmit electricity at 69 kV, 130 kV, 90 percent of it is lost in the air versus high voltage.

Mr. OLSZEWSKI. Yeah.

Mr. CROSBY. Ninety percent. That means we don't have to produce more generation. That means we have generation that just gets wasted.

And this is one of the biggest things that we should—that all parties should rally around. We need to upgrade this. That is the easiest, cheapest way for us to do things.

Mr. OLSZEWSKI. Yeah.

Mr. CROSBY. And data centers want to contribute to that. Come to any of our locations and you will see that brand-new transmission and——

Mr. OLSZEWSKI. And I appreciate the consensus.

Just with my 30 seconds left—and, Mr. Offel, hopefully I will give you a chance to respond as well—but I just want to put on the record, Mr. Chairman, a 2024 "Lazard's Levelized Cost of Energy" report as well as a NextEra Energy's 2025 investor presentation. I ask unanimous consent to enter those into the record.

Thank you very much.

I just want to point out that renewable energy projects, according to these, are both cheaper and faster to get built to help fuel this need. So I appreciate our opportunity to look at that.

And I apologize we didn't get to you on the answer there, but I really appreciate your testimony.

Thank you. I yield back.

Chairman ELLZEY. I now recognize Mr. Schmidt from Kansas for 5 minutes.

Mr. SCHMIDT. Thank you, Mr. Chairman.

And, like my colleagues, I want to thank our witnesses for being here today. It is a topic not new to you but still very new to many of the communities that we represent, and, like a lot of new subjects, as has been suggested here today, it tends to present itself in different ways in different communities.

And I have listened carefully, during the time I have been here, to some of the suggestions and responses you have had regarding questions about community engagement, which I appreciate very much. But let me ask just a much more, sort of, global question on that.

So I came out of State government. I am a State- and local-control person philosophically, and I believe it in my bones, and I am certainly not advocating something different here.

Having said that, one of you, at least, compared in your written testimony the development of the data-center industry to the development of the railroads. And, obviously, 150 years ago, that was a nationalized policy conversation that resulted in national control, some of which, you know, we still deal with the downstream effects of that today, but it also created a tremendous industry.

And I guess I would just ask you to speak, either with particularity or philosophically, about, as you look forward, how this industry is going to grow. What is the right balance between federalizing some of these decisions, standards, requirements, and leaving it to those case-by-case local advocacy decisions?

And we can just go down the row.

Mr. Crosby?

Mr. CROSBY. Thank you.

Look, I believe the local is always the first approach. You know, there were comments about water and water usage. Those are negotiated locally. Those are not negotiated on a big basis. So those communities are making those decisions live, and we see that.

The State of Texas has an advantage, in some ways, because FERC is not engaged with some of the things, and the ability to adapt technology is a little bit faster to try new things.

I think speed is one of the elements, where there is an aspect where you are continually making adjustments, continuous-improvement type of items, as you get feedback from these sorts of infrastructure investments.

We are putting in massive amounts of capital into the ground and into the wires that are going ahead, building plants. Renewables was mentioned. Data centers have been—data centers and data-center users have been responsible for over 70 percent of the PPAs that are around renewables.

We are driving change. We want to do the right thing. The top companies definitely do. And let us work with those communities to continue to innovate and come up with these new and creative ways to do things.

Mr. SCHMIDT. Mr. Offel.

Mr. OFFEL. Yes, sir. Thank you for the question.

Just to put a pattern together for a bit of history, when we started with the first major infrastructure upgrade in America, the railways, the number-one concern was energy, and the number-two was environmental impact.

And when we did the electrification of the grid, the number-one concern was energy, and the number-two was the environmental impact.

The third was the Interstate Highway System, and the fourth was the automobile. And, in every case, the primary theme has always been energy and what is the impact on environment. And now we are evolving too, what are the jobs that are being created as a byproduct of these vertical industries that are emerging?

The things that take an industry like ours, which is niche—and, today, this represents the fact that we are now in the mainstream—is industries that—like the automobile industry, when we were rolling those cars out on the road, they lacked safety, regulation, oversight, governance, regulation, and, many would argue, ethics—some of the same things that you are challenging us on, and justifiably so, today.

The answer is, we have a partnership with you. We must be working with all elements of levels of government. And we need to be able to make sure that someday you understand that we are no longer consumers of your utility, we are creators of it, making us partners of it.

We will be able to reinforce—and I think in your district, what he was talking about was to have the ability to island ourselves. If we have, since the birth of this vertical, 55 gigs of energy on the grid, we are under construction today for 40 to 80 gigawatts of natural renewable energy, meaning that we will not only put our own energy on the grid and tie it into the grid in a closed transition, allowing us to co-generate, that gives us not only the ability to move the needle to the left, but we reinforce that grid so that the people that are out in the urban areas aren't at risk of losing power, because data-centers providers are the ones that are building it.

And, today, with the exception of a few misfit toys, we are at zero-water design on data centers. We don't use water, for the same reason you don't use water in your radiator, which is a closed-loop system. It doesn't absorb and reject heat fast enough. These data centers are so dense that we can't use water.

So, we are here to partner with you on creating more water, and we are partners to the utility. We will become a utility ourselves.

Mr. SCHMIDT. Doctor, I have 10 seconds.

Ms. TURNER LEE. Yeah, just 10 seconds.

I actually challenge the railroad analogy, so I will start there, because I think we need to think about the railroad as it allowed rural communities to become transit points for the way in which we were actually moving trade, and data centers that actually may be incentivized to bring more profit to companies versus people.

I want to actually challenge that, because I think AI needs more industrial policy, in many respects, to ensure that we get national benefits.

I would just say outside of just the energy policy for the Congress, it is important for Congress to also create a certain environment in the marketplace. Tariffs, the availability of critical minerals, our availability to have the aluminum that is going into the buildings—it is all uncertain right now. And I think those costs could actually be passed on to communities if we actually don't get

the certainty of the marketplace right in terms of our congressional policies.

Mr. SCHMIDT. Thank you.

I yield back, Mr. Chairman.

Chairman ELLZEY. Thank you.

I now recognize Ms. Scholten from Michigan for 5 minutes.

Ms. SCHOLTEN. Thank you, Mr. Chairman.

Dr. Turner, every 2 years, we pass a bipartisan Water Resources Development Act, which authorizes the Army Corps of Engineers to address water supply needs and carry out vital infrastructure products.

I am happy to report that the Committee has been hard at work to develop the seventh consecutive bipartisan WRDA to navigate local water resource challenges, boost regional economies, create jobs, and protect our natural environment.

What is the importance to our rural communities that WRDA is passed in a bipartisan fashion?

Ms. TURNER LEE. It is extremely important. I have nothing else to say. But I think we do need to keep passing this, because that is actually going to allow us to negotiate through some of these challenges that we have been talking about today.

Ms. SCHOLTEN. Absolutely.

The few operations jobs that data centers create require IT expertise, meaning individuals in career and technical education—careers in technical education will be increasingly in demand.

Last week, I introduced my bill, the Honoring Vocational Education Act, which would permanently establish a survey on education attainment within the skilled technical workforce. It is critical to advancing and maintaining a skilled workforce. We have to ensure that skilled tradespeople and technical workers are fully accounted for in federal workforce data, especially when these jobs are becoming so critical to building and supporting innovation.

Again, Dr. Turner Lee, what is the role of career and technical education in ensuring that these local jobs can be filled and created as data centers are developed?

Ms. TURNER LEE. I completely agree with you. A couple years ago, when we had the BEAD money, I did the same thing with broadband, because these are livable wage jobs.

Ms. SCHOLTEN. Yep.

Ms. TURNER LEE. They are jobs that we need to build the infrastructure. Just as the Hoover Dam, we had to build that dam, we had to find workers to do the same thing.

I think we need to continue to invest in technical training, but I also want to make sure that there will be jobs that have some IT slant to it, because technical jobs—even your greatest plumber has to rely upon AI in some way or form to do their job.

And so it is important for us to balance that—how do we do the acute, you know, faculty skills alongside making sure rural communities and rural citizens know how to actually maneuver through AI itself.

Ms. SCHOLTEN. Absolutely. They go hand-in-hand——

Ms. TURNER LEE. They do.

Ms. SCHOLTEN.—and have to be developed together.

One last question for you, Dr. Turner Lee: In your testimony, you discuss the importance of ensuring early collaboration between utilities, local governments, and their rural communities.

Just last month, in my district, a planning meeting for a data center in Kent County was canceled due to overcapacity, with hundreds of residents showing up to make their voices heard in these discussions.

How can we, as Members of Congress, help facilitate and support these conversations to ensure that residents aren't left in the dark as planning for these data centers continues?

Ms. TURNER LEE. Well, I want to agree with my colleagues, particularly the—my colleagues who are in a space where they are working every day with some of these local communities. And I commend them on the efforts that they have put forth.

I do think Congress should put out some type of data-center literacy act——

Ms. SCHOLTEN. Uh-huh.

Ms. TURNER LEE.—something that allows people to know that this next stage of innovation, if we are comparing it to the railroad, is an all-in project.

Ms. SCHOLTEN. Yeah.

Ms. TURNER LEE. Everybody needs to be at the table.

I think we are seeing these rooms full to capacity because people are really worried. They are worried about the things that they know based on what the media is telling them, and they are worried about the things that they do not know.

Ms. SCHOLTEN. Yeah.

Ms. TURNER LEE. It is an easy fix if we find ways to raise their literacy around what data centers are and what they do.

And I actually would say that we connect this to AI literacy bills——

Ms. SCHOLTEN. Yeah.

Ms. TURNER LEE.—so people know that when there is a data center in your neighborhood, there is a benefit to you as well——

Ms. SCHOLTEN. Yeah.

Ms. TURNER LEE.—and, you know, what you can access and do.

Ms. SCHOLTEN. Absolutely. I am already working on something like that with one of my colleagues from Michigan. We would love to run it by you, get your input on it as well.

So thank you so much for your testimony.

I yield back.

Ms. TURNER LEE. Thank you. I look forward to working with you.

Ms. SCHOLTEN. Thank you.

Chairman ELLZEY. Thank you.

I now recognize Mr. Wied from Wisconsin for 5 minutes.

Mr. WIED. Thank you, Mr. Chairman.

Thank you to all of the witnesses for being here today. We appreciate the work each of you are doing to shape the future of America's digital infrastructure and the communities that support it.

Across the country, we are seeing a rapid growth in data centers, driven by the accelerating demand for AI. Increasingly, these facilities are choosing rural communities, creating new opportunities in

skilled trades, construction, and facility operations, offering a pathway to stable, middle-class careers in regions that have too often been left behind.

At the same time, this expansion brings real challenges, from meeting the energy needs of these facilities to the increase in workforce demands.

Small businesses are central to this story. They are the contractors, suppliers, and service providers who make these projects possible and who stand to benefit long after construction ends.

As AI demand centers continue to grow, it is my hope that we can find solutions that balance the needs of tech entrepreneurs while also protecting the rights and the voices of, of course, our local communities.

Mr. Crosby, I will start with you. In your testimony, you said that data centers act as anchor tenants that put downward pressure, actually, on electricity rates. And that is one of the biggest concerns. We have a project in northeastern Wisconsin that was—you know, the local, the community was very, very involved. That was one of the big concerns, is electricity rates.

Could you expand, walk us through, you know, how rural taxpayers actually could see savings?

Mr. CROSBY. Yes. In States where it is not regulated that they have to share everything with consumers—so there are States and regions in the country that it is forced to be shared, so even if you wanted to foot your own bill, you are not allowed to foot your own bill; it is forced onto consumers.

In those other States that that is not the case, you can—one is the connection interconnect charges. That is paying to bring the power to you. That is what we pay for, those charges to do that.

The second is, how do the rates come down? So keep that first cost off, of bringing the transmission to you. Now, how do the rates come down? Because if we can utilize existing infrastructure—the grid runs at about 50 percent right now. And if we can use that infrastructure for the vast majority of the year—in a State like Wisconsin, you might have 20 hours a year of peak power, out of 8,760 hours. That means we could be utilizing that capacity and then island ourselves during those times where the grid operator says, "It is a tough environment. Go ahead and come off the grid. We don't want consumers to—we don't want there to be anything to hurt the grid." That is a grid stability.

If you are using infrastructure that is already built and paid for, it will drive down costs for consumers. We have seen that. Southern Company, Chris Womack's company, they put out a report there about that. PGE put out a report, Maria Pope.

We work very closely with utilities—EPRI, EEI. We are trying to get the regulatory environments to allow us to pay for what we want—pay for the power that we want to use and help us drive down these costs.

Mr. WIED. You also mentioned—another thing that I have heard a lot with this most recent one in our community is depletion of the aquifer.

You mentioned that Compass mandates water-free cooling technology to protect agriculture water supplies. Can you explain what that looks like in practice?

Mr. CROSBY. Yeah. I grew up in the State of Texas. Water has always been a precious resource. We were one of the very early adopters of saying no water. A lot of evaporative cooling was used in the space.

That got eliminated several years ago but for a few, as Kirk likes to say, misfit toys and then some that are using evaporative cooling but creating water-positive environments, where they are investing in and replenishing aquifers more than what they use.

I do not think it is a valid claim anymore to say with a blanket statement that data centers use water. I reject the premise of that.

Mr. WIED. Let's go to Mr. Offel.

I think you—well, you acknowledged that the industry hasn't communicated very well with local communities. And I feel, you know, we don't want them blindsided.

And so, from your point of view, what is—no question, we need early engagement, and engagement is very important in these types of things. What does early engagement look like to you? How do we ensure that rural residents, they feel informed rather than blindsided?

Mr. OFFEL. That is a fair question. And their concerns are extremely valid. We are not trivializing those. The only way to solve it is with immersion.

There are three different types of audiences that we need to address. There is no silver-bullet answer that will make everybody happy.

We need to convert the way that we view these things as something that is just a consumer of utilities, and we need to help them understand what AI means to them as a human beings, how does it help them.

As a small business, AI gives me the ability to compete against the Goliaths of this world, because it level-sets the playing field. Plus, for those people that want to be in the game, it opens up better career opportunities, because it lowers the barrier of entry to market for new jobs.

Mr. WIED. Thank you, Mr. Chairman. I yield back.

Chairman ELLZEY. Thank you.

I will now recognize Dr. Morrison for her closing statement.

Ms. MORRISON. Thank you, Mr. Chairman. And congratulations on a very amiable hearing. I think this has been a really interesting and important conversation.

And I am grateful to the witnesses for your presence.

You know, we have talked about the good, the bad, and the ugly, in some cases, parts of the data-center boom. It is a very nuanced topic. And there are so many ways that data centers play with existing issues, such as tariffs, which are crushing our main streets and industries—we have recent evidence that supports what economists have been saying from the beginning of this chaotic tariff war, that Americans pay them in taxes; 96 percent of tariffs have been paid for by Americans over this past year—and the immigration crackdown choking our workforce and entrepreneurs and, as someone from the Twin Cities, literally terrorizing our communities.

I intend to submit further questions for the record. I hope to keep the conversation going down the line. There is so much to discuss.

Thanks so much, again, to the witnesses for your insights.

And, with that, I yield back.

Chairman ELLZEY. Thank you, Dr. Morrison.

I recognize myself for a closing statement.

I am so proud to have data centers in my rural community just south of Dallas.

There was a lot of concern at the very beginning about what does this mean, this new technology, this new horizon of ours in technology and AI and everything that goes with it. I understand the fear of some of my colleagues on particularly the Eastern Seaboard, which is stretched thin with energy, power, and water and lines and so many other things.

I am here to tell you that if you are interested in seeing what they really do, how they really contribute to our communities, Doctor, come visit us in Red Oak and Midlothian for a couple days, stick around. These gentlemen would be happy to host you, and so would I.

As I look at the city of Red Oak, which is growing by leaps and bounds because of industry coming there, a talented workforce—all of the people in that community are benefiting from these data centers coming to them, from construction, from flipping burgers, from Walmart, from Brookshire's, to homebuilders, to everybody else in between, and a strong, stable tax base to provide excellent schools, excellent public schools for our kids.

They are not drawing on the water. They are adding to the power. They are adding security in a lot of rural communities that, in many cases in Texas and elsewhere, those rural communities are looking for a reason to survive, and many of them are struggling. This new technology gives them an opportunity to do so. They are doing so responsibly, with the cooperation of State and local governments. And they are an incredible benefit to the State of Texas and to Red Oak, Midlothian, and Ellis County.

So I want to thank everybody for participating in this robust discussion today. It has been a fantastic hearing. I hope it generates more discussion going forward. Thank you all for being here.

And, without objection, Members have 5 legislative days to submit additional materials and written questions for the witnesses to the Chair, which will be forwarded to the witnesses.

I ask the witnesses to please respond promptly.

If there is no further business, without objection, the Committee is adjourned.

[Whereupon, at 11:22 a.m., the Subcommittee was adjourned.]

APPENDIX

Chris Crosby
CEO of Compass Datacenters
Congressional Testimony

House Small Business Committee
Rural Development, Energy and Supply Chains Subcommittee

January 21, 2026

Hearing:
“Empowering Rural America Through Investment in Innovation”

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Chairman Ellzey, Ranking Member Morrison, and distinguished members of the Subcommittee:

Thank you for the opportunity to testify on the vital role digital infrastructure plays in the revitalization of rural America.

My name is Chris Crosby, and I am the founder and Chief Executive Officer of Compass Datacenters. After 25 years of working at the intersection of tech and real estate development, I founded Compass in 2011 to take a new approach to data center development, with a vision to deliver customizable, scalable, and sustainable data centers in an expedited time frame. What began as a single project in 2012 has evolved into a global enterprise serving the hyperscale market—a success built upon our core convictions and a "give before take" philosophy that prioritizes the communities where we operate.

Defining Hyperscale: Beyond Crypto and AI Factories

Let me first begin by making clear that we are in the midst of the most profound global economic transformation since electrification, and we commend this administration’s focus on winning the global AI race. However, the AI infrastructure landscape is as prolific as it is multifaceted, so it is important to distinguish between key categories. "Hyperscale" refers to the massive, scalable infrastructure that supports the world’s largest service providers—the platforms underpinning our modern economy. Not all digital infrastructure is the same. While terms like "crypto farms" or "AI factories" are often used interchangeably in public discourse, Compass constructs and operates hyperscale campuses that differ fundamentally in purpose, scale, stability, and longevity.

Crypto farms tend to be transient operations tied to a single volatile activity. In contrast, a hyperscale campus represents enduring civic infrastructure. When Compass began, data center facilities primarily managed enterprise data; today, they have evolved into sophisticated hubs supporting a diverse ecosystem of cloud workloads, social connectivity, and the burgeoning AI

revolution. They enable the essential services Americans rely on daily—from banking and financial systems to entertainment streaming and enterprise cloud computing.
Today's large-scale data center campuses function as the "railroads" of the 21st century, driving significant regional economic impact. As artificial intelligence and cloud computing mature, this innovation is moving beyond traditional tech hubs and into rural America. Chairman Ellzey, our campus in Red Oak, Texas—located in your district—exemplifies this potential.

Rural Economic Impact

The outdated narrative that data centers generate only temporary construction jobs no longer reflects reality. Our campuses provide stable, high-quality employment for approximately 1,500 construction workers at any given time over a decade or more during the initial expansion phases[1]. Furthermore, these facilities are designed as "permanent build" campuses in a state of continuous evolution—true evergreen assets.

Beyond the initial ten-year construction period, data centers require billions of dollars in IT equipment refreshes every three to five years, creating a reliable, long-term stream of skilled, high-paying technical and operational positions that remain in the community for the campus's 100-year operational life.

Chairman Ellzey, our campus in Red Oak exemplifies this enduring economic commitment. Upon full build-out, we anticipate creating a total of over 400 full-time jobs through the combined job creation of Compass, our customers, and our partners. These are not merely positions—they are high-paying careers, with many specialized technical and managerial roles offering six-figure salaries.

These multi-billion-dollar campus investments serve as powerful economic multipliers, prioritizing local small businesses—including electrical contractors, onsite service providers and suppliers—generating a "butterfly effect" that spurs further commercial development. A prime example of this effect is our strategic partnership with Schneider Electric. To support our supply chain, we constructed a 105,000-square-foot dedicated manufacturing facility in Red Oak, located immediately adjacent to our data center campus. This facility, which opened in June 2024, produces the prefabricated modular power and IT infrastructure required for hyperscale growth. By integrating manufacturing directly into our ecosystem, we haven't just built a data center; we have anchored a new industrial hub that currently employs nearly 350 people in the local community[2].

The data continually proves out this impact. In the ten-year period preceding our 2021 campus investment in Red Oak, new sales tax business permits grew at a steady but modest rate of 12% year-over-year. However, since our construction began, that growth rate has surged to

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[1] McKinsey & Company, "The data center balance: How US states can navigate the opportunities and challenges," August 8, 2024, https://www.mckinsey.com/industries/public-sector/our-insights/the-data-center-balance-how-us-states-can-navigate-the-opportunities-and-challenges.

[2] Schneider Electric, "Schneider Electric Opens Data Center Integration Facility in Red Oak, TX," Press Release, June 20, 2024, https://www.se.com/us/en/about-us/newsroom/news/press-releases/schneider-electric-opens-data-center-integration-facility-in-red-oak-tx-66739ba970de4cb867027917.

43% annually[3]. Data center campuses function as sustained economic engines, fostering new restaurants, retail, housing, and other developments that build thriving, resilient communities.

Energy: Driving Affordability and Grid Resiliency

There is a common misconception that the power requirements of data centers drive up energy costs for residents. In reality, large-scale energy users serve as vital "anchor tenants" for the power grid, creating an economic framework that exerts downward pressure on rates for all consumers. The U.S. electric grid currently operates at roughly 50% capacity on average, representing significant underutilization[4]. By leveraging this unused capacity, data centers help spread fixed infrastructure costs across greater volumes of electricity sales, creating downward pressure on rates for all consumers. From research groups such as E3[5] to large service providers like Georgia Power[6], to bipartisan statements from former Sec. Granholm and Gov. Ducey[7], the message and data is clear: **data centers are paying more so that families and small businesses can pay less.**

This "anchor tenant" effect is further strengthened by a proactive approach to infrastructure known as the "co-serve" model. Under this philosophy, data center developers like Compass act as active grid partners rather than mere consumers. Instead of arriving with an “ask”, we arrive with a checkbook, negotiating upfront Contributions in Aid of Construction (CIACs) to fund the specific infrastructure required for our operations. We purchase land to facilitate interconnects, and fully fund the construction of transmission lines, high voltage switching, and substations. By paying our own way and directly investing in the grid, we help strengthen the local system and clear the path for upgrades that benefit the entire community. This ensures that the growth of digital infrastructure serves as a catalyst for local stability, allowing utilities to meet rising demand without ever shifting the financial burden to existing ratepayers. However, several regulatory barriers still limit the industry’s ability to support the grid and must be addressed to maximize these benefits:

- **Rigid emission permitting standards** often fail to distinguish cleaner backup fuels like Hydrotreated Vegetable Oil (HVO) from traditional diesel, restricting data centers like Compass from running backup power for longer durations during emergencies or peak load times, which could help stabilize the grid for the entire community and reduce overall emissions.

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[3] Texas Comptroller of Public Accounts, "Recent Sales Tax Permits," Open Data Portal, accessed Jan. 2026, https://comptroller.texas.gov/transparency/open-data/recent-sales-tax-permits/.

[4] Pacific Northwest National Laboratory (PNNL), "Impacts Assessment of Plug-in Hybrid Vehicles on Electric Utilities and Regional Grids," U.S. Department of Energy. *(Finding that the existing U.S. grid has approximately 50% idle capacity on average due to the need to build for extreme peak events).*

[5] Energy and Environmental Economics, Inc. (E3), "Tailored for Scale: Designing Electric Rates and Tariffs for Large Loads," December 2025, https://www.ethree.com/wp-content/uploads/2025/12/RatepayerStudy.pdf.

[6] Georgia Power, "Georgia regulators approve historic energy capacity increase to meet state's growing demand," Press Release, December 19, 2025, https://www.georgiapower.com/news-hub/press-releases/georgia-regulators-approve-historic-energy-capacity-increase.html.

[7] Jennifer Granholm and Doug Ducey, "How Data Centers Can Lower Your Electric Bill," *The Wall Street Journal*, October 23, 2025, https://www.wsj.com/articles/how-data-centers-can-lower-your-electric-bill-bipartisan-energy.

- **Synchronizing Federal and State Emergency Definitions** to resolve the significant disconnect between federal EPA standards and state-level developments like Texas's Senate Bill 6 (SB 6). Formal EPA confirmation is required to ensure that mandatory grid curtailments—where large loads deploy onsite backup generation during declared emergencies—are classified as true "emergency" operations. This clarification would prevent these critical grid-support activities from being mischaracterized as voluntary demand response, allowing them to proceed without counting against the federal 50-hour non-emergency limit and providing the regulatory certainty needed to support grid resilience without risking compliance violations. Activating these resources during energy emergencies provides vital stabilization and, during extreme weather events, serves as a life-saving measure for the broader community.

- **Restrictions on private investment** prevent proactive contributions to grid upgrades. Unlike real estate development, where developers can contribute directly to community infrastructure, utilities' regulated fixed returns structure prohibit direct private investment outside of CIACs. Developers like Compass are willing to invest more to the overall benefit of our power infrastructure, but current energy frameworks limit proactive private investment in grid improvements. Legislative flexibility for long-term private funding—such as substations and transmission—would significantly accelerate infrastructure delivery for both data centers and surrounding rural areas.

Workforce Development and Community Investment

Our commitment to rural communities is rooted in sustainable workforce development. We are not offering temporary employment; we are facilitating multigenerational careers. Because our campuses are designed as 100-year assets, the specialized talent we cultivate—from mechanical and electrical trades to HVAC and IT—remains vital to the community for decades.

Recognizing this, Compass partnered with Texas State Technical College (TSTC) last year to establish the Mechanical, Electrical & Information Technology Pathway Program. This program provides accessible pathways to those high-tech, high-paying roles that allow individuals to join the global tech economy without needing a traditional four-year degree. Compass provided full scholarships for the inaugural cohort and collaborated with industry partners—including competitors—to guarantee immediate job placement. Due to the immense success of the program - 90% of the first graduating class having secured roles with leading national companies - we are now scaling the TSTC model to locations across the country.

Additionally, we partner with companies like Overwatch and Salute to train and place veterans in critical data center roles, allowing them to stay in their home regions while joining the global tech economy.

We operate under the principle of "listening before building." By engaging local stakeholders early in the development process, we tailor our projects to meet specific regional and community needs. This includes establishing conservation buffers to protect local watersheds, upgrading utility infrastructure, and supporting local law enforcement and community recreation facilities.

Environmentally, we mandate water-free cooling technologies to preserve vital agricultural water supplies. Crucially, we view our sites as grid contributors. During peak events, our on-site generation can support the community, provided we have a common-sense regulatory framework that permits us to run these assets when the grid needs them most.

Closing Statement

In summation, large-scale data center campuses provide unprecedented capital and infrastructure investments for rural community prosperity. Compass does not come to these communities seeking a "free ride"; we come with a multi-generational commitment to invest in the people and the businesses. We are proud to help build the digital foundations in places like Red Oak, and we look forward to working with this Subcommittee to ensure that the AI revolution empowers every corner of our nation.

Innovation is not merely a destination – it must be an opportunity for all Americans. At Compass, we are committed to a future where the infrastructure of tomorrow is built on a foundation of innovation and partnership today. Thank you for your leadership on these critical issues, and I look forward to answering your questions.

Kirk Offel, Founder & CEO, OVERWATCH Mission Critical

SDVOSB

Opening Statement

House Small Business Committee

Rural Development, Energy, and Supply Chains Subcommittee Hearing

"Empowering Rural America Through Investment in Innovation"

January 21, 2026, 10:00 a.m. EST

Chairman, Ranking Member, Members of the Committee, thank you for the opportunity to testify today.

As an industry, we did not communicate early enough or often enough about our datacenter plans, and that created avoidable concerns. We didn't clearly explain what we were building, why it mattered, or how communities would benefit and we relied on trust we hadn't yet earned. We're fixing it by increasing transparency, tightening our outreach, and making sure every community and stakeholder understands the mission, the safeguards, and the benefits. We know trust is earned, and you'll see that reflected in how we engage moving forward.

My name is Kirk Offel. I'm the CEO of Overwatch, and we're proud to be a Service-Disabled Veteran Owned Small Business. Before I ever set foot in a data center, I spent five years in the United States Navy, serving aboard the Nuclear Fast Attack Submarine USS Memphis. That experience taught me something simple: *you don't accomplish big missions with big slogans, you accomplish them with small, highly capable teams who know how to execute.*

And that's exactly what's happening with the AI boom today.

Let me be blunt: small businesses are the backbone of this entire industry.

Not “a part of it.” Not “important contributors.”

I’m saying the AI boom does not happen without us. Period.

Today, more than 75% of the whole AI - infrastructure ecosystem is driven by small businesses. We are the ones building AI factories. We are the ones pulling fiber, erecting steel, trenching conduit, fabricating components, hauling equipment, running logistics, and delivering the professional services that keep projects moving.

And as our grid gets pushed harder than ever before, it won’t be a big company flying in from out of state fixing that.

It’ll be local electricians, local line crews, local engineering firms, and local contractors, small businesses that actually understand the communities they serve.

We’re going to see new small businesses pop up in manufacturing, equipment rental, transportation, environmental services, permitting, legal, security, cleaning, maintenance, you name it. And all the indirect jobs, housing, food, retail, childcare will all grow because of this work.

We’ve seen this before.

Every major leap in American infrastructure has had the same outcome: small businesses became the biggest winners. They grew with the railroad era. They scaled during the electrification of America. They expanded through the construction of the interstate system. And they absolutely exploded during the automobile revolution. Each of those moments didn’t just change the country; they created millions of small businesses that reshaped the American workforce.

And today, we are living through what I believe is the Fifth Industrial Revolution, a revolution powered by data, by intelligence, and by the people who build and sustain the infrastructure behind it.

AI factories are no different.

They are simply the 21st-century version of those earlier transformations, and they will become the next great engine of American small-business growth.

Let me put some numbers behind that. For every **$100 billion** we invest in building digital infrastructure, we get roughly:

- **$800 million in tax revenue**
- **500,000 new jobs**
- **$40 billion in labor income**
- **And a $140 billion boost to U.S. GDP**

This isn't theory. This is basic economics playing out in real time.

Now, I want to address the concerns we all hear - **energy, water, environmental impact, and job creation.**

Look, those concerns are valid. They deserve attention. And they're being monitored closely. But the answer is not to hit the brakes. The answer is the same answer we used with railroads, electricity, cars, and roads: *govern it, guide it, and build it responsibly.*

People forget this, but the first cars were horribly inefficient, wildly polluting, incredibly dangerous, and brutal on city infrastructure. Between 1900 and 1930, gasoline consumption grew

fiftyfold. Roads were a mess. Cities were choking on fumes. Noise, pollution, congestion, every argument you hear today about data centers was made about cars.

So what did we do?

We built smarter. We built safer.

We set standards.

We improved efficiency.

It took decades for seat belts to get adopted, and even longer to become a requirement.

Progress doesn't happen because we avoid the challenge.

It happens because we take it head-on. I believe this is the American Way.

Today, we have 5,400 data centers in the U.S. The most in the world.

Hyperscale capacity has doubled in the last five years.

We're staring down $5 trillion in construction over the next five years.

And the industry is on track to triple by the end of the decade.

And for the first time ever, we have the ability to retrofit the past, to take older facilities and make them just as efficient as the new data centers we build today.

Let me say something that I don't think gets said enough:

AI factories are the most transformational infrastructure America has ever attempted to build. Henry Ford enabled the movement of people and goods. AI factories enable the movement of data, intelligence, and services.

And once again, they're going to create millions of small-business opportunities. Just like cars did. Just like railroads did. Just like electricity did. But here's the part that matters most, and this is where my Navy background speaks up:

If we don't build this infrastructure here…If we don't scale it…

If we don't support it with American labor and American small businesses…Those jobs and that technology are going overseas.

And they'll go to countries with worse environmental standards, less transparency, and strategic interests directly opposing ours.

This is not just an economic issue.

It is a national security issue.

So, to the Committee, I'll leave you with this:

Energy use isn't a reason to stop. It's a reason to lead.

Growth isn't a threat. It's an opportunity.

And small businesses aren't just part of this story; they are the story.

Empower them, and they will build the next generation of American infrastructure.

Fail to empower them, and we will fall behind nations that would love nothing more than to take our place.

Thank you. I look forward to your questions.

Written Testimony of Nicol Turner Lee
Director, Center for Technology Innovation
Senior Fellow, Governance Studies
The Brookings Institution

Before the United States House of Representatives Committee on Small Business
Subcommittee on Rural Development, Energy, and Supply Chains
Hearing on "Empowering Rural America Through Investment in Innovation"
January 21, 2026

Chairman Ellzey, Ranking Member Morrison, and distinguished members of the Subcommittee on Rural Development, Energy, and Supply Chains: Thank you for the invitation to testify today. I am Nicol Turner Lee, a Senior Fellow in the Governance Studies program and Director of the Center for Technology Innovation at the Brookings Institution. With a history of over 100 years, Brookings is committed to evidence-based, nonpartisan research in a range of focus areas. My research expertise encompasses data collection and analysis around regulatory and legislative policies that govern telecommunications and high-tech industries, along with the impacts of digital exclusion, artificial intelligence (AI), and machine learning algorithms on vulnerable populations, including rural populations. I am also the author of *Digitally Invisible: How the Internet is Creating the New Underclass*, which explores the historical complexities of the U.S. digital divide.

I. Introduction

Technological innovation has been pivotal to economic growth and prosperity. Artificial intelligence (AI) is contributing to this by rapidly transforming areas like health care, education, financial services, housing, and employment. AI developers are investing billions to build and power the technology with the promise of it bringing new insights, innovations, and access to government,

companies and individuals.[1] As AI becomes more integrated into all aspects of life, it will change the way we work, how we learn, get well, and interact online, as well as embolden other transformative use cases like speeding up the development of scientific discoveries, and better evaluating climate impacts.[2]

However, AI presents a set of challenges that include embedded biases in algorithmic models that deny certain consumers access to credit and home loans, and environmental impacts related to the vast computing needs of generative models. Further, not all consumers have full access to AI products and services, especially those with limited internet access, or who lack the digital skills to utilize AI in their lives.

Rural communities have been historically left behind when it comes to technological innovation and can benefit from what AI offers.[3] With vast topography, rural areas tend to have the land needed to support physical data centers, especially those needed for advanced computing. Technology can create new avenues for economic development in rural areas that are experiencing declines in population and farming assets, as well as insufficient access to high-speed broadband services. Between 2010 and 2020, the population in rural areas remained stagnated or decreased.[4] U.S. family farms also declined in 2024 to 1.88 million, reflecting an 8% decrease from the 2.04 million reported in 2017.[5] While gains have been

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[1] Munjal, Mayank and Vineet Sachdev. "Investment in AI is exploding." *Reuters*, December 5, 2025. www.reuters.com/graphics/USA-ECONOMY/AI-INVESTMENT/gkvlqbgxkpb/.

[2] Mock, Marissa, Suzanne Edavettal, Christopher Langmead and Alan Russell. "AI can help to speed up drug discovery — but only if we give it the right data." *Nature*, September 19, 2023. www.nature.com/articles/d41586-023-02896-9;
"Harnessing the Power of AI for Climate Change Impact Assessment," United Nations University, UNU-INWEH, August 27, 2024. unu.edu/inweh/article/harnessing-power-ai-climate-change-impact-assessment.

[3] Dumont, Andrew. "Changes in the U.S. Economy and Rural-Urban Employment Disparities." Board of Governors of the Federal Reserve System, January 19, 2024. www.federalreserve.gov/econres/notes/feds-notes/changes-in-the-us-economy-and-rural-urban-employment-disparities-20240119.html.

[4] Davis, James C., John Cromartie, Tracey Farrigan, Brandon Genetin, Austin Sanders and Justin B. Winikoff. "Rural America at a Glance: 2023 Edition." U.S. Department of Agriculture Economic Research Service, November 15, 2023. www.ers.usda.gov/publications/pub-details?pubid=107837.

[5] Lacy, Katherine. "The number of U.S. farms continues slow decline." U.S. Department of Agriculture Economic Research Service, March 12, 2025. www.ers.usda.gov/data-products/chart-gallery/chart-detail?chartId=58268.

made in rural broadband access, many residents are still not connected to the internet, which has huge consequences for their access to health, employment, and educational resources.[6]

Throughout the U.S., affordability is a major concern that is equally affecting rural residents, especially those in poverty or with limited incomes who currently struggle to meet the cost of groceries, housing, and transportation.[7] Rural innovation can facilitate greater economic opportunities and data centers have gotten increased visibility as economic drivers for local communities; *but that is only if they are built in ways that are additive to the local economy and bring limited harms to residents and local businesses*.

In my testimony, I will discuss the increasing explosion of data centers across the U.S. and particularly in rural areas. To address everyone's needs, state and local leaders, business owners, employees, and residents should participate in planning and implementation together with technology companies. Because data centers can present both foreseen and unforeseen challenges, communities must be actively involved at the onset of data center development and have transparency from companies to assess the impacts on local utilities, jobs, and land use, among other areas. Without meaningful community engagement and appropriate safeguards to protect local resources, proposed data centers are likely to be perceived as liabilities rather than assets. This may result in sustained community opposition, which is already emerging across urban, suburban, rural, and tribal regions throughout the United States.

II. Data centers and rural America

Connectivity is driving transformation across health, education, finance, employment, manufacturing, and agriculture. In a recent paper, my Brookings colleague Darrell West and I note that advanced data centers are vital to the AI economy but require a national framework for resources,

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[6] Sanders, Cynthia K. and Edward Scanlon. "The Digital Divide Is a Human Rights Issue: Advancing Social Inclusion Through Social Work Advocacy." *Journal of Human Rights and Social Work*, 6(2), 130–143. doi.org/10.1007/s41134-020-00147-9.

[7] "The American Affordability Tracker." *Urban Institute*, accessed January 18, 2026. www.urban.org/data-tools/american-affordability-tracker.

security, permitting, and community benefits.[8] Data centers host file servers and networking equipment to store, process, and analyze information sources, including text, code, and images.[9] There are several types of facilities, including enterprise, hyperscale, colocation, and edge. The first refers to data centers that companies construct on premises and are used for that business or organization, while colocation and/or managed centers offer leases for the use of the facility, a model more frequently used by smaller businesses.[10] Edge centers are smaller, decentralized centers that are local and keep data close to the end user. These have various use cases, including health care and agriculture.[11]

Since the explosion of AI, technology companies are investing in larger facilities for greater amounts of computing power. For example, 10 years ago, centers with 30-megwatt capacities were considered large, but more recent builds regularly have capacities in the hundreds.[12] More compute power requires more space, equipment, and electricity, resulting in the demand for many more hyperscale centers—facilities that typically have more than 5,000 file servers and can span millions of square feet.[13] These types of data centers are leveraged for processing information quickly and support low latency to accommodate AI services and agents, large language models (LLMs), and other high-scale applications, including military intelligence. The companies building hyperscalers, including Microsoft, Google, and Amazon, have greatly benefitted from the explicit support of the Trump administration whose favorable stance toward more data centers to compete with China, has expedited permitting and bypassed environmental remediations as per the tenets in the AI Action Plan published in July 2025.[14] However, the current administration also has threatened to rescind federal funding to states if they stand in the way of

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[8] Turner Lee, Nicol and Darrell West. "The future of data centers." *Brookings*, November 5, 2025. www.brookings.edu/articles/the-future-of-data-centers/.
[9] Ibid.
[10] Susnjara, Stephanie and Ian Smalley. "What is a data center?" IBM. www.ibm.com/think/topics/data-centers
[11] "Edge data centers: how to participate in the coming boom." PwC, accessed January 18, 2026. www.pwc.com/us/en/industries/industrial-products/library/edge-data-centers.html.
[12] "What is a data center?" McKinsey & Company, July 29, 2025. www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-a-data-center.
[13] Susnjara, Stephanie and Ian Smalley. "What is a data center?" IBM. www.ibm.com/think/topics/data-centers
[14] White House. "Winning the Race: America's AI Action Plan." July 2025. www. whitehouse.gov/wp-content/uploads/2025/07/Americas-AI-Action-Plan.pdf

AI deployments. In December 2025, the White House issued an executive order making states ineligible for BEAD non-deployment funds if their laws threatened such, which could include data centers.[15]

Companies state they are racing to build more data centers to keep pace with customer demand for AI.[16] This is reflected by the vast amount currently under construction or announced within the last few years, which both number in the hundreds according to multiple sources.[17] Given the land requirements for these vast centers, companies often look to rural areas for construction, intriguing state and local leaders who, in turn, offer tax incentives and abatements as they expect billions of dollars in new tax revenue from data centers.[18] At least 36 states have created subsidies for data center projects to attract companies to their area.[19] Additionally, officials in rural communities have sought out these projects to bring higher-speed connectivity to their residents and new job opportunities that may have been lost in past years.[20] For example, new data center projects can bring faster broadband and greater processing power to surrounding communities if assets are effectively leveraged, expanding digital opportunities to areas where they currently lag.[21]

However, rural communities can suffer when the details about these deals are not transparent. For example, companies may promise investment in new infrastructure or job opportunities, but these can be

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[15] JSITEL. "White House links BEAD non-deployment funding eligibility to state laws through new executive order." December 17, 2025. www. www.jsitel.com/resource/white-house-links-bead-non-deployment-funding-eligibility-to-state-ai-laws-through-new-executive-order/.
[16] Novet, Jordan. "Microsoft reiterates plan to invest $80 billion in AI, but may 'adjust our infrastructure in some areas.'" *CNBC*, February 24, 2025. www.cnbc.com/2025/02/24/microsoft-reiterates-plan-to-invest-80-billion-in-ai-.html.
[17] Turner Lee, Nicol and Darrell West. "The future of data centers." *Brookings*, November 5, 2025. www.brookings.edu/articles/the-future-of-data-centers/.
[18] O'Neal, Connor. "New Microsoft data center to add dozens of more jobs in West Des Moines." *We Are Iowa*, June 7, 2024. www.weareiowa.com/article/tech/new-microsoft-data-center-west-des-moines-jobs-construction-environmental-impact/524-0d8f0a15-c73f-4986-9f70-aae1ec351cea.
[19] Hardy, Kevin. "Study Finds Lack of Transparency in State Data Center Incentives." *Government Technology*, November 14, 2025. https://www.govtech.com/infrastructure/study-finds-lack-of-transparency-in-state-data-center-incentives.
[20] Pipa, Anthony F. and Nicol Turner Lee. "Data centers in rural America: Nicol Turner Lee on the global race for AI, local impacts and trade-offs, and community oversight." *Brookings*, December 10, 2025. www.brookings.edu/articles/rural-data-centers-ai-nicol-turner-lee/.
[21] Turner Lee, Nicol and Darrell West. "The future of data centers." *Brookings*, November 5, 2025. www.brookings.edu/articles/the-future-of-data-centers/.

difficult to quantify if not formalized in community benefits agreements. State legislators can also get ahead of discussions when the whole community is not involved like the governor of West Virginia, who signed a data center bill into law without community input. Residents of Tucker County expressed great resistance to the media after finding out that it strips away any guardrails on noise, lighting, and land use from future data centers, and directs tax revenue to the state instead of the county.[22]

III. What worries local communities about data centers

More communities are actively and loudly expressing their discontent as data center developers exhibit urgency in their efforts without sharing information with local communities on the short- and long-term consequences of doing so. According to Data Center Watch, at least 53 groups spanning 17 states are organizing against proposed facilities, and $98 billion in projects were canceled between March and June 2025 alone.[23] Data centers have been the central focus of some gubernatorial and state legislature campaigns during recent elections in New Jersey and Virginia, where consumers saw rising electricity rates coincide with unprecedented demand for new data centers.[24] A bipartisan group of governors recently banded together to demand that tech companies foot their own bill when it comes to the electricity that data centers consume.[25] This effort is happening as local officials in Kentucky, Missouri, Georgia, and 11 other states have passed temporary moratoriums on new data centers.[26]

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[22] Culvyhouse, Henry and Sarah Elbeshbishi. "Western Virginia lawmakers offer no clear plan for addressing local concerns about data centers." *Associated Press*, December 15, 2025. www.kvue.com/article/syndication/associatedpress/west-virginia-lawmakers-offer-no-clear-plan-for-addressing-local-concerns-about-data-centers/616-648dcbf8-7c97-4c2a-820a-8d282b94ddb1.

[23] Taft, Molly. "The data center resistance has arrived." *WIRED*, November 14, 2025. www.wired.com/story/the-data-center-resistance-has-arrived/.

[24] Kimball, Spencer. "Skyrocketing electricity prices fuel political backlash against tech sector's AI data centers." *CNBC*, November 12, 2025. www.cnbc.com/2025/11/12/electricity-prices-data-center-ai-new-jersey-virginia-midterm-election.html?msockid=3b99ec5d4388685138b6faf5421c6976.

[25] Bell, Brad. "Skyrocketing electricity prices fuel political backlash against tech sector's AI data centers." *Fox 45 News*, January 17, 2026. foxbaltimore.com/newsletter-daily/wes-moore-electricity-costs-bipartisan-effort-maryland-virginia-pennsylvania-energy-policy-pjm-interconnection-power-plants-regional-cooperation-energy-security-glenn-youngkin-josh-shapiro-doug-burgum-chris-wright-whitmer.

[26] Ruddock, Jenna. "The real race for an AI moratorium: Stopping data centers." *Tech Policy Press*, December 17, 2025. www.techpolicy.press/the-real-race-for-an-ai-moratorium-stopping-data-centers/.

Land preservation has become part of the growing list of community concerns about data centers. This month, six conservation groups joined the first-ever lawsuit in Prince William County, Virginia opposing the construction of 37 data centers around 1,750 acres in Manassas Battlefield Park.[27]

With communities becoming bold in their opposition to data centers, a middle ground must be met to balance the needs of advanced technologies with the demands of community residents who seek more clarity, buy-in, and oversight over the decisions to build data centers in their backyard. Further, the demand for more transparency will only grow due to the lack of more robust information about the impacts of data centers on electricity and water, noise, pollution, land use, and the creation of jobs.

Electricity and water concerns

Because of their architecture, data centers require large amounts of electricity, and cooling alternatives mainly through water. In 2023, data centers accounted for 4.4% of U.S. electricity demand, and this number is expected to rise in the coming years. On the global scale, data centers account for 1-2% of energy needs, with some estimating this reach 21% by the end of the decade.[28] Even if these forecasts prove outsized on the international scale, the electricity needs of individual centers can have a significant impact on surrounding communities given their considerable and constant electricity needs. Upgrades to the grid are wholeheartedly necessary in the U.S. and have been for decades. However, energy infrastructure modernization will be a long process, and one wrought with the red tape of permitting and zoning hurdles. Electricity rates have already increased by 30% since 2020, and despite evidence that data centers may have not contributed this rise in years past, experts are concerned that the massive buildout will cause rates to spike in the future.[29] Microsoft recently pledged through their

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[27] Turco, Rebecca. "Conservation groups support lawsuit to block Prince William Digital Gateway." *ABC7 News*, January 16, 2026. wjla.com/news/local/six-conservation-groups-file-brief-supporting-lawsuit-against-pwc-digital-gateway.

[28] Stewart, Josie, Brooke Tanner, and Nicol Turner Lee. "As energy demands for AI increase, so should company transparency." *Brookings*, July 14, 2025. www.brookings.edu/articles/as-energy-demands-for-ai-increase-so-should-company-transparency/.

[29] Klaus, David M. and Mark MacCarthy. "Boom or bust: How to protect ratepayers from the AI bubble." *Brookings*, October 30, 2025. www.brookings.edu/articles/boom-or-bust-how-to-protect-ratepayers-from-the-ai-bubble/.

Community-First AI Infrastructure to pay the full costs of their centers to ensure increases to consumers' electricity bills are not the result of their facilities, demonstrating the scale of public concern and a shift to address them.[30]

The modernization of existing transmission lines is also at stake in data center expansion, ensuring that the electric grid can scale with reliability and stability. In rural communities, transmission line placement and upgrades support new data centers, but invade the solitude of farmland. Building them can take more than 10 years as they enable electricity to flow from region to region. Farmers in Maryland are currently embroiled in conflict with private companies over a proposed 67-mile transmission line project that would cut through their land as part of efforts to support incoming facilities.[31] The project, which has been called an "extension cord" for the growing number of data centers in Northern Virginia, has the developer threatening to exert the power of eminent domain to proceed with the project, making local farmers feel helpless in their fight to quell the influence of big companies.[32]

Similar local concerns arise around the water usage of data centers. My Brookings colleague, Joe Kane, wrote about the balancing act that technology companies undertake with water intake to data center for cooling purposes. In his blog, he states that "a typical data center uses 300,000 gallons of water each day (equivalent to the demands of about 1,000 households), but large data centers can use an estimated 5 million gallons of water each day, equivalent to the needs of a town of up to 50,000 residents."[33] His research also found that these projections do not account for water that will be used to cool offsite facilities.[34] Some technology companies are moving away from evaporative water cooling systems to

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[30] Weise, Karen. "Microsoft pledges to pay more for electricity, drawing praise from Trump." *The New York Times*, January 13, 2026. www.nytimes.com/2026/01/13/technology/microsoft-electricity-data-center-trump.html?mc_cid=5d18073cab&mc_eid=0ee55c89c1.
[31] Harris, Bracey. "Farmers fight an 'extension cord' for data centers." *NBC News*, November 1, 2025. www.nbcnews.com/news/us-news/maryland-farmers-data-centers-extension-cord-power-lines-rcna233324.
[32] Ibid
[33] Kane, Joseph W. "AI, data centers, and water." *Brookings*, November 20, 2025. www.brookings.edu/articles/ai-data-centers-and-water/.
[34] Ibid.

those that are closed-loop and zero-water cooling using AI applications for greater efficiencies.[35] Google has introduced alternatives for more climate-conscious water cooling and has been the first company to make information public on the water consumption of their data centers.[36]

Whether it's water or electricity, the goal of technology companies should be to modernize infrastructure, especially in rural towns and cities. Communities should not feel the drain of data centers on their natural and generated resources. They should also not be overlooked by companies attempting to build their own power substations or irrigation systems in places with dire needs for infrastructure improvements. The situation in Latin American countries should flag potential problems around water use for rural regions as many of their locations are facing serious droughts due to increased water extraction.[37]

Other environmental concerns

While the environmental impacts of data centers are still largely unknown, researchers have attempted to quantify the amount of electricity and water required per AI inquiries to the alarm of some whom worry about mass adoption and the scale of training these models could accelerate the climate crisis. These concerns may be furthered exacerbated by the current administration, which quickly upended progress toward clean energy sources. This includes an executive order directing the Environmental Protection Agency (EPA) to modify regulations like the Clean Air Act and Clean Water Act for large-scale data center projects seeking faster approval.[38] As more technology companies look to nuclear power as another energy source, advantages and disadvantages should be explored. For example, Microsoft is slated to reopen the Three Mile Island plant in 2028 to power their data centers after it

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[35] Craske, Ben. "How are data centres shifting to zero-water cooling tech?" *Data Centre Magazine*, January 22, 2025. datacentremagazine.com/news/how-are-companies-pioneering-data-centre-zero-water-cooling.
[36] Miller, Rich. "Google developing new climate-conscious tech to save water." *Data Center Frontier*, March 1, 2023. www.datacenterfrontier.com/cooling/article/33001080/google-developing-new-climate-conscious-cooling-tech-to-save-water.
[37] Uribe, Pablo Medina, Francisca Skoknic, Alberto Pradilla, Laura Scofield, Justin Hendrix, Julia Gavarrete. "Many Latin Americans living near data centers don't feel welcome in the future." *Tech Policy Press*, September 12, 2025. www.techpolicy.press/many-latin-americans-living-near-data-centers-do-not-feel-welcome-in-the-future/.
[38] The White House. "Accelerating federal permitting of data center infrastructure."July 23, 2025. https://www.whitehouse.gov/presidential-actions/2025/07/accelerating-federal-permitting-of-data-center-infrastructure/.

suffered a partial meltdown in 1979.[39] The company projects that they will bring about 3,400 jobs and generate increased tax revenue for the area.[40] On the one hand, nuclear power projects can generate jobs, and money for desolate areas. They are also less likely to produce the byproducts associated with fossil fuels, while furnishing a consistent energy supply for data centers. On the other hand, nuclear sites can take some time to build from scratch, require extensive permitting and remediation, and can generate far-reaching consequences to local communities if radioactive waste materials are not properly handled and disposed of.[41]

Communities adjacent to planned or existing data centers also have other concerns, including noise and light pollution from the vast facilities. Most facilities currently run on natural gas, and the turbines powering them can produce constant humming sounds that reach nearby homes.[42] To date, Virginia has reported the most data centers (over 200) with more in the works. In 2023, a study explored the low-frequency noise that data centers emit, concluding that the concerns were not warranted and not enforceable given the lack of inclusion in existing zoning ordinances.[43] However, residents, who are displeased with the number and location of data centers in their communities, have waged this as a complaint, urging companies to conduct sound modeling prior to construction. In fact, anti-data center advocacy groups have used noise pollution as one of the many reasons for rejecting these projects despite the nominal effect of noise pollution on residents.[44]

Data center location and zoning

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[39] Mandler, C. "Three Mile Island nuclear plant will reopen to power Microsoft data centers." *NPR*, September 20, 2024. www. npr.org/2024/09/20/nx-s1-5120581/three-mile-island-nuclear-power-plant-microsoft-ai.
[40] Ibid.
[41] ANS Nuclear Café. "The advantages and challenges of nuclear-powered data centers." ANS / Nuclear Newswire, April 11, 2025. www. ans.org/news/2025-04-11/article-6927/the-advantages-and-challenges-of-nuclearpowered-data-centers/,
[42] Chen, Amber X. "A.I. Is on the Rise, and So Is the Environmental Impact of the Data Centers That Drive It." *Smithsonian Magazine*, September 29, 2025. www.smithsonianmag.com/science-nature/with-ai-on-the-rise-what-will-be-the-environmental-impacts-of-data-centers-180987379/.
[43] "Data Centers in Virginia." Joint Legislative Audit and Review Commission, December 9, 2024. https://jlarc.virginia.gthe rov/landing-2024-data-centers-in-virginia.asp.
[44] Murphy, Ryan and Emily Feng. "Why more residents are saying 'No' to AI data centers in their backyard." *NPR*, July 17, 2025. www. npr.org/2025/07/17/nx-s1-5469933/virginia-data-centers-residents-saying-no.

Companies should consider several factors when scouting areas, including the current infrastructure and proximity to clients who rely on these facilities. With global demand for data centers increasing, the impact on real estate, especially in communities with stagnant growth, could be significant. A 2025 study by real estate services firm, CBRE, found that 95% of major investors globally are projected to invest in data centers; 41% of those in the study planned to allocate $500 million or more in equity to the data center sector in 2025.[45] As interest increases in more rural areas, parcels of land are likely to be bought to host hyperscale data centers, presenting new opportunities for economic development. Realtors should be seen as an important stakeholder in this wave of AI expansion, and rural communities should think carefully about the possible locations of proposed facilities, as well as their proximity to housing, schools, firehouses, and other community assets. Ideally, they should be built in industrial corridors or near other logistics or manufacturing plants.

Given the timing of the current data center boom, local governments should be updating their zoning code to account for data centers, which may have previously fallen between classifications. To avoid contention over land use, it's also important for construction to be in accordance with local zoning requirements and economic development plans.

State and local revenue

As mentioned, tax revenue is a primary benefit for communities that local and state officials want for their communities. This can result in billions of dollars in funding for communities surrounding data centers, with some companies also committing additional funds for other projects. Especially in rural communities, tax revenues from new data centers can support investments in community institutions from firehouses to schools, while helping small businesses scale their operations with greater connectivity. However, tax revenue is only realized once the data center is active, and before this, many states are

[45] Shan, Lee Ying. "Data are a gold rush for global real estate- but can funding keep up?" CNBC, October 1, 2025. www.cnbc.com/2025/10/01/data-centers-hyperscalers-gold-rush-global-real-estate-commerical-real-estate-funding.html.

offering tax rebates and other cuts to incentivize and court data center developers. In a forthcoming paper, West and I argue that localities should have some stated and clear expectations on the projected revenue promised by companies and have firm, written commitments from them on steady revenue if there were to be an AI bubble or implosion. Further, we suggest in our paper that tax assessments should include the tax revenues minus any tax abatement incentives offered to developers and operators who, in many states, are receiving substantial tax discounts to build in certain communities.

Job creation and workforce development

One of the other major benefits technology companies espouse for these facilities is job creation, though these are questions about the scale of these roles and whether they are long-term. For example, a 2024 study from the Joint Legislative Audit & Review Commission in Virginia found that about 80% of the jobs created for data centers in the state between fiscal years 2021-2023 were from the construction phase.[46] Despite the scale of most new builds, which can require thousands of people to construct, far less staff is required in the actual facilities for the upkeep and protection of equipment. These roles may number in the tens or hundreds depending on the project.

My Brookings colleague, Darrell West and I have argued that "data centers will spur labor demand, particularly in construction and engineering, where there might be a groundswell in job opportunities and subcontracts. However, the current workforce simply does not have the necessary supply of technical workers."[47] Constructing these facilities requires the expertise of electricians, welders, and more. Nationally, the construction sector is facing huge shortages in trained and licensed workers, roughly half a million workers. These challenges offer a chance for government agencies, businesses, and local governments to collaborate on solving workforce shortages. In fact, rural areas are primed to cultivate the next generation of men and women in the trades to aid in pre- and post-construction

[46] "Data Centers in Virginia." *Joint Legislative Audit and Review Commission*, December 9, 2024. jlarc.virginia.gthe rov/landing-2024-data-centers-in-virginia.asp.
[47] Turner Lee, Nicol and Darrell West. "The future of data centers." *Brookings*, November 5, 2025. www.brookings.edu/articles/the-future-of-data-centers/.

opportunities arising from the data center market. A recent Fortune article suggested that one in four postings in rural job markets are for unfilled construction, health care, and warehousing jobs.[48] It also suggested that even with AI scaling in society, most IT jobs are being fulfilled by remote workers, which automatically excludes rural talent given their lack of sufficient access to high-speed broadband. Finding ways to increase the pipeline of trained and licensed tradespeople in partnership with community colleges or federal apprenticeship programs not only creates a viable, local workforce, but also roots that talent in their respective rural communities once the data center is active.

Further, more flexible licensing of workers in the trades should be encouraged across states; for example, electrician certifications could be transferable to enable greater geographic mobility of workers with the necessary skills.[49] West and I argue in our published paper on data centers that the U.S. Department of Labor, in coordination with state workforce agencies, also could support a temporary or flexible labor initiative tailored to large-scale data center construction.[50] There are also opportunities for technology companies to invest in rural community colleges, including land grant Historically Black Colleges and Universities, as well as trade schools to support AI-enabled training, licensing, certification, and recertification to tap a pipeline of workers from site engineers to electricians; many of whom will be newly credentialed and able to serve their respective communities beyond the work and life of the physical data center.

Access to high-speed broadband

Despite decades of funding toward closing the digital divide, millions of rural residents remain offline and foreclosed from the opportunity of the digital economy. People in rural areas are less likely to have internet service subscriptions, and even when residents are connected, they more often rely on

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[48] Kibarian, Chris. "The real problem gripping rural America and the jobs of the future." *Fortune*, August 21, 2025. fortune.com/2025/08/21/rural-america-jobs-not-enough-workers-ai-mike-rowe-lightcast/.
[49] Turner Lee, Nicol and Darrell West. "The future of data centers." *Brookings*, November 5, 2025. www.brookings.edu/articles/the-future-of-data-centers/.
[5050] Ibid.

wireless or satellite connections—options that are less reliable than wired ones.[51] Data centers typically run 24 hours a day, seven days a week, requiring reliable, high-speed connection, most frequently through fiber optic cables. When this infrastructure is built for data centers, there is an opportunity to connect or strengthen connections for surrounding communities who may currently lack access to high-speed internet. This is critical to ensure everyone can participate in the digital economy and use the applications these facilities power. Having broadband access can also enable digital skills training, especially AI literacy for young people and adult residents in rural areas. If positioned effectively, AI-enabled tools can even be used to license and recertify those in the trades, enabling them to compete for the jobs afforded by data centers. Amazon has invested more than $2.5 billion in students, adults, and their own employees as part of a workforce development initiative to train more than 50 million people.[52] Their curricula have resources supporting skills development f data center jobs, enabling more local workers to benefit from these new opportunities.

Long-term resilience and sustainability

Data centers are the infrastructure for the latest digital revolution, and we must have some foresight about their long-term impact on surrounding communities, the environment, and their overall resilience. This is especially important as fears over a potential AI bubble escalate and feed the possibility of stranded assets after communities have given the green light to new data centers. Technology companies have committed to ensuring their data centers will be adaptable to future innovations, but it's not always clear to communities if contingency plans exist. Communities should be asking about the plans for stranded and/or deserted buildings including how they can be repurposed or better integrated into community settings at the onset.

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[51] Junod, Anne N. and Corianne Payton Scally. "Expanding Digital Opportunity in Rural Communities." *Urban Institute*, February 2025, www.urban.org/sites/default/files/additional-materials/Expanding_Digital_Opportunity_in_Rural_Communities_.pdf.
[52] Galetti, Beth. "How Amazon is upskilling 50 million people for the future of work." Amazon News, October 23, 2025. www.aboutamazon.com/news/workplace/amazon-future-of-work-skills-jobs-training.

There have also been calls to link data centers and biodiversity to support greater sustainability efforts. Researchers have proposed sustainable drainage systems, wetlands, planted swales, or vegetated retention walls as ways to bring more nature to otherwise stark buildings.[53] Biodiversity efforts could improve water quality, soften the aesthetic of the building, and provide natural cooling systems as "the integration of vegetation across the built environment can lower peak ambient temperatures."[54]

IV. What's next to encourage responsible and ethical data center development

Data centers are critical to the digital economy and the expansion of AI, but getting more online will require extensive buy-in from communities. Companies will need to work not only with partners in state and local governments, but civil society and communities at large to ensure deals have a vision for the path ahead and address the current disconnect between stakeholders about the benefits of these proposals. Transparency should be central to these conversations and will be critical to help narrow the existing gap.

The concerns communities have with these centers mirror many of the same worries expressed about AI more broadly, and right now, lawmakers and everyday people are unable to keep up with the pace of innovation. As state lawmakers seek to better understand and address these challenges, they should not feel encumbered by the current administration's threats to their autonomy. The Trump administration's signing of a Dec. 11 executive order that grants the attorney general authority to sue states for laws that do not "sustain and enhance the United States' global AI dominance through a minimally burdensome national policy framework for AI" will have a disproportionate impact on the ability of communities to pursue authentic partnerships with technology companies in ways that protect public interests. Further, the order threats to withhold BEAD funding from states who obstruct AI

[53] Davies, David. "From grey boxes to green spaces: designing data centres that give back." *Data Centre Review*, August 4, 2025. datacentrereview.com/2025/08/from-grey-boxes-to-green-spaces-designing-data-centres-that-give-back/.

development seems counterintuitive to the ultimate goal for having data centers in the first place.[55] Though the executive order states that a "fragmented State regulatory landscape for AI threatens to undermine BEAD-funded deployments," withholding funds runs contrary to the mission of AI dominance by not expanding potential routes for adoption and counters the BEAD program's goal of universal connectivity.

Communities should have some agency and say in conversations involving data centers in their communities, and for rural populations, their engagement is even more critical as they recover from some of the more devastating blows of economic and population declines. To close my testimony, I offer the five points below to rural community leaders and legislators that ensure early collaboration and accountability toward more responsible and ethically built data centers.

A. **Ensure early and ongoing collaboration between energy, water, and telecom utilities to ensure reasonable use and costs for assets and a local return on investments.** Utility companies must coalesce with data center developers to modernize local infrastructure or at least find ways to accommodate the growing demand of AI. With data centers accounting for the largest share of energy load, it is important that these entities find paths for affordable and available power generation in ways that do not produce higher prices for consumers. AI also can be used to determine energy flows and be integrated into electricity monitoring for households adjacent to data centers to determine their share of resources. With energy demand for data centers projected to be more than $2 trillion in the next few years, it's imperative that energy companies find innovative ways to build their capacity, and in some instances, work with technology companies to bring power directly to new data centers if no other alternative exists. Similar collaborations should be sought with telecom companies that are providing fiber directly to data centers, or to consumers. While many telecommunications companies operate their own

[55] The White House. "Ensuring a national policy framework for artificial intelligence." December 11, 2025. www.whitehouse.gov/presidential-actions/2025/12/eliminating-state-law-obstruction-of-national-artificial-intelligence-policy/.

data centers, they do provide connectivity to AI-enabled applications and other software. Rural leaders should be connecting the dots between these and other stakeholders (like realtors), as well as Public Utility Commissions (PUC) who set the rates for payers, to ensure that they are also gaining from infrastructure upgrades and investments, while maintaining affordability for their residents. This might also be an opportunity to develop a more formal advisory that works on data centers from inception to implementation, keeping the community informed.

B. **Develop community benefit agreements that resolve and make public the major concerns around data centers.** Community benefit agreements (CBAs) are documents that outline the costs and benefits of data centers in specific communities. These agreements should be central to community negotiation processes with AI companies to clarify building and operating data costs in addition to other factors of interest to residents and government leaders. CBAs are negotiated as formal contracts and should be subject to legal safeguards. They can help communities anticipate possible problems and address them before construction begins, especially in areas of major concern like electricity, water, tax revenue, location, and jobs. In our forthcoming paper, Darrell West and I encourage communities to negotiate all these areas, and request companies to deliver planning documents, including environmental assessments. We also propose the development and regular updating of a public dashboard with key metrics hosted on town, county, and city web sites to enable transparency and accountability. A public dashboard will also allow officials, residents, and reporters to assess project impact and determine whether data centers met their stated goals. These community benefit agreements can also generate value for small businesses who can be provided with training resources, and contracts with their local data centers in areas like food service, security, and maintenance, among other locally sourced services.

C. **Focus on job creation in data center development, especially in the trades.** Jobs created for data center development must not be temporary in nature. These opportunities that will primarily be in the skilled trades must be coupled with appropriate and timely training and certification,

enabling rural residents to benefit from the wages and work related to new data centers. As mentioned, technology companies should be partnering with the Department of Labor, community and land-grant colleges, and trades schools to institute national skills requirements and professional credentials for workers building and working in these facilities. Depending on the facilities' size, data centers might end up creating around 200-300 onsite jobs, but communities should focus on training local tradespeople to keep talent in the area after the lifespan of the enterprise. Community benefit agreements also could include investments in education and job opportunities, with developers supporting K-12, occupational, and higher education.

D. **Support smaller data centers when appropriate.** While hyperscalers are dominating conversations around data centers, smaller facilities do exist and can be preferable in some cases. The largest companies will continue to invest in scale, but for other companies or communities, edge centers can provide the necessary compute power and be used to host equipment for small- and medium-sized businesses. Smaller and more localized data centers are currently being leveraged by rural Tribal communities, who not only benefit from greater security and lower latency, but can ensure digital sovereignty efforts when it comes to the information stored and exchanged across Tribal lands.[56] Considering that health, education, and financial data are the primary reasons why AI is skyrocketing in terms of use, rural communities should question the size of large data centers as the only route to connectivity, and find ways to work with local institutions providing these services to guarantee accessible and seamless access, especially in rural communities experiencing high rates of health disparities.

E. **Create safeguards to protect communities from stranded assets.** Community benefit agreements also will be important to address the risk of stranded assets, ensuring that utility

[56] Williams, Chancellar. "Tribal Digital Sovereignty: How Native communities are powering their own tech future." Ford Foundation, November 12, 2025. www.fordfoundation.org/news-and-stories/stories/tribal-digital-sovereignty-how-native-communities-are-powering-their-own-tech-future/.

providers won't pass costs onto consumers if data center projects are paused or close after a few years. Communities can also negotiate how physical facilities can be repurposed to avoid the eyesore of empty data centers, especially in states with huge clusters of physical facilities. For example, China who like the U.S. has speculated on the importance of data centers has recently found the country with underutilized or idle data centers.[57] The reality is that critical minerals, semiconductors, and other materials are still the ingredients of efficient and sprawling data centers, and with uncertain global markets, including tariffs, these components could be more expensive to obtain.

V. Conclusion

One final note in my testimony is that local communities—whether rural, urban, or suburban—should have the right to refuse a data center if they feel that they are not being responsibly or ethically planned and developed. Having a data center in their communities still should be their choice, and not one driven by the interests of big technology companies who may not have to deal with the long-term consequences of environmental or community harm. As most people are clear that AI is the new normal in society, the rush to build them should also ensure the same compliance and integrity that was undertaken during other large-scale industrial movements like the railroad. Without guardrails, data, and feedback, the U.S. could find themselves overbuilding and overpromising in this area despite the large, private investments by technology companies.

Thank you again to the Members of the Subcommittee on Rural Development, Energy, and Supply Chains for the opportunity to testify. I also want to thank Josie Stewart for her assistance in preparing my statement. I look forward to your questions.

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[57] Chen, Caiwei. "China built hundreds of AI data centers to catch the AI boom. Now many stand unused." *MIT Technology Review*, March 26, 2025. www.technologyreview.com/2025/03/26/1113802/china-ai-data-centers-unused/.

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Questions for the Record
Hearing: Empowering Rural America Through Investment in Innovation
House Committee on Small Business
Subcommittee on Rural Development, Energy, and Supply Chains
Wednesday, January 21, 2026

Questions from Rep. Kelly Morrison, Ranking Member, to Dr. Nicol E. Turner Lee, Senior Fellow, Governance Studies and Director, Center for Technology Innovation, Brookings Institution

1. **Could you expand on what's driving the recent increase in data center demand?**

   Developers are pouring trillions of dollars into developing artificial intelligence (AI) systems and AI-enabled technologies.[1] As the popularity and accessibility of these products rises, so does the need for greater compute power. Data centers provide this support, which is far more significant than previous digital technologies. For example, recent centers regularly have hundreds of megawatts capacity, yet a decade ago, 30-megawatt capacity centers were considered large.[2]

   Companies are betting on the transformative possibilities of technology with the support of the current administration, who is trying to streamline the construction of data centers.[3] This is largely to support the White House's goals of maintaining U.S. leadership in AI development on the international stage, especially in relation to China.[4]

2. **Last year, over two-thirds of electric utility customers nationwide experienced a rate hike. These rate increases are projected to total $68 billion over the next two years. How could a new data center further spike rates for its neighbors, particularly for residential customers and small businesses?**

   New data centers can drive up electricity rates by increasing local power demand.[5] In some instances, they might tap into exiting utility resources based on the commercial arrangements with localities.[6] Utility companies are also behind in the investments needed for appropriate new power generation and grid upgrades to meet the growing demand.[7] The costs are then distributed among consumers, businesses, and other institutions in the area.[8] This issue can be particularly intense in rural or underserved areas, where the current grid may already face significant strain, and contribute to challenges with consumer affordability.

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[1] Letzing, John. "To fully appreciate AI expectations, look to the trillions being invested," *World Economic Forum*, April 3, 2024. www.weforum.org/stories/2024/04/appreciate-ai-expectations-trillions-invested/.
[2] "What is a data center?" *McKinsey & Company*, July 29, 2025. www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-a-data-center.
[3] "Fact Sheet: President Donald J. Trump Accelerates Federal Permitting of Data Center Infrastructure," The White House, July 23, 2025. www.whitehouse.gov/fact-sheets/2025/07/fact-sheet-president-donald-j-trump-accelerates-federal-permitting-of-data-center-infrastructure/.
[4] "America's AI Action Plan," The White House Office of Science and Technology Policy, July 2025, www.whitehouse.gov/wp-content/uploads/2025/07/Americas-AI-Action-Plan.pdf.
[5] Stewart, Josie, Brooke Tanner, and Nicol Turner Lee. "As energy demands for AI increase, so should company transparency." *Brookings*, July 14, 2025. www.brookings.edu/articles/as-energy-demands-for-ai-increase-so-shouldcompany-transparency/.
[6] Penn, Ivan, "Data Centers and Utilities Clash Over Who Pays for Rising Electricity Demand," *The New York Times*, May 16, 2025. https://www.nytimes.com/2025/05/16/business/energy-environment/data-centers-utilities-electricity-bills.html.
[7] Ford, Neil. "US grid investors focus on demand hotspots in planning shift," *Reuters*, October 20. 2025. www.reuters.com/business/energy/us-grid-investors-focus-demand-hotspots-planning-shift--reeii-2025-10-20/.
[8] Klaus, David M. and Mark MacCarthy. "Boom or bust: How to protect ratepayers from the AI bubble." *Brookings*, October 30, 2025. www.brookings.edu/articles/boom-or-bust-how-to-protect-ratepayers-from-the-aibubble/.

Some companies have sought to address this possibility by paying for infrastructure upgrades necessary for their facilities and vowing to pay the full cost of the data center's energy usage.[9] This is also something communities have sought to ensure through community benefit agreements, and it is an important step to ensure communities are not subsidizing the companies' electricity needs. In a recent paper that is attached to the questions, co-author, Darrell West and I discuss what could become part of more formal community negotiations between states, municipalities, and AI developers.[10]

3. **President Trump's tariffs are affecting construction material costs and making it more difficult to engage in long-term business planning. How are President Trump's tariffs impacting the cost of data center projects?**

In 2025, the Trump administration imposed 50% tariffs on copper and raised rates from 20 to 50% on steel and aluminum.[11] These materials are important for the construction of data centers and the equipment within them, which could drastically raise the cost of such projects despite stated efforts to streamline them and support AI developers.[12]

The instability caused by tariffs can thwart investment. Companies need certainty on the cost and timeline of these projects, especially as they face opposition from surrounding communities. Changing rates and legal battles may make planning more difficult. Further, any uncertain cost implications on imported chips or other necessary element for the AI stack can impact U.S. global leadership.

4. **Last June, the Full Committee held a hearing on America's need for critical minerals to power innovation and build new technologies like AI. At that hearing, we discussed how tariffs affect 35 of the 50 critical minerals, many of which are used for computer parts. How did part prices react, and therefore data center equipment prices?**

While I have not reviewed comprehensive data on how prices have changed, tariffs on 35 of the 50 critical minerals could raise the production costs of semiconductors and other core computer components. These higher input costs would then move through the supply chain, resulting in more expensive servers, storage units, and networking equipment. Given that the U.S. AI infrastructure buildout is projected to reach around $3 trillion, these increased expenses significantly complicate planning and deployment.[13]

5. **The Trump administration has constantly and chaotically changed its tariff policies. Does the resulting uncertainty impede data center project planning?**

[9] Smith, Brad. "Building Community-First AI Infrastructure," Microsoft, January 13, 2026. blogs.microsoft.com/on-the-issues/2026/01/13/community-first-ai-infrastructure/.
[10] Turner Lee, Nicol and Darrell West. "Why community benefit agreements are necessary for data centers," *Brookings*, January 29, 2026. www.brookings.edu/articles/why-community-benefit-agreements-are-necessary-for-data-centers/.
[11] "Fact Sheet: President Donald J. Trump Increases Section 232 Tariffs on Steel and Aluminum," The White House, June 3, 2025, www.whitehouse.gov/fact-sheets/2025/06/fact-sheet-president-donald-j-trump-increases-section-232-tariffs-on-steel-and-aluminum/.
[12] Turner Lee, Nicol and Darrell M. West, "The Future of Data Centers," *Brookings*, November 5, 2025, https://www.brookings.edu/articles/the-future-of-data-centers/.
[13] Luck, Philip. "How Tariffs Could Derail the United States' $3 Trillion AI Buildout," *Center for Strategic and International Studies*, August 7, 2025. www.csis.org/analysis/how-tariffs-could-derail-united-states-3-trillion-ai-buildout.

Yes, as discussed, tariffs directly impede data center project planning. This uncertainty disrupts the predictable costs and stable supply chains required for the long-term capital investment these projects demand.[14]

6. **The country has been dealing with a labor shortage for quite some time, which is why industries like construction turn to immigrants. In fact, one in eight construction workers is undocumented. Can you share how President Trump's immigration crackdown is impeding the construction of these data centers?**

In January, Immigration and Customs Enforcement (ICE) agents stopped and arrested construction workers who were traveling to the construction site of a Meta data center in Louisiana.[15] This is one of the clearest illustrations of how the administration's immigration policies could impede data center construction.

Companies building these facilities will require vast amounts of technical and blue-collar workers (including site engineers, plumbers, electricians, water inspectors, etc.), who are already in short supply in some areas. Mass deportation efforts could exacerbate this problem given the high rate of construction workers who are immigrants in the U.S.[16] One study estimates that roughly 30% of this workforce are immigrants, including some who are undocumented.[17]

Even though there is limited data about the direct impact of the immigration crackdowns on data center construction, it certainly has had impacts on construction sites and other industrial development projects. In fact, a workforce survey last year found that 28% of subcontractors reported being affected by immigration enforcement activities, which in turn has an impact on local businesses vying to partake in data center development.[18]

7. **The attached white paper from a county supervisor in the "Data Center Capital of the World," Loudon County, Virginia, notes key factors, such as noise and air pollution, for local officials to think about when considering new data center projects. How crucial is it that local voices are respected in permitting data centers?**

Community input is essential because the impact of data centers is felt at the local level. Community members—especially those on the cusp of data center plots—have a right to voice concern about the negative impacts of having these facilities built in their backyard, including noise and light pollution that can be difficult to mitigate.[19]

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[14] Turner Lee, Nicol and Darrell M. West, "The Future of Data Centers," *Brookings*, November 5, 2025, https://www.brookings.edu/articles/the-future-of-data-centers/.
[15] Vipers, Gareth. "ICE Targets Meta Site Under Construction in Rural Louisiana," *The Wall Street Journal*, January 16, 2026, www.wsj.com/us-news/ice-targets-meta-site-under-construction-in-rural-louisiana-9877a236?.
[16] Rubin, April. "The Industries That Could Be Hardest Hit by Trump's Immigration Crackdown," *Axios*, November 19, 2024, www.axios.com/2024/11/19/undocumented-workers-immigration-deportation-trump.
[17] U.S. Bureau of Labor Statistics, "Foreign-Born Workers: Labor Force Characteristics— 2024," May 20, 2025, https://www.bls.gov/news.release/pdf/forbrn.pdf.
[18] "Construction Workforce Shortages Are Leading Cause Of Project Delays As Immigration Enforcement Affects Nearly 1/3 Of Firms," Associated General Contractors, August 28, 2025, https://www.agc.org/news/2025/08/28/construction-workforce-shortages-are-leading-cause-project-delays-immigration-enforcement-affects.
[19] Chen, Amber. "A.I. Is on the Rise, and So Is the Environmental Impact of the Data Centers That Drive It," *Smithsonian Magazine*, September 29, 2025. www.smithsonianmag.com/science-nature/with-ai-on-the-rise-what-will-be-the-environmental-impacts-of-data-centers-180987379/.

When data centers were permitted "by right" in Loudon County, projects automatically advanced as long as they met zoning requirements.[20] These facilities began to appear closer to residential neighborhoods, and proposals for new transmission lines emerged to meet rising power demands. In response, residents organized and urged officials to take these impacts seriously. Following community opposition, county officials reevaluated several major transmission projects. In 2025, the Board of Supervisors halted "by-right" approvals for new data centers, marking a shift in how these projects are treated in land-use decisions.[21]

8. **The *Inflation Reduction Act* created sweeping tax credits to make electricity cheaper by reducing the costs of new clean energy projects. But the Trump *One Big Beautiful Bill Act* slashed those incentives, making electricity costlier. How does this impact the electricity supply for data centers and Main Street?**

   As electricity demand from the data center sector accelerates, the elimination of clean energy incentives constrains the ability to add new power supply on the timelines utilities need. However, data center developers may perceive this as contributing to higher operating costs, delays in securing power for new facilities, and increased reliance on more expensive generation to ensure reliability.[22] For Main Street, utilities facing higher system costs to serve large industrial loads are more likely to pass those costs through rates accrued by payors, creating increased affordability pressures on consumers and small businesses.[23]

9. **Data centers require reliable, high-speed, high-capacity broadband internet. Does that mean data centers rely on fiber cables?**

   Fiber-optic infrastructure is essential for today's data centers. Data centers typically operate around the clock and require uninterrupted connections, which other technologies may not provide or enable seamless connectivity.

   Loudoun County, which has one of the densest fiber networks in the world, is located at a major intersection of long-distance internet routes.[24] This strong infrastructure enables data centers to run efficiently and makes the area a global technology hub. As a result, data centers rely on fiber-optic cables, and development tends to concentrate in regions with robust fiber access.[25] It is imperative that Congress consider aligned investments in broadband infrastructure to ensure the long-term resilience of the compute architecture for data centers. Doing otherwise would be counterproductive and serve as a barrier to the full utilization of AI by enterprises, and consumers, which is more about the future connectivity goals of the U.S.[26]

10. **The last administration created the $42 billion Broadband Equity, Access, and Deployment (BEAD) program for broadband deployment with a fiber focus. Then, President Trump changed BEAD,**

[20] Turner, Mike. "A Strategy for a Changing Paradigm," Loudon County, October 20, 2025, www.loudoun.gov/ArchiveCenter/ViewFile/Item/13979.
[21] Ibid.
[22] Stewart, Josie, Brooke Tanner, and Nicol Turner Lee. "As Energy Demands for AI Increase, So Should Company Transparency." *Brookings*. July 14, 2025. https://www.brookings.edu/articles/as-energy-demands-for-ai-increase-so-should-company-transparency/.
[23] U.S. Energy Information Administration, "Electricity Prices and Factors Affecting Prices," https://www.eia.gov/energyexplained/electricity/prices-and-factors-affecting-prices.php.
[24] Turner, Mike. "A Strategy for a Changing Paradigm," Loudon County, October 20, 2025, www.loudoun.gov/ArchiveCenter/ViewFile/Item/13979.
[25] Ibid.
[26] Ibid.

redirecting funds to satellite technology cornered by Elon Musk. Can data centers rely on satellites for broadband internet?

Data centers require the high throughput and low latency of fiber optic networks to support AI services and large language models (LLMs). Since satellite technology cannot meet these requirements, fiber remains the critical framework for advanced computing. Data centers and the advanced computing they enable depend on fiber for reliable performance.[27]

11. **Is there anything else you would like to add to the record?**

We submit for the record three papers for consideration.

- Nicol Turner Lee and Darrell West, "The Future of Data Centers"
- Nicol Turner Lee and Darrell West, "Why community benefit agreements are necessary for data centers"
- Daniel Goetzel, Mark Muro, and Shriya Methkupally, "Turning the data center boom into long-term, local prosperity"

[27] McKinsey & Company, "What Is a Data Center?," www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-a-data-center.

BROOKINGS

RESEARCH

The future of data centers

Nicol Turner Lee and Darrell M. West

November 5, 2025

- → Data centers undergird the growing use of AI by storing and processing data, text, images, code, and other information sources.
- → Varying considerations need to be addressed as demand increases, including energy and water consumption, critical mineral requirements, permitting, investment in the electric grid, costs, and the impact on the job market.
- → Improvements in these areas will be crucial to the United States' international competitiveness and future economic prosperity.

Artificial intelligence is the transformative technology of our time. As argued in the Brookings Press book, "Turning Point: Policymaking in the Era of Artificial Intelligence (https://www.brookings.edu/books/turning-point/)," it is powering applications in finance, health care, education, transportation, defense, and e-commerce, among other sectors. AI's ability to process large amounts of information and act independently on that basis is altering communications, service delivery, financial transactions, administrative processing, and a host of other areas.

Undergirding this growing use of AI is the need for state-of-the-art data centers ↗. This paper examines the future of these entities. It examines what they are, their numbers and distribution, the different types of centers, financial investments, barriers to development, workforce impacts, economic implications, and considerations for guiding their future growth. Briefly, we argue for a framework for data centers that

addresses challenges such as access to critical minerals, workforce shortages, community benefits, permitting reforms, energy and water needs, electric grid investment, national security considerations, and geographical placement. Improvements in these areas will be crucial to ensuring a smooth transition to a digital economy.

WHAT ARE DATA CENTERS?

Data centers host a large number of file servers and networking equipment that can store, process, and analyze text, images, code, and other information sources. Guided by large language models (LLMs) and machine learning, data centers can parse through these materials and act autonomously upon the derived insights. The applications that are hosted at these facilities can summarize text, edit photos or videos, examine data, code software, and perform many administrative and financial tasks in real time. These applications offer tremendous convenience, efficiency, and effectiveness to consumers, businesses, and governments.

"Hyperscale" data centers typically have more than 5,000 file servers within their facilities and can house equipment utilized by many different organizations. With the large-scale growth of generative AI, there is tremendous reliance on data centers that process information quickly and with low latency to enable the use of a wide range of AI services and agents. It is estimated that the generative AI market is accelerating around 40% a year and is projected to increase from $43.9 billion in 2023 to nearly $1 trillion in 2032. This high AI growth rate, generated by skyrocketing digital demand, makes it imperative to expand data centers.

TYPES OF DATA CENTERS

There are different kinds of data centers. One type is data centers for generative AI, which are based on graphics processing units (GPUs) that can deal with vast amounts of information. These facilities process extraordinary amounts of data in text, numeric, or graphic forms and power LLMs and machine learning. They scour the internet, find logical patterns, summarize information, and act on these insights in real time. AI-directed data centers require high computing power and are energy-intensive.

As interest in generative and agentic AI has skyrocketed and major tech companies roll out new AI products, there has been a substantial growth in these types of operations. Data center facilities can be enterprise systems operated on behalf of a specific organization or co-location centers that host the platforms of multiple organizations.

One of the most sensitive developments has been high-security centers for military and intelligence gathering. ↗ Governments have substantial security needs and require online platforms that house their most confidential secrets, including information on defense applications, battlefield logistics, foreign adversaries, or domestic terrorists, as well as proprietary systems provided by private firms. Processors need to be super-fast to analyze incoming material and super-secure from hackers, malcontents, and enemies. President Trump's recently launched AI Action Plan ↗ directs the Department of Defense and the National Institute of Standards and Technology (NIST) to develop new technical standards for government entities.

"Edge centers" ↗ are situated close to particular activities they support, in order to reduce the latency of computation and networking. Applications such as autonomous vehicles, stock trading, or manufacturing facilities with widespread use of robots need fast communications. These systems don't want too much of a lag between a query and its implementation. Human lives may also depend on speed in analyzing certain risks, so these kinds of centers need to be very close to where people are utilizing their services.

ENERGY AND WATER REQUIREMENTS FOR DATA CENTERS POWERING AI

Data centers supporting AI applications require a considerable amount of electrical power ↗ and water ↗ for their computer storage and processing. In particular, LLMs and other forms of generative AI need a tremendous amount of power. In 2023, data centers consumed around 4.4% (https://www.brookings.edu/articles/as-energy-demands-for-ai-increase-so-should-company-transparency/) of America's electrical power, and that percentage is expected to rise substantially in the next years. According to the Lawrence Berkeley National Laboratory, energy growth is likely to increase between 6.7-12% ↗ by 2028. Around the world, it is projected ↗ that AI's energy needs could account for as

much as 21% of all electricity usage by 2030. According to McKinsey ↗, American data centers will utilize 35 gigawatts of electricity by the end of this decade.

Water is a problem as well. Some data centers consume as much as 500,000 gallons ↗ per day, making them a substantial draw on what is a limited resource in many communities. Data centers require a lot of water ↗ to cool the buildings and the computers inside. Electronic devices heat up during processing, and when thousands of file servers are grouped in a small area, the cooling needs increase dramatically.

Clean water is in short supply ↗ in a number of places. This is especially a challenge ↗ in the Rocky Mountain states and on the West Coast. In numerous cities and communities, water rates are rising substantially to deal with short supply and increasing demand. One county in Georgia is raising its rates by 33% ↗, far higher than the usual low single-digit increase, which critics attribute to data center needs. New advances in microfluidics, ↗ where coolants are applied directly to chips, may improve our ability to cool semiconductors and make data centers more sustainable and less energy-reliant, but much is still unknown about the efficiency of such advances.

As data centers expand, the question is how to generate the energy and water they need. The bulk of American electricity (https://www.brookings.edu/articles/the-enduring-dilemma-of-managing-american-high-level-nuclear-waste/) currently comes from fossil fuels such as natural gas ↗ (43%) and coal (16%), followed by wind, solar, and thermal (21% together), and nuclear energy (18%). Diversifying energy sources will be essential to meeting the growing demands of data centers, which cannot operate reliably without significant improvements in U.S. energy production.

Nuclear power↗ appears to be rising as a possible energy source, with AI companies planning to open or reopen new plants in the United States. It offers the advantage of not generating the byproducts of fossil fuel consumption while being available all the time once facilities go online. The Three Mile Island plant suffered a partial meltdown in 1979, but it is planned to reopen in 2028 to power Microsoft's data centers, provide 3,400 jobs↗, and generate billions in new tax revenue.

This increase in energy needs is occurring against the backdrop of rollbacks on clean energy sources. One organization estimates there will be 344 gigawatts ↗ of lost

generating power over the next decade linked to the 2025 federal budget bill. Provisions in the bill, particularly changes to tax credits, undermine the financial viability of solar and wind generators and make it harder for consumers to afford the electricity they generate. At a time of dramatically rising energy needs, it is short-sighted for the Trump administration to cut back on renewable energy sources, especially those that will be needed to operate data centers.

Overall, it is clear that the United States will need a substantial boost to electrical production to meet the increased demand of AI and data centers. Companies may mitigate these needs by developing more efficient cooling, lighting, and semiconductor processors. Greater (https://www.brookings.edu/articles/as-energy-demands-for-ai-increase-so-should-company-transparency/) transparency about their energy and water use would also enable policymakers and researchers to better understand the scope of the challenge and plan for sustainable growth.

NUMBER AND DISTRIBUTION OF DATA CENTERS

It is hard to get complete information on the number of data centers because of the ambiguities in how they are both defined and perceived by the market. Since there is no central clearing house regarding the numbers in operation, under construction, or in the planning stage, it is imperative that some type of future dashboard be developed. But according to the available data shown below, there are now an estimated 11,800 data centers around the world, powering AI and the digital economy. The United States leads the world in the number of centers as of June 2025, followed by Germany, the United Kingdom, China, and France. Around two-thirds of existing data centers are located in the United States, China, or Europe, and only a small number are found in Africa, Latin America, India, or other regions in the Global South. As is outlined later in the paper, geographic inequities will be crucial in assessing the global impact of data centers.

TABLE 1

Number of data centers by country

United States	□□□□□
Germany	□□□
United Kingdom	□□□
China	□□□
France	□□□
Australia	□□□
Netherlands	□□□
Russia	□□□
Japan	□□□
Brazil	□□□
Mexico	□□□
Italy	□□□
Poland	□□□
Spain	□□□

Source: Brightlio

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Table 2 breaks down data center numbers by U.S. state, based on two different sources: DataCenterMap.com ↗ and Aterio ↗. As with the global estimates, the overall numbers vary considerably depending on how data centers are defined, the stage of construction and operations, and the time period being covered. Some inventories appear to include small-scale centers, while others stick to larger facilities.

The state of Virginia has the largest number of data centers, followed by Texas and California. Northern Virginia has emerged as the “Silicon Valley” of data centers because of its proximity to federal government agencies, which make extensive use of

data storage and processing, in addition to the availability of land, energy, and water sources that support data center operations ↗.

TABLE 2

Number of US data centers by state from two different sources

State	Number in Operation (DataCenterMap)	Number in Operation (Aterio)	Number Under Construction (Aterio)	Number Announced (Aterio)
Virginia	□□□	□□□	□□□	□□□
Texas	□□□	□□□	□□□	□□□
California	□□□	□□□	□	□□
Illinois	□□□	□□	□□	□□□
Ohio	□□□	□□	□□	□□
Arizona	□□□	□□	□□	□□□
Georgia	□□□	□□	□□	□□□
New York	□□□	□□	--	□
Oregon	□□□	□□	□	□□
Washington	□□□	□□	□	□
Florida	□□□	□□	□	□□

Source: Data Center Map and Aterio.

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Table 2 also makes clear that the number of newly announced data centers continues to grow. States and localities are actively competing to attract these facilities in pursuit of economic growth. Several states view data centers as essential to establishing themselves as digital hubs for AI and other emerging technologies.

COPPER, STEEL, AND ALUMINUM REQUIREMENTS

Some of the most important barriers to data center expansion involve the critical components used for their construction and deployment. These facilities need a considerable amount of copper, steel, and aluminum for the building and equipment, as well as semiconductors, electronics, fiberoptics, and wiring for file servers, storage devices, and networking equipment.

President Trump's decision to impose tariffs on many commodities has dramatically raised the price tag of data centers. This year, the administration imposed tariffs of 50% on copper and raised rates from 25 to 50% on steel and aluminum. These measures dramatically increase the construction and operating costs for data centers.

The costs of semiconductors and electronic equipment imported into the U.S. have also increased by 25%. These increases are meant to boost domestic production and reduce trade deficits with major trading partners. This could eventually happen, but it is hard to construct new facilities and redirect supply chains in a short period of time, especially simultaneously with the expansion of data centers. While tariff negotiations with individual countries continue, the uncertainties associated with this policy remain a drag on data center construction in the United States.

One worrisome policy concern is that while President Trump's AI Action Plan prioritizes data center construction, his approach to tariffs makes this effort far more expensive. Alternative U.S. suppliers that could reduce costs are also limited, highlighting the inconsistencies between AI national goals and policy implementation. If the United States is to sustain its global leadership in AI, any barriers to data center development (whether stemming from trade policy or supply chain) will impact the timing and sustainability of construction. Despite billions in investments, logistical and permitting obstacles continue to delay data center buildout and operations, as discussed later in this paper.

THE NEED FOR CRITICAL MINERALS

A major limiting factor in semiconductor manufacturing is China's control over critical minerals needed for their production. Materials such as gallium,

germanium, antimony, tungsten, tellurium, bismuth, indium, and molybdenum are vital for many products and are not readily available from domestic sources.

Furthering the problem is that getting mining permits in the U.S. and Europe can take many years, while countries such as Canada, Australia, and China have far shorter timelines. The length of time required for U.S. and European mining permits limits domestic production of semiconductors and electronics and harms the ability to expand data centers. In the U.S., there is a growing urgency to expedite mining permits and justify the domestic expansion and construction of data centers. Without reliable access to prime materials, overbuilding is a possibility, and in the absence of long-term commitments from AI companies, vast amounts of land could become "data center deserts" if cheaper alternatives emerge elsewhere.

WORKFORCE SHORTAGES

Data centers will spur labor demand, particularly in construction and engineering, where there might be a groundswell in job opportunities and subcontracts. However, the current workforce simply does not have the necessary supply of technical workers. The Trump administration's current immigration and deportation policies compound this workforce problem, especially when it comes to the software engineers needed to power data centers. While the lack of homegrown talent could be resolved with workers from other countries, the current administration has moved in the opposite direction, deporting workers and slowing the supply of foreigners coming into the U.S.

There aren't enough electricians in the U.S. to meet the demand for laying wires and construction workers to build data centers. There are also shortages of construction workers, which typically include a large number of immigrant workers. It has been estimated that roughly 30% of construction workers in the U.S. are immigrants, including some who are undocumented. However, mass deportations limit the growth of data centers by draining the supply of individuals needed to build and wire such facilities. In every sector involved in data center development, from tech to blue-collar and trade, the Trump administration's immigration crackdown works against its stated goals of furthering American leadership in AI and expediting the construction of the data centers supporting it. This approach contradicts an early

commitment (https://www.brookings.edu/articles/trumps-immigration-policies-may-threaten-american-ai-leadership/) made to the major AI companies, which expect reciprocity for their support of the broader Trump agenda.

To redress the labor shortages threatening data center expansion, the U.S. should expand its job training ↗ and vocational education programs. More flexible licensing ↗ of workers in the trades should be encouraged across states; for example, electrician certifications could be made easily transferable ↗, allowing for more geographic mobility of workers with the necessary skills. The U.S. Department of Labor, in coordination with state workforce agencies, could support a temporary or flexible labor initiative tailored to large-scale data center construction. A stronger national commitment to the skilled trades overall would go far toward closing existing workforce gaps.

When workers can be found, housing problems ↗ are an additional concern. Housing costs have skyrocketed (https://www.brookings.edu/articles/what-is-driving-up-housing-costs-across-the-us/) in many places, and trade workers will need affordable and reasonable accommodations, especially in expensive areas where data centers are concentrated, like Northern Virginia. Some firms already provide mobile homes as temporary housing for these individuals; based on the expeditious and lofty agenda to build data centers, this could be a viable option.

Finally, most states require inspectors ↗ in construction with the duty to keep workers safe. Many places don't have enough inspectors, slowing down facility development. Even if completed, projects will be stalled until inspectors certify each facility. This is yet another sign that greater coordination between state and local agencies to address these worker shortages is necessary.

PERMITTING REFORMS

Obtaining state and local permitting for data centers can take a long time. There are mandated checks for the environment, worker safety, and community well-being. Companies need to get easements and right-of-way privileges to move forward. Some community groups have organized to stop construction. In Northern Virginia, for

example, which is home to a sizeable percentage ↗ of the world's data centers, neighbors of adjoining properties have complained in recent years about water shortages, light pollution, and air conditioning noise ↗. Companies need to make sure their sites are safe and clean, and do not endanger community residents.

In its AI Action Plan ↗, the Trump administration is pushing for expedited permitting. Republican lawmakers ↗ have repeatedly voiced that current processes are unnecessarily slow and more needs to be done to help companies that want to build technology facilities. The administration is likely to authorize building ↗ sites on federal lands under a fast-track system designed to reduce approval times, freeing up unused terrain for large-scale data centers and helping companies move more quickly from permitting to construction.

Another proposal is to exempt data center projects from certain review requirements dictated by the National Environmental Policy Act ↗, the Clean Water Act ↗, and the Clean Air Act ↗. Another is to have national permits for data centers as opposed to locally required ones. While these measures might expedite construction, communities may still oppose the projects, especially if residents are not involved from the beginning.

ELECTRIC GRID AND TRANSMISSION LINE INVESTMENT

Among the most critical infrastructure priorities are modernizing transmission lines and ensuring that the electric grid can operate at the required scale, stability, and reliability. With the dramatic increase in electricity needed for data centers, upgrades to the grid will be necessary. It can sometimes take up to 10 years to build the transmission lines ↗ that move electricity from region to region. Such transmitters rely upon steel and aluminum, but researchers say materials such as carbon fiber would be lighter and could move larger amounts of electricity. The U.S. Department of Energy intends to upgrade 100,000 miles ↗ of new transmission lines this decade, though AI companies are seeking to build many of these data centers on a much shorter timeframe.

With the growth of AI and the design of new materials, there are new tools that will make transmission lines operate more efficiently ↗. AI can improve operations and facilitate a more efficient and sustainable electrical system, preventing loss of power as electricity is moved geographically. In addition, data centers can use "closed cooling systems↗" that require less water and keep file servers at the temperatures needed for effective operation. These measures will reduce energy costs and keep water and energy demands down.

It is also possible that there will be improved efficiencies in other areas. The Chinese firm DeepSeek↗, for example, claims it can process tremendous amounts of information with reduced processing power, lower costs, and fewer electrical requirements. A recent peer-reviewed *Nature* article co-authored by a company leader said DeepSeek's "reasoning-focused R1 model cost $294,000 ↗ to train and used 512 Nvidia H800 chips," which is a fraction (https://www.brookings.edu/articles/why-ai-demand-for-energy-will-continue-to-increase/) of what most Western models require to operate. While it is not clear how seriously to take such claims, digital technologies have a tradition of becoming more efficient over time; it is possible that design and processing improvements will increase financial and energy sustainability, thereby easing the current pressures facing data centers. AI companies will face many of the same regulatory and state-level hurdles that energy companies do, as was the case in the expansion of 5G↗ technology, when colocation of radios and power generators became a concern. Securing access to modern and resilient power systems may prove one of the stickier points for AI companies.

DATA CENTER COSTS

Many factors go into the costs of data centers ↗, including acquiring land, construction, equipment, labor, heating and cooling, security, power consumption, permitting, operations, and more. Jeff Howell of Encor Advisors ↗ has examined this issue in-depth and found that "construction costs for data centers are estimated to average at approximately $9.5 million per megawatt" in the U.S., and once facilities are built, annual operating expenses ↗ can range from $50,000 to $100,000 for a small center to $10 to $25 million for a larger facility.

Recent hyperscale data centers that feature thousands of servers were found to cost $1 billion or more to build. They can cover more than a million square feet of land and feature sophisticated computer processing power. In addition to being very expensive, such facilities have huge upfront costs. Many of these expenditures, such as land and construction labor, vary tremendously within the United States, and the same is true for different places around the world. How close installations are to supply chains affects overall costs, as do transportation, logistics, energy, and taxes.

Billions of dollars are currently being invested in AI, cloud computing, and the data centers that power digital applications. Money is flowing from the top tech firms, investment funds, sovereign wealth funds from other countries, financial institutions, industry partnerships, and more. As of 2024, the financial investment required for data centers reached hundreds of billions of dollars, and that number is expected to increase into the trillions by 2030.

WHO PAYS?

Barring major advances in efficiency, the big question is who pays for the increased data center capacity. Right now, ratepayers shoulder some of these costs. Consumer bills have risen in a number of places, fostering resentment about the additional expenses. David Klaus and Mark MacCarthy have argued that since the major technology companies are building data centers and will benefit from their services, they should shoulder more of the costs. They note that the top AI firms have a market value "seven times that of the entire S&P 500 Utility Sector" and therefore have the financial means to pay for the increased electrical power. As an illustration of how this could work, the Public Utilities Commission of Ohio has proposed that firms operating data centers larger than 1 gigawatt should pay 85% of their electricity costs, up from the current 60%. This change would shift a greater share of financing to technology firms with the capacity to absorb it.

To guard against the consumer backlash over rising electrical bills, several companies are using bonds to finance their long-term investments. Meta, for example, has floated $26 billion in bonds to pay for its new data centers. That allows the company to gain access to capital upfront, with expected revenue gains from AI applications paying for the bonds overtime. That model puts the payment onus more on companies but also

assumes the cash flow from new AI revenue will be sufficient to cover bond repayments. If AI accelerates as currently are projected, that should be a relatively safe bet.

Because of the high investment costs, many of the current hyperscale data centers are set up by the large technology firms themselves. According to the scholars at Vanderbilt University, platforms such as Amazon Web Services, Microsoft Azure, and Google Cloud Platform own around two-thirds ↗ of the cloud computing market, which serves as the digital infrastructure for the data center sector. Data centers rely upon cloud storage and processing facilities to power AI and other emerging applications, making it essentialy to ensure these markets function efficiently and effectively.

WHO BENEFITS?

Consumers, businesses, and government actors will likely benefit if the development of large-scale data centers spurs advancements in AI applications, machine learning, data analytics, and robotics, which in turn could lead to more efficient manufacturing, autonomous transportation systems, the development of new drugs, personalized learning, and much more. There will be faster broadband for ordinary consumers and greater processing power for businesses, governments, and health and educational institutions, especially if the assets of telecommunications companies are effectively leveraged.

Our goal should be to extend the benefits of the digital revolution (https://www.brookings.edu/books/digitally-invisible/) to everyone, allowing people to share in technological innovation without facing exclusion or harm.

This is where the question of community benefits for residents living near data centers must be made clearer. For example, can local electrical grids be upgraded as part of the broader infrastructure improvements needed to power these facilities? Could irrigation systems be modernized in areas slated for data center construction? Who decides what community investments are made, and how are tech companies and the government working to support local education and workforce development so that residents can access new trade and professional opportunities?

As more data centers are built, multiple stakeholders, spanning AI companies to civil society organizations, should consider the risks of accelerated growth. There should be community surveys to understand people's concerns and ways for public utility commissions to gather feedback from affected neighbors and incorporate that information into their rate decisions. In other words, communities should not view these buildings as isolated entities, but rather as valued assets that bridge local dynamics with global concerns, as well as an opportunity for local development.

JOB IMPACT

One area of community benefit that might be less promising is job creation. Even in large-scale centers, construction jobs often total around 1,500 skilled trade workers and 100 operational jobs. Since centers largely consist of file servers and networking equipment, it does not take a lot of employees to staff them. Hyperscale data centers may comprise a million square feet of space and cost a billion dollars to build, but they are not likely to create a large number of jobs outside of construction, which is why other community benefits may be more salient for regions expanding their data center footprint.

CLIMATE AND ENVIRONMENTAL RISKS

Natural disasters are major threats to data centers. The prevalence of U.S. data centers in places such as Texas, California, and Virginia makes them susceptible to hurricanes in the Southeast, floods in Texas and Virginia, and earthquakes along the West Coast.

As climate change fuels more destructive floods and storms, companies must carefully select the construction sites of new data centers. In disaster-prone areas, it is also crucial to build in data and operational redundancy in case particular centers go down due to weather problems.

NATIONAL SECURITY CONSIDERATIONS

Increasingly complicated geopolitical dynamics are affecting data centers. Shifting alliances and the polarization of global relations alter the United States' risk profile. Competition with China ↗ has intensified, and so have concerns about national defense, cybersecurity, and international competitiveness (https://www.brookings.edu/articles/interwoven-frontiers-energy-ai-and-us-china-competition/) . Decisions about where to build data centers carry national security implications, raising questions about the nature of a host nation's relationship with the United States and its level of democratic governance. Careful deliberation about these subjects is necessary, as the implications on intelligence gathering and defense are significant.

On the hardware side, the Biden administration dealt with some possible security threats by limiting chip exports ↗ to adversarial countries. It imposed controls on the kind and sophistication of semiconductors that American firms could sell to Chinese entities, for example. It invested in domestic manufacturing capabilities through the CHIPS and Science Act ↗, in order to boost American capabilities and make sure U.S. companies had access to chips in case of any disruptions in production in Taiwan and South Korea, where the most advanced chips↗ are made.

Trump has altered that strategy in two ways. He has weakened support ↗ for CHIPS Act funding and loosened restrictions ↗ on chip sales to China. The administration's argument is that it is better to have foreign competitors reliant on American products than for them to develop their own domestic capabilities. The belief is that these actions will protect American security, while still maintaining export markets to China and elsewhere.

DATA PORTABILITY

It is important for organizations to avoid data center "lock-in" and have the means to move their information and models from platform to platform. While this was a problem

in the early days of some social media sites, companies can now export their data and switch to another platform if they choose.

There should be a similar mechanism for convenient data migration so that individuals and organizations are not locked into individual sites with limited migration options. Both the General Data Protection Regulation (GDPR) of the European Union and the California Consumer Privacy Act (CCPA) give people control over their own data and mandate the data portability rights of any individual or organization. This requirement should be extended throughout the U.S. to give people more choices and greater control over their personal information and applications. In the future, more interoperability could be built into data centers to ensure more seamless data coordination.

EUROPE'S DISTINCTIVE CHALLENGES

Europe faces some distinctive challenges in building out data centers, owing to the inadequacy of its current power grid, permitting obstacles, and poor access to capital in order to scale its businesses.

It is expensive to build data centers in many European nations. There are high land costs, cumbersome permitting procedures, high labor and tax costs, and infrastructure development barriers. Similar to the U.S., the members of the European Union must address these obstacles and ensure their businesses have access to the data centers that will power the AI economy.

In general, the European Union has been slow to overcome barriers to data center development and is building these facilities at a far slower rate than the United States. A similar challenge could emerge domestically if U.S. states diverge in how they support data center construction. However, as Table 2 indicates, state-level approaches in the United States have so far remained consistent, enabling effective coordination with federal initiatives to advance these projects.

INVESTING IN THE US HINTERLAND AND GLOBAL SOUTH

Most data centers now reside in American states on the East or West coasts (https://www.brookings.edu/articles/mapping-the-ai-economy-which-regions-are-ready-for-the-next-technology-leap/) or in developed countries that already have ample financial resources. There is a real risk that the U.S. hinterland will be left behind, as well as the Global South, including substantial parts of Africa, Latin America, and Asia. Table 1, for example, shows that there are no African countries with a substantial number of data centers, and the only Global South nations among the top 16 places were Brazil and Mexico.

The problem with the narrow geographic scope of data center locations is that it reinforces existing inequities and accelerates the gap ↗ between digital "haves" and "have-nots." Data centers are crucial for future economic development. It will be hard for nations to be competitive if they do not have their own data centers or if their AI applications lag due to insufficient infrastructure. We need a geographical distribution of data centers that promotes economic growth in the Global South and enables AI for the public good ↗ around the world.

To deal with equity issues, Daniel Goetzel of Harvard University has discussed "AI economic zones↗" as ways to diversify the geography of AI and data centers. The idea is that cities could establish areas similar to urban economic zones where public and private investment could facilitate technology developments and make it easier for those without much access to capital to develop their ideas. Similar approaches may work globally through the World Bank or other international development agencies.

CONCLUSION

In summary, several obstacles and barriers must be addressed to enable data centers –and, by extension, AI applications–to reach their full potential and support economic flourishing. Challenges involving critical minerals components, workforce shortages, permitting reforms, energy and water needs, electric grid investment, national security, and geographical distribution are all critically important. Improvements in all these areas will be crucial to the international competitiveness and economic prosperity of the United States. This paper is part of a broader research

effort to monitor these and other emerging areas and track community benefits and risks, while measuring progress toward national and international goals.

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RESEARCH

Turning the data center boom into long-term, local prosperity

Daniel Goetzel, Mark Muro, and Shriya Methkupally

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- → The standard data center development model—speedy dealmaking and opaque negotiations—delivers short-term construction jobs and revenue, but little durable local economic upside.
- → However, AI-era scaling and competition for mega-sites, grid access, and permits are giving regions new leverage.
- → Early examples suggest that negotiated data center co-investments can anchor regional tech ecosystems. Regions should ask for this.
- → Regions should treat data center negotiations not as isolated real estate transactions but as ecosystem-shaping moments that trade infrastructure access for commitments to advance local innovation, talent, and industry strengths.
- → Hyperscalers should proactively develop new economic development frameworks to fast-track negotiations while unlocking partnerships that are core to their business model's success.
- → A shared playbook for such partnerships should focus on shared prosperity through co-investment, regional testbeds, workforce and R&D alignment, and energy innovation from the start.

The AI goldrush roars on. Hyperscalers like Google and artificial intelligence (AI) upstarts like OpenAI continue to pour massive sums ↗ into building gargantuan data centers (https://www.brookings.edu/articles/the-future-of-data-centers/) , often in small- and medium-sized communities ↗.

As the deals proliferate, concerns are rising about the huge amounts ↗ of electricity ↗ and water (https://www.brookings.edu/articles/ai-data-centers-and-water/) required to keep the centers running. At the same time, pitched battles ↗ over zoning and permitting rules are pitting tech-firm developers against local land-use managers, especially in rural and exurban America.

Yet beyond such infrastructure and resource concerns, sharp debates are also engulfing the facilities' core economic proposition for communities. Local leaders are questioning the credibility of Big Tech's promises of spillover effects that will produce high-quality economic development beyond near-term construction. What's more, skeptics are wondering about the veracity of the developers' assurances ↗ of a thrilling new era of "reindustrialization" across Main Street America.

These debates raise fundamental questions: To what extent are the data center builders' promises of economic development more than hype? And if these promises are more than hype, how can communities make sure these pledges translate into a durable local economic advantage?

As to the historical answers to those questions, they are mixed. Yes, data centers can contribute to local economic development, including by generating meaningful tax revenues ↗. But for all that, the current, often-secretive site selection game ↗ tends to pit states and localities against each other, creating a fear-of-missing-out (FOMO) dynamic that limits creativity and leverage.

Given that, local elected officials are frequently rushed into hasty sprints to negotiate complicated power, permitting, and financial incentives with community benefits often tacked on at the end of the discussions only as a supposed sweetener or to counter community unease. As a result, few negotiations explore how siting for data centers can be leveraged into truly win-win partnerships for economic development—ones that unlock high-value tech opportunities in host regions while preserving hyperscalers' and data center developers' core business models and timelines.

All these issues suggest that the standard model for economic development involving siting deals for data centers needs rethinking, especially as the deals get bigger and the opposition to them grows more fraught. Governors, commissioners, and other

elected officials across the country, in short, should insist on a more creative ecosystem-like view of the economic benefits that AI-related centers can deliver alongside the cloud services they provide. And for its part, the AI sector should truly engage with local communities because getting this model right can transform isolated data center projects into community-supported AI ecosystems that deliver with the speed and scale that the AI sector has promised—but not yet fully delivered.

The rest of this analysis contains two parts, then. First, it features a look at the current AI-supported data center opportunities that regions are facing. Second, it includes a playbook or set of scenarios for regional leaders who are negotiating with a range of data center developers and end users—including developers like Equinix and Digital Realty; newcomers like OpenAI, Anthropic, and CoreWeave; and established hyperscalers like Google, Amazon, and Oracle. Ultimately, the hope is to suggest routes toward truly mutualistic siting deals that truly benefit U.S. communities.

Moving beyond the standard calculus on data centers

The opportunities at hand reflect the urgency of today's AI scale-up moment. Traditionally, data centers have been built as standalone industrial facilities designed to securely store, manage, process, and share large amounts of data for various digital services. Accordingly, the facilities have required major upfront infrastructure investments—including in large tracts of land, expensive server hardware, and reliable utility-scale power—while generating relatively few local benefits ↗.

Accordingly, both developers and communities have treated data centers like warehouses—routine projects that produce a surge in short-term construction jobs followed by a steady stream of tax revenue without offering many direct contributions to or interactions with the local economy. In that sense, an out-of-sight, out-of-mind approach has been the preferred state for data center management.

As to their specific local impacts, the centers' contributions have been mostly modest in the last decade. Data ↗ from the U.S. Chamber of Commerce's Technology Engagement Center documented this trend. Using data from 2017, the chamber showed that economic benefits of a typical large data center decline substantially after the construction phase. Similarly, Table 1 below, which was reproduced from research ↗ in November 2025 by Michael J. Hicks, summarizes input-output model

estimates from multiple studies and shows that long-term, operational employment is small relative to job creation during the construction phase.

TABLE 1

Construction versus operational jobs from data center development

Study	Construction Jobs (one-time)	Operational Jobs (ongoing)
PwC (2023)	1,000–10,000	50–300
JLARC (2024)	3,000–5,000	100–400
Sage Policy (2024)	~2,000	~200
Thompson (2019)	~1,200	100–150
Morrow County (2024)	~1,500	80–120

Source: Adapted from multiple economic impact studies compiled in Michael J. Hicks, "Data Centers and Local Job Creation."

Note: Estimates vary by project scale, location, and reporting conventions (e.g., per data center, per campus). For indirect and induced employment effects, as well as additional methodological caveats, see original source.

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In short, the standard model of data center development has produced mostly short-term construction jobs in recent years and relatively little long-term, high-value tech activity or large-scale employment. That is true, at least beyond a limited number of dense clusters in places like Northern Virginia and, more recently, Texas, where workers can easily and quickly move between multiple sites that are coming online.

Yet now the ChatGPT era is disrupting the standard model. From the moment the AI titans committed to super-scaling their models to unprecedented sizes, they began to require unprecedented amounts of computing infrastructure to train and operate their datasets. What's more, the faster the firms have sought to scale, the faster they have needed to strike deals with communities to build massive computing facilities, often in

the face of increased local concerns about electricity use, noise issues, and other side effects (see Map 1).

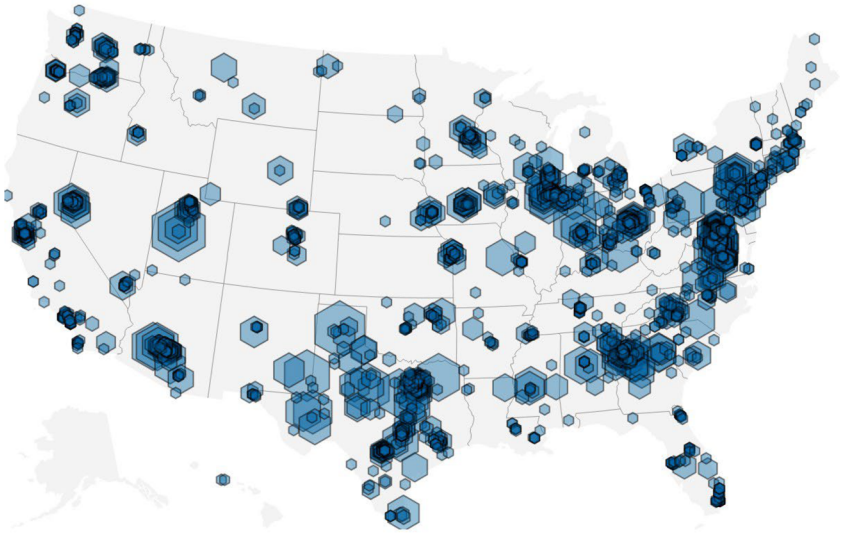
MAP 1

Data center campuses in the US

Hover over the map to see the number of data centers in each campus that are active, under construction, and announced.

Go to AI only facilities

No. of data centers 5 20 50



Source: Brookings' analysis of data from Aterio (2026)

Note: Standalone data centers not associated with a campus are mapped individually above. Data coverage is as of 20 January; announcements made after are not included. Land Bank, Cancelled, Not Approved/Withdrawn Data Centers are shown but not broken out in the tool tip.

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These industry changes are shifting the balance of power. For years, data center development has pitted community against community in races to attract data centers

and their perceived jobs. Now, the new frenzy of competition between the hyperscalers themselves (and other actors) for the biggest sites with the best power connections has given communities at least a sliver of their own leverage to shape AI-focused data center deals into more forward-looking, mutually beneficial development projects.

In that vein, more regions have a chance now to wield their leverage over siting-game rights in ways that engage data center developers to become partners in a given region's own AI readiness strategies. These areas for engagement with Big Tech might involve advancing a local agenda for enhancing high-tech talent initiatives at local institutions and schools. Alternatively, they might involve securing abundant computing resources for local academic work from an incoming hyperscaler, or they could entail enlisting partnerships in other forms of R&D at local universities, startup companies, or entrepreneurial energy companies.

In any event, regions have a legitimate opportunity now to leverage the data center gold rush in support of building up true local tech clusters. With AI centers spreading across the country and with more being announced daily, more regions should weigh their opportunities to leverage these data centers to attain true local benefits.

Exploring new avenues for economic development driven by data centers

Delving deeper into the current AI moment, it is possible to see the first outlines of a more valuable buildout of data centers coming into focus on its own—in a way that helps regions gain benefits that meaningfully support the development of local tech ecosystems.

Even allowing for a degree of hype, the hyperscalers' urgency to close deals has already driven several announcements in the last year in ways that suggest how data center agreements could—with greater levels of intentionality—more meaningfully benefit local communities' economic development.

As a matter of high-level rhetoric, for instance, OpenAI's update last year to its "AI in America" economic "blueprint" statement set out a useful high-level vision of

community gains. It proposed the creation of "AI Economic Zones ↗"—government-industry development areas where permitting is expedited in exchange for substantive commitments to local high-tech development. As part of that proposal, the firm floated the idea of creating as part of siting commitments local "AI research labs" and workforce pipelines "aligned with key local industries." To that end, the firm spoke about making available "meaningful amounts of compute to public universities" and "equitably scal[ing] the training of a homegrown AI-skilled workforce."

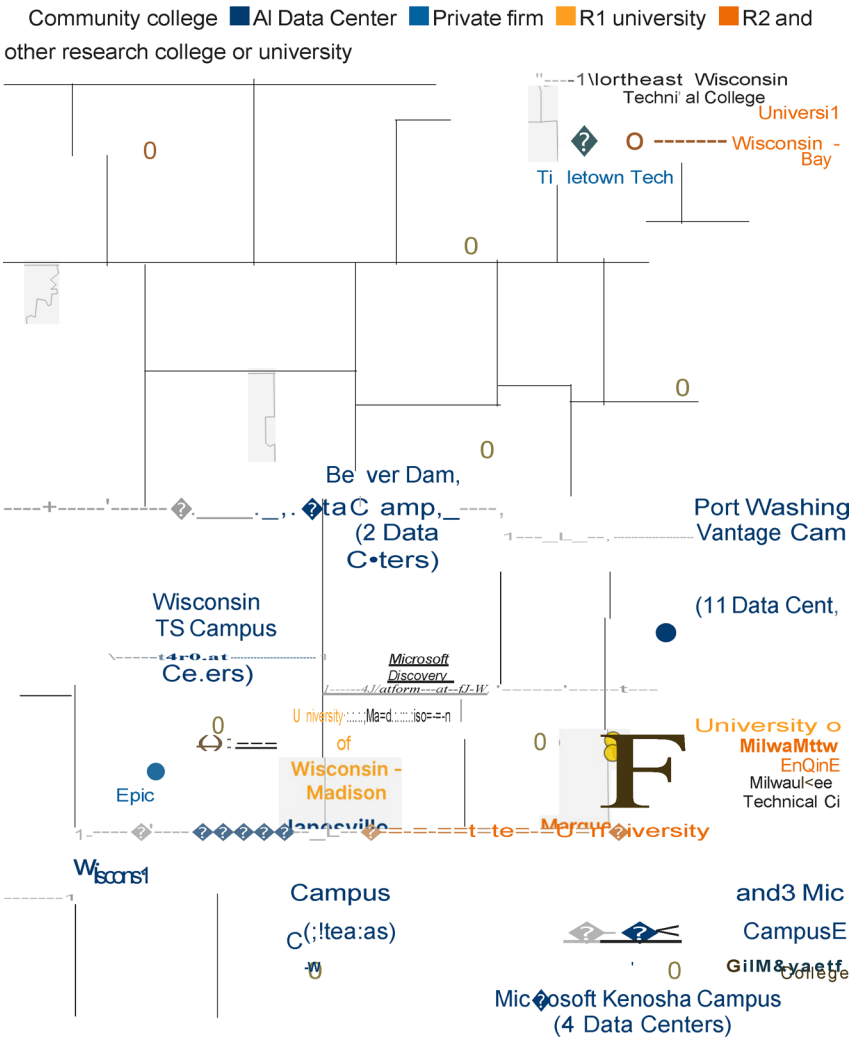
For its part, the U.S. Department of Energy (DOE) is promoting opportunities ↗ to accelerate the development of data centers on lands belonging to national laboratories while prioritizing public-private partnerships to enable the development and use of such infrastructure by local institutions and the sharing of compute resources back with the national lab research teams. Sixteen locations have been nominated for such collaboration by the DOE.

At the same time, several real-world data center operators are demonstrating elements of a more symbiotic development stance. Notably, Microsoft's launch of a major AI data center ↗ in Mount Pleasant, Wis., is bringing about meaningful investments in the state's broader tech ecosystem (see Map 2).

Simultaneous to the data center project, Microsoft is partnering ↗ with the University of Wisconsin-Madison to accelerate scientific discovery through its AI-driven Microsoft Discovery ↗ platform, an agentic AI tool for R&D. Likewise, Microsoft has helped to open a manufacturing-focused AI Co-Innovation Lab ↗ on the campus of the University of Wisconsin-Milwaukee to leverage AI adoption in the manufacturing sector. As of the fall of 2025, the lab had helped several dozen Wisconsin companies —including Regal Rexnord, Renaissant, and BW Converting— practically adopt AI development ideas. In addition, Microsoft is partnering in Racine, Wis., with Gateway Technical College to launch Wisconsin's first Datacenter Academy ↗ to train more than 1,000 students in five years for high-demand data center roles. Across the state, the firm and more than 40 partners like the United Way, the University of Wisconsin, and the Wisconsin Technical College System have worked together with Gener8tor to train ↗ 114,000 Wisconsinites in AI. Complementing this work, the hyperscaler recently launched a national agenda ↗ to build "Community-First AI Infrastructure," which includes investments in local training, job creation, and nonprofits along with commitments to cap electricity and water demands.

MAP 2

The geography of existing and forecasted AI data centers and institutions in Wisconsin



Source: Brookings' analysis of data from Ateno (2026), IPEDS (2024-25)

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Note: For Wisconsin, identification of 'AI data centers' is not limited to data provider flags. Classifications reflect additional validation with local experts and judgment based on characteristics reported in project announcements (e.g., scale).

And other actors are following suit in Wisconsin, seeking to link the construction of data centers at least somewhat to higher-value economic benefits. OpenAI's Stargate campus in Port Washington, Wis., for example, will generate more than 1,000 long-term jobs according to Open AI, and the campus ↗ will "be water-positive, using closed-loop cooling that requires minimal water, and supporting local projects that restore more water than the campus uses." This seems to be a starting point for delivering on the firm's larger reindustralization ↗ mission.

And so, without fully reorienting the data center game, OpenAI's words in its blueprint document and its early actions in Wisconsin as well as Microsoft's decade-plus of activities in the Badger State (home of the firm's Vice Chair and President Brad Smith) point in a needed direction. This new approach to the development of data centers does not yet comprise explicitly negotiated alignments or a new standard framework, but a new approach has begun to emerge organically.

Reimagining success: Leveraging data centers to scale up regional tech hubs

The problem is that the Open AI and Microsoft announcements, while encouraging, aren't yet translating into widespread change on the ground. Most data center deals continue to reflect the standard model of one-to-one, highly asymmetric face-offs between Big Tech and local governments. For the most part, elected officials (cowed by a sense of FOMO) take the first deal offered or only negotiate around the edges rather than treating data center negotiations as a core opportunity for higher-value development. The result is more of the standard dealmaking that's been around for years.

So, what would it take for regions to enlist the development of data centers in their most ambitious aspirations of building high-value local economies? To start with, regions need to marshal the high levels of **focus** and **alignment** that Joseph Parilla

and Mayu Takeuchi show (https://www.brookings.edu/articles/from-federal-investment-to-regional-economic-transformation-a-new-model-linking-industry-growth-to-economic-mobility/) have characterized the shift of leading-edge communities from "traditional" to "transformational" approaches to economic development. In this vein, Parilla and Takeuchi document how the Syracuse, N.Y., region's clear set of high-level strategic priorities has helped it obtain stellar local outcomes from a recent $100 billion semiconductor siting ↗ by Micron Technology.

At the same time, states and regions need to **ask for more**, recognizing that they have more clout today than they did five years ago. Most notably, data center developers—faced with too few mega-sites, too much backlash, and sharpening battles with their competitors to secure previous land and approvals—are finding they need to give a little to get deals done. For their part, more communities and states are remembering that their land, infrastructure, approvals, education systems, and worker training organizations are precious. In doing so, they should be and increasingly are elevating their aspirations for siting deals that remain at base asymmetric face-offs with huge tech firms and hard-driving developers. Given that, county executives, local and regional development officials, and governors need to have some game-changing scenarios in mind.

What follows, then, are some initial tenets for such a playbook aimed at enlisting AI data center investments into higher-order economic agendas.

Structure negotiations as opportunities to unlock regional economic development rather than merely as chances to deliver narrow data center deals.

Challenge: Too often, data center deals play out as single-project siting games that pit giant developers in narrow negotiations with local governments. This mindset results in deals that focus on an important but circumscribed set of issues (electricity, water, and zoning) but leave out larger questions of regional advantage such as higher-value tech benefits and gains for the broader technology ecosystem.

Opportunities: In contrast, the controversy and competitiveness of new data center sitings mean that regions and states have a chance to **negotiate harder for a broader**

set of benefits aimed at supporting their boldest economic aspirations in sectors where a given region has a competitive advantage. In that vein, more communities have the leverage to trade expedited permitting and approvals for substantive gains that truly advance the region's goals, whether that involves donations of compute to local universities, R&D partnerships, support of local talent programs, or investments in AI startup intermediaries. Nor do these gains need to be broached as mere deal sweeteners or appended community benefits. Instead, communities can now argue for strategic benefits like these as core elements of any deal, given the increasingly challenging atmosphere surrounding such deals and the overstretched, specialized workforce needed to build these sites. Regions should therefore broaden their agendas.

The focus, meanwhile, should be on sectors where a given state or region has the right to win. For example, shouldn't Michigan's self-driving car companies be an attraction and point of collaboration for the hyperscalers and regions in that state? Or can OpenAI develop custom models (and provide technical support) that meet the needs of manufacturers in Wisconsin as part of a grand bargain there? Striking these types of partnerships can benefit both hyperscalers and regions by advancing key AI use cases from the theoretical to the actionable in the eyes of community members. An additional benefit is that such corporate partnerships can be leveraged in applications for future federal, state, or regional competitions such as the U.S. Economic Development Administration's Tech Hubs Program or the National Science Foundation's Regional Innovation Engines awards.

Examples: What might this look like, results-wise? In many respects, the tech ecosystem emerging in southeastern Wisconsin provides an aerial view of the kind of regional benefits creative management of data center negotiations could help yield. There, Microsoft's recent announcement ↗ of 15 more data centers in Mount Pleasant follows on the heels of the firm's multiple continued investments in workforce development, R&D, manufacturing, and tech startups. While not negotiated in overarching grand bargains, the coinciding of data centers and new tech ecosystem developments points in the right direction.

For its part, CoreWeave is taking a similar approach in its home state of New Jersey, where it is building multiple data centers while serving as a founding partner of the NJ AI Hub ↗ with Princeton University, N.J.; Microsoft; and the New Jersey Economic

Development Authority (NJEDA). CoreWeave worked together with the NJEDA to invest $20 million↗ into emerging startups as a part of this effort. While not directly tied to the NJ AI Hub, former Governor Phil Murphy and his economic development team intentionally structured carrots that made it attractive for CoreWeave and other AI companies to make similar bets in New Jersey. The former governor pushed new state legislation ↗ that offered AI companies up to $250 million in tradeable tax incentives built around mega deals in return for making similarly sized investments back into New Jersey's tech ecosystem with a focus on collaborative partnerships ↗. These prospective partnerships ↗ could, according to the statute ↗, be "between an eligible business… and a (1) New Jersey-based public or private research university or universities; (2) [New Jersey-based] technology startup company or companies; or (3) [New Jersey-based] incubator(s), accelerator(s), [or] studio(s)." In practice, the governor receives a pool of flexible economic development funds that he or she can redirect to high-priority areas (without a new piece of legislation), while the AI company secures an invaluable tax credit and public relations benefits, making them feel like winners in the process too.

Neighboring Michigan has a similar opportunity to add to this new style of playbook, in light of OpenAI's new Stargate data center ↗ down the street from Ann Arbor, Mich.; the University of Michigan's partnership ↗ with the Los Alamos National Laboratory on a joint AI research center in the state, and the university's inclusion in OpenAI's NextGenAI ↗ research partnership.

Convert AI investment into local wealth creation, moving from a community-benefit model to a shared-prosperity model.

Challenge: Large, complex sums of private capital ↗ are surging into data center projects, enlarging unicorn AI companies, supporting infrastructure, and leading to multi-billion-dollar announcements. On the infrastructure side, investors capture most of the upside once project buildouts are completed and stabilized. For their part, by contrast, communities typically receive limited community-benefits agreements at the outset, while over the long-term, tax payments from data centers are largely invisible to residents—both in terms of how much is paid and how local governments ultimately spend the funds. These dynamics are creating an infrastructure wealth gap.

Concurrently, in-state university endowments, community foundations, and state pension funds have deep financial pockets and are looking for impactful opportunities for double-bottom-line investments. However, it is very difficult for universities (and states) to secure access to compute, toolsets, and the world-class large-language models that are largely being built in for-profit labs. Meanwhile, these same for-profit labs, backed by significant venture capital investments, are often poaching top talent from compute-constrained academic labs.

Opportunities: Given these deficits of local financial participation, a two-fold opportunity for local wealth participation exists here: Communities should become participants in real estate deals for data centers, and universities and states should participate in large and small funding rounds for AI startups. On the real estate side, communities or community-designated entities should seek to **co-invest in AI-related real estate deals** alongside developers of data centers. Both parties (impact investors and data center developers) would commit to transferring a portion of their illiquid equity shares into a separate fund ↗ called a community equity endowment (CEE). If (and only if) a given project is successful, then a portion of any windfall financial returns would be distributed to community members via the CEE, with direct community oversight on the uses of funds. The community shareholders could collectively decide if they wanted to use their CEE allocation to introduce universal basic income programs, develop a fund for one-time emergency expenses, provide micro-grants to small businesses, or even develop programs like local baby bonds. Citizens in the surrounding community could receive their shares as cash or compute, with the ability to use their personal compute allocation on their own projects at nearby OpenAI Academies (like the ones proposed by OpenAI in their Stargate Community ↗ plan) and at local small business hubs. As outlined in the aforementioned CEE white paper ↗, the benefit of this model is that community members get the advantage of an "inheritance… linking their personal financial opportunity to a project's success, without their needing to have the means to invest in the project."

In a parallel fashion, universities and states should seek to **participate in AI players' super-sized fundraising rounds**, perhaps by asking for early access to cutting-edge models for their researchers in exchange for their investment. Using this approach, AI companies (at the scale of Anthropic and OpenAI), or smaller, high-growth companies, receive an inflow of much-needed capital and the ability to train their models on university datasets. Universities, meanwhile, receive near-term access to compute, which is critically important to their faculty recruitment and retention and broader R&D

efforts. In the long run, universities can hold equity stakes in increasingly valuable companies, hoping to replicate Stanford's windfall from its early equity stake in Google. OpenAI even suggested pursuing this partnership approach in their June 2025 paper entitled "Ideas to Power Democratic AI."

Examples: These investment models may seem ambitious, but they are already happening in the wild. For decades, the citizens of oil-, mineral-, and gas-rich states like Alaska and North Dakota have received direct payments from oil revenues, through state-operated entities like the Alaska Permanent Fund and the North Dakota Legacy Fund. More recently, New Mexico created a $7 billion fund for universal childcare, using endowment revenues from the oil and gas industry. More sophisticated investment models are starting to take shape in the data center and venture capital spaces. The O.H.I.O Fund ↗ is actively investing in growth-stage startups and real estate projects for data centers in the state. The fund's general partners have proactively committed to donating 25% of the general partnership's profits to a newly formed Ohio Fund Foundation, focused on supporting community and economic development efforts. Emerson Collective, whose chief operating officer is a co-author of the CEE paper, is building a community hub in Southeast Washington, D.C., adjacent to the new WNBA basketball arena, aiming to bring this innovative real estate product to life.

On the direct private investment front, several foundations and innovative pension funds are already investors in AI companies. These arrangements range from the Emerson Collective's investment in OpenAI ↗ to the Ford, Kapor, and Cummings Foundations' positions in Anthropic ↗ to Ontario's Teacher Pension Plan and its investment in Anthropic ↗. It is also rumored that several university endowments are direct investors in these companies, building upon Washington University in St. Louis's strategy of direct investing ↗ in the most promising startups from their endowment's venture capital portfolios. Tying such investments to useful regional ecosystem development commitments looks like a very real strategy for communities.

Develop regional testbeds for collaboration between local academia, startups, and data center operators.

Challenge: Data center operators and AI companies tend to operate clandestinely. As discussed earlier, data center operators negotiate these deals quietly through site

selectors, and then, once projects are up and running, they oversee and manage massive amounts of confidential data. As such, they severely limit access into and out of their data center campuses. This model makes it very hard for university researchers and startup companies to forge partnerships in a live data center environment. States and municipalities are subsidizing large projects to the tune of billions of dollars without unlocking any of the R&D innovation occurring within these AI factories.

Concurrently, AI companies are deploying increasingly large sales teams to sell products and give away software to universities, state and local governments, teachers, journalists, and even startup companies, who might become the next big thing. AI and chip companies, like Nvidia and OpenAI, want startups to build on their proprietary AI rails. The current approach is that these companies provide heavily discounted or free tools (such as ChatGPT or Claude) and API calls in the early days to encourage tech lock-in.

Overall, piecemeal approaches are complicating cohesive adoption. For example, universities are regularly involved in negotiating data center deals for their on-campus computing needs while concurrently negotiating research agreements with Microsoft and OpenAI for cloud credits and research collaboration, yet communication is not necessarily occurring between the teams involved in those efforts. Additionally, pilot projects are often narrowly structured and miss out on opportunities to build broader, replicable forms of collaboration that unlock meaningful ecosystem value. For example, Maryland has partnered with Anthropic ↗ and the Rockefeller Foundation to deploy proprietary AI tools inside state agencies—focused on improving service delivery and eligibility navigation for programs like the Supplemental Nutrition Assistance Program; Medicaid; the Special Supplemental Nutrition Program for Women, Infants, and Children; and temporary cash assistance. However, the state's collaboration with Anthropic is disconnected from its efforts to attract data centers. It is also missing an opportunity to intersect with the research and educational work of its largest anchor institution, Johns Hopkins University, which is investing significant funds ↗ into a Data Science and AI Institute, which will drive an infusion of AI talent into the region and require large amounts of compute.

Opportunities: Yet there are opportunities here, too—if mindsets shift. States working with universities and other actors can and should develop the negotiating muscles,

infrastructure, and whole-of-government approaches needed to **ask AI negotiating partners to commit to organizing AI-related pilot programs and testbeds** as a condition of incentives for data center buildouts. By incorporating phased asks into these negotiations (such as calls for tech pilots, shared compute, and other benefits), states and regions can transform their interactions with the AI sector from a series of disconnected, isolated data center projects into AI hubs.

What could this look like? Regions could launch R&D testbeds—co-financed by builders of data centers in partnership with universities, states, or nearby national labs. Likewise, communities could build on and expand on the largely proprietary collaboration models employed by Open AI, Anthropic, and Nvidia—which are not readily accessible to most academic and startup partners. In this way, new facilities would allow local startups to validate technologies before deployment in live AI factories, while encouraging more applied university research and attracting startups to participating regions. Successful pilots—in partnerships with tech giants like Microsoft, Nvidia, and OpenAI—would help hyperscalers adopt new technologies faster, let startups scale up their operations, and lead to advanced market commitments. States could use innovation vouchers and compute vouchers to incentivize the large companies and startups participating in such programs to do some of this R&D work at nearby campuses, creating a self-sustaining flywheel effect.

Along these lines, testbeds supported by data centers could:

- Develop and deploy of next-generation liquid cooling systems and advanced materials hardware ↗ to materially reduce the energy intensity, operating costs, and national security risks of large-scale data centers;
- Engage local universities and labs in the design and commercialization of novel semiconductor chips ↗ and chiplet architectures; and
- Link local quantum-enabled computing clusters with data center environments.

Examples: The testbed model is gaining significant traction in Europe, including in the United Kingdom (UK), through the creation of supercomputing campuses, which facilitate cross-sector partnerships and often provide free or discounted computing to the most promising startups. In addition to creating AI Growth Zones ↗, the UK developed the National Quantum Computing Centre (NQCC), an effort to bring

quantum into data center environments, investing 30 million pounds ↗ to establish seven quantum computing testbeds, all built by quantum hardware companies at NQCC facilities. Meanwhile, European Union (EU) officials are working closely ↗ with Europe's most promising AI startups like Mistral AI on startup support programs within state- sponsored computing facilities and on commercial deployments ↗ that bring together AI-native firms like Nvidia and homegrown companies, with financing from the French national investment bank. In conjunction with a recent announcement about a large-scale data center campus in Greece, OpenAI structured an agreement ↗ with the Greek government to develop a Greek AI accelerator program with Endeavor Greece providing OpenAI credits and technical support. The memorandum of understanding between the government and OpenAI also included a third signatory, the president of the Onassis Foundation ↗, who is co-investing in efforts to introduce AI education and tools into Greek schools.

Finally, promising efforts are getting off the ground in the U.S. with the creation of the Massachusetts AI Hub, through the Mass Leads Act ↗. The act commits $100 million to a new nonprofit ↗ called the Massachusetts Green High-Performance Computing Center, which is a testbed data center built in partnership between the AI industry (including Dell Technologies, VAST, and Nvidia ↗) and academic institutions. Six universities from Massachusetts and Connecticut already have signed on, including Boston University, Harvard, the Massachusetts Institute of Technology, Northeastern, the University of Massachusetts system, and Yale. Notably, the center is based in Holyoke, Mass., rather than the tech epicenter of the Boston and Cambridge area, which shows how these innovations can spur activity outside of core urban centers. This was an intentional effort by Massachusetts Governor Maura Healey's team to stay competitive with Silicon Valley in the AI talent agglomeration race while distributing the benefits of such innovation across the state.

Turn AI firms' demand for energy into a regional R&D driver using new energy procurement tools and grid stabilization policies to develop a future-leaning energy economy.

Challenge: Companies operating large-scale AI models have significant and growing energy needs to power their computing infrastructure. There are mounting, legitimate concerns about how these energy requirements will stress the grid, increase

households' energy bills, and lock communities into an energy stack that is heavily reliant on gas turbines and non-renewable energy sources (at least in the short term).

At the same time, governors must make tough choices about what technology, energy, or other sectors they should prioritize and how to double down on their investments in those areas. When negotiating with emerging and large AI companies, states should focus on making asks in critical sectors where they have a competitive advantage, including opportunities to become emerging hubs for energy innovation.

Opportunities: By thoughtfully partnering with energy companies, utilities, and regulators, governors can reduce the risks of data center projects and the environmental and financial costs to their states' citizens while simultaneously establishing their states as hubs for energy innovation. In that vein, novel **partnerships designed to address data centers' energy demand** could vary widely and include the following aspects.

- Models where energy companies, hyperscalers, and utilities jointly share the cost and risk of new projects;
- Activities undertaken by governors, legislators, and local leaders to minimize rate payer risk, including opportunities for energy companies to support these efforts (financially or through other innovative capital stack models);
- Forward-looking research and development (R&D) and partnership strategies to pilot emerging technologies (including nuclear, geothermal, and other forms of energy) and grid stabilization platforms.

To bring this kind of cooperation to life in a win-win manner, a state could offer a hyperscaler expedited approvals and permitting on a project in exchange for commitments to areas like the following examples:

- Reduced energy usage during periods of peak usage;
- Jointly funded pilots of AI-driven technologies that shift loads and energy mix during peaks and lulls in data center activities, while giving opportunities to locally sited data centers and proposed testbeds to incubate and stress-test these models;

- Economic development commitments that expand beyond traditional short-term construction jobs;
- Market commitments and conditional purchase agreements with geothermal and nuclear companies that are building projects within a given state, as a way to allow states to invest in new technologies and finance pilot projects without sticking ratepayers with the future bill; and
- Commitments and investments that replicate at the state scale the arrangements emerging AI companies are making with federal agencies and national labs, such as Anthropic's commitment ↗ to the Department of Energy's Project Genesis or OpenAI ↗'s and Nvidia's agreements for sharing supercomputer and model resources with national laboratories ↗.

Examples: Innovative pilots of new technologies, financing, and approval models are already taking shape in a growing number of states as the demand for new solutions grows. On grid stabilization models and pilots, Nvidia has already announced a new data center project ↗ with the developer Digital Realty and the startup Emerald AI in Virginia. The project is a testbed for the new approach. Emerald AI's software focuses on quickly and temporarily shifting AI workloads downward during high-stress moments for the energy grid. The Federal Energy Regulatory Commission is taking notice too, calling for large grid operators ↗ like PJM to incorporate "enhanced load forecasting and demand flexibility measures."

On emerging technologies and creative financing models, Google is partnering ↗ with a startup called Fervo Energy in Nevada, which has developed new technology for harnessing geothermal power. The project has the capacity to generate 3.5 megawatts of power and will feed electricity into the local grid, which serves two of Google's data centers outside of Las Vegas and Reno. This in turn makes Nevada a new testbed for energy innovation and financing, given the use of a Clean Transition Tariff, a first-of-its-kind rate structure ↗. To execute the pilot, Fervo is bringing skilled scientific talent into the state and developing apprenticeship programs ↗ with neighboring Southern Utah University (home to a second Fervo project), which leads to knowledge spillovers and a stronger research ecosystem.

Relatedly, regional actors are working to leverage fast-track approvals for data centers as incentives for stronger economic development benefits. ComEd, a utility in Illinois,

for example, is working with the state, its economic development agency, and regulators to create a new tariff model ↗ where data center projects with an outsized economic development impact can get a fast pass for approval if that project has been formally designated by the Illinois Department of Commerce and Economic Opportunity or another unit of Illinois's state government. To participate, ComEd is requiring ↗ data centers to make higher deposits and to post collateral in case "loads and revenues do not materialize as planned." This approach creates a meaningful incentive for utilities, data centers, developers, and companies to develop activities that promote the emergence of regional AI hubs rather than isolated data center islands. For its part, Pennsylvania last year announced ↗ major data center deals and grid modernization efforts totaling $90 billion. However, the deals also enshrined the development of an AI-oriented regional cluster as a goal and sought concessions from the AI industry to support it. Quietly tucked into the announcement ↗ with President Donald Trump hosted by Carnegie Mellon University (CMU) were $2 million in commitments from Anthropic to provide cybersecurity education ↗ to middle and high school students in Pennsylvania and funding for energy research at CMU, which is increasingly becoming a nexus of AI, energy, and industrial innovation.

Conclusion: Summing up the shift

The standard model of data center siting—based on asymmetric face-offs, fraught battles over electricity, and questionable long-term economic benefits—may be giving way to an alternative model of at least partially shared gains for host regions.

Deals that have for years seen powerful tech firms set the terms almost unilaterally show signs of shifting. Stiffer competition among developers for limited land and harder-to-win approvals may be giving regions more leverage. Recognizing that, Big Tech and AI upstarts have dialed up their stories of corporate citizenship and a future world ↗ where AI is a "force multiplier" for local transformation and shared prosperity.

At the same time, more regions have been lifting their aspirations on economic development in recent years. They are focusing more on their own high-value industrial and technology development goals. They are seeking to build their own regional tech ecosystems on their own strengths and local industry specializations. As they do, more of them may be emboldened to ask the developers of data centers for

more: more electricity and water assurances, more engagement locally, much more high-value, high-tech economic development, and more workforce development.

In that vein, states and regions are beginning to remember that their land, approvals, infrastructure, water, and electricity are invaluable. As they do, they—and in time, industry actors—may well soon come to believe those important AI resources should be shared only as part of grand bargains that deliver true, high-value economic development to the regions that provide them.

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RESEARCH

Why community benefit agreements are necessary for data centers

Nicol Turner Lee and Darrell M. West

January 29, 2026

- → Data centers are crucial for AI, but protests have arisen throughout the U.S. over financial, energy, and environmental concerns as companies try to build more facilities.
- → AI companies can work closely with local leaders to establish community benefit agreements (CBAs), which can help address public concerns and provide greater benefits to communities impacted by data center construction.
- → Transparency and cooperation between firms, local institutions, and residents are essential to facilitate community input into CBAs, and for proposals to support residents' digital access, well-being, employment, and more.

Data centers are both controversial (https://www.brookings.edu/articles/the-future-of-data-centers/) and critical to the artificial intelligence technologies undergirding the digital economy. Data centers house thousands of file servers and networking equipment to enable e-commerce, data analytics, health care, and other functions of a connected society. Without abundant data centers, the digital revolution could potentially stall, restricting access to the benefits of digital technologies for individuals, communities, governments, and businesses.

Despite the crucial role of data centers in the emerging economy, protests ↗ have arisen throughout the country over financial, energy, and environmental concerns. Plans to build data centers have been stymied in Ohio ↗, Georgia ↗, Virginia ↗, Arizona

↗, and Indiana ↗ over worries about increases in electric bills, noise, and light pollution, and the possible dangers of AI itself. Public opinion surveys reveal a "techlash↗" where worries about AI's impact on jobs, privacy, security, and human safety combine to increase concerns about wealth accumulation and corporate power in the tech sector, forming a populist backlash. Voter worries have roiled recent elections in New Jersey ↗, Virginia↗, and Georgia ↗, where opposition to data centers was part of campaign promises. Left unchecked, these community concerns could slow down the rapid construction of data centers, weaken AI growth, and slow AI revenue streams, all of which would limit the AI benefits promised by tech firms and government officials.

In this report, we explain how AI companies can work more closely with local leaders to establish viable community benefit agreements ↗ (CBAs) to address public concerns. These agreements should be legally binding and developed collaboratively with host communities to demonstrate reciprocity between the developers of data centers and the communities in which they are housed. In particular, communities need to know the cost of data centers, understand who pays, examine local benefits and risks, and have back-up plans for the long-term evolution of AI.

A community benefit agreement for data centers should include quantifiable data on the job opportunities, tax revenue, workforce training programs, health and well-being contributions, and other benefits of proposed facilities. Combined with metric tracking and rigorous evaluation programs, CBAs can mitigate community concerns and help community leaders and residents achieve a better understanding of how data centers function and affect local areas. They can also ensure that the process involves mutual respect among all parties.

WHAT ARE COMMUNITY BENEFIT AGREEMENTS?

Community benefit agreements ↗ are formal documents that spell out the costs and benefits of data centers for specific communities and detail areas for cooperation. CBAs should be an important part of the community negotiation process with AI companies and explicate the building and operating costs, among other factors of interest to residents and government leaders. CBAs should be transparent and publicly available to help residents not involved in community discussions better understand

what is happening in the pre- and post-construction phases. Negotiated as formal contracts, they should be subject to legal safeguards and provide communities with a way to anticipate potential problems and address them before construction begins.

In an earlier paper (https://www.brookings.edu/articles/the-future-of-data-centers/), we outlined growing local concerns about data centers. Residents complain about various issues, from electric rates and water usage to noise and light pollution. People can see the large scale of such developments–which often are the size of several football fields or more–and fear the facilities will overwhelm local resources and subject communities to long-term financial and environmental degradation.

Some contracts are heavily redacted such that key sections are hidden from the public. The redactions involve energy requirements, water usage, cost-sharing, and infrastructure enhancements. Full transparency is important to keep local communities well-informed, so they have a realistic sense of how data centers will affect their areas, and for companies to avert complete resistance to new construction.

A few organizations have examined what should be part of CBAs. The Sabin Center for Climate Change Law at Columbia University published a best practices guide for clean energy infrastructure projects. While not limited to data centers, it argues that local communities can be aided by direct payments, a community fund, hazard monitoring, and requirements for local labor. The NAACP also developed a framework for improving community transparency, engagement, and investment, which is helpful to evaluate data center impact and potential local benefits. In the end, communities, government, and AI companies should have a path toward open dialogue to determine how to best leverage data centers and ways to extract the greatest value in accordance with those conversations.

DIFFERENT TYPES OF AGREEMENTS

Communities across the United States have begun to develop various types of community benefit agreements. For example, the city of Cleveland has used CBAs since 2013 for a variety of economic development projects. It distinguishes between

"standard" agreements, covering projects under $20 million in business investment, and "expanded" ones for more expensive projects. Developers are required to specify hiring targets, meet low-income employment goals, and create mentorships, apprenticeships, and internships, with additional commitments for large-scale projects.

Lancaster, Pennsylvania, developed more focused CBAs for data centers. Chirisa Technology Parks wanted to develop a 450,000 square-foot data center and had a $6 billion commitment from cloud provider CoreWeave. Local officials then worked with business officials to negotiate an agreement that they thought would facilitate the project while helping the community. The discussions took several months but ultimately generated a written contract that restricted water usage to 20,000 gallons a day, established reliance upon clean energy, and set strict noise levels, among other provisions.

Officials in Cedar Rapids, Iowa, negotiated a "community betterment" agreement with Google and QTS. The contract provided a "20-year, 70 percent tax exemption, as long as the project meets the job threshold of at least 31 full-time positions at a high-quality wage rate of at least $26.20 per hour after construction." City officials touted the data center's economic development benefits along with the job and wage guarantees as vital for the locale's future. Google agreed to pay the city "$400,000 for the next 15 years," while QTS provided "$18 million over the next 18 years."

Leaders in West Des Moines, Iowa, negotiated an agreement with Microsoft to build several data centers there in return for benefits of interest to that community. The firm will rely completely upon renewable energy sources, such as wind power, and its data centers will generate over $2 billion in tax revenues. The facilities have also created at least 3,000 construction jobs and 400 permanent positions.

Officials in northern Indiana announced plans for a $15-billion investment by Amazon to build data centers there. As part of the agreement, the company committed to creating 1,100 new positions, supporting infrastructure improvements with local utilities, and developing STEM learning opportunities for K-12 schools in the area.

El Paso, Texas, leaders negotiated an agreement with Meta to develop a $1.5-billion data center in return for an 80% abatement of property taxes over 35 years. As part of the plan, the company specified its water usage starting at an average of 750,000 gallons per day and said it would deploy a closed-loop cooling system that would recycle water instead of using more local resources. Meta promised to publish a sustainability report each year that would detail its water and electricity usage and indicated it planned to employ 1,800 construction workers and 100 operating employees at the facility.

KEY FEATURES OF BENEFIT AGREEMENTS

Several key features stand out in these agreements, including transparency, affordability, and sustainability for communities. These manifest in firms making direct payments, creating community funds, and delineating tax revenues, and affect issues such as infrastructure improvements, construction and operating jobs, electric rates, water usage, noise levels, light pollution, workforce training, health and well-being services, digital access for the underserved, and public dashboards with key metrics.

Taken together, these agreements address key community concerns and explain how companies will deal with those matters. While some AI companies prefer more behind-the-scenes negotiations, CBAs should not be subject to non-disclosure agreements because transparency is core to determining and understanding both the costs and benefits. Failure to deliver upon key commitments can form the basis of lawsuits, civil actions, or government penalties. One proposal calls for fines of up to $50,000/day for "willful violations" of specified agreements. Explanations on the other themes are below.

Direct payments or community funds

Companies can help communities by making direct payments or establishing community funds that local leaders can use for high-priority projects outside of data centers. Much of the enticement for data centers has to do with the projected tax revenues for states and localities. Most communities are under financial stress due to a slowing economy and sometimes unsteady federal support for local initiatives. Direct

payments or community-directed funds can provide local leaders with some flexibility to invest in areas that are not well-covered by other sources.

A proposal entitled the "Community-Integrated AI & Data Center Development Act" calls for the creation of a community investment fund ↗ that would be financed by an "annual contribution equal to at least 0.5% of gross revenue to a locally administered fund for infrastructure, education, or public services." The goal is to ensure that data center developers contribute to local communities at a level commensurate with their revenue streams to help localities address projected concerns related to their activities or other areas in need of critical resources.

Tax revenues

Tax revenues are a primary driver for localities approving data center deals. However, the potential of tax revenue from data centers is only realized once the business is up and running. For this reason, CBAs should provide realistic projections of expected tax revenues and have some commitment by AI companies to commit revenue, also in the case of an AI bubble (https://www.brookings.edu/articles/is-there-an-ai-bubble/) occurring. Further, tax assessments should include the tax revenues minus any tax abatement incentives offered to developers and operators who, in many states, are receiving substantial tax discounts to build in certain communities.

Most large-scale projects compile data on expected taxes based on their level of economic activity and business operations. Developers commission expert assessments of expected tax revenues. These projections, along with the models used to estimate them, should be made public so residents can see how these developments may benefit their community. This process can also help residents examine whether the projections are realistic, since many economic development projects overestimate the expected revenues to win community support. Every community considering a data center needs to ensure that the government is engaging in careful consideration of the tax benefits, as well as drawbacks, as part of the negotiations.

Officials should also be careful about how they negotiate tax abatements, as one key aspect is the length of the tax exemption ↗. Agreements can range from 10 to 50 years

and have different trigger points. Leaders should tie abatements to the number of jobs created or the amount of tax revenue generated. Having abatements that last too long or are not directly linked to job creation and retention likely would be risky because the abatement may outlast the functioning of particular data centers. Nothing would be worse for communities than having a decommissioned data center that generates little tax revenue yet still receives tax exemptions.

One firm announced ↗ it will not seek reductions in property tax rates from local communities in exchange for building data centers in those areas. It says it will add to local tax bases ↗ and thereby help those locales pay for vital municipal services.

Data center location and infrastructure improvements

Some data center projects require rezoning and infrastructure improvements to roads, bridges, power grids, or water treatment plants. Land use is a contentious issue in many areas, and land acquisition needs to be in accordance with local zoning requirements and economic development plans. When possible, data centers can be located in industrial corridors or away from residential areas.

The CBAs should outline how rezoning requests are handled, what infrastructure improvements are required, who is going to pay, expected benefits in terms of local usage, longer-term economic benefits, and how the infrastructure improvements would aid local communities. These are particularly compelling points for communities to consider, especially those that are in need of general infrastructure improvements, including outdated electricity grids or eroded irrigation systems. Data center development projects could provide a means to secure funding or technological support for needed ventures, working with other federal agencies now committed to infrastructure modernization. Another way AI companies can help is to provide free hardware or software for power grid or water treatment improvements, which are tenets of improved infrastructure in the digital age. Since most power transmission lines are over 25 years old ↗, power grid improvements will probably be a long time in the works. However, AI companies, alongside community leaders, residents, and local businesses, should be part of the broad solution for infrastructure improvements.

Exit fees↗ could also be negotiated for situations where a data center might close or the project faces some risk of collapsing. If left unchecked, utility companies or grid operators could be stranded and left holding the financial bag if data center projects do not start or close after a few years. Communities can protect themselves by specifying exit fees that get charged to data center developers when projects don't operate for the agreed-upon length of time. As far as real estate acquisition, communities can also negotiate how the space could be repurposed to avoid empty data centers, especially in states with huge clusters of physical facilities. For example, communities should be asking themselves if an abandoned data center can be repurposed as a community asset, including a youth center or incubator for aspiring tech entrepreneurs.

Construction and operating jobs

Community benefit agreements should enumerate the number of construction and operating jobs from pre-construction and construction to post-building development. For example, Meta's $1 billion data center in Kansas City generated around 1,500 construction jobs as compared to 100 operations jobs when the data center was fully functional. Well-designed benefit agreements can tie tax abatements to the specific number of jobs a project creates. They can also require there be no worker layoffs↗ during the course of the abatement, on top of provisions that mandate workers can join unions, make no less than $20/hour, or be paid a living wage appropriate for that locale. Good-paying jobs are vital for every community; local leaders can use these agreements to specify what they want and make sure companies follow up on their commitments. Failure to meet specified targets would subject companies to fines or civil action.

In this area, communities can encourage the use of local trades professionals, from plumbers to electricians. Having a commitment to hire locally can ensure that, in the absence of new jobs, place-based enterprises are supported. Where local trades professionals are not available, the community can consider working with their state workforce office to determine regional talent availability and ensure that compensation stays within the general community, or at least close to it.

Electricity rate coverage

One of the biggest public concerns about data centers is their impact on electricity rates. These rates have increased in various places across the country, leading people to request more detailed information from AI companies, elected and appointed officials, public utility commissions, and their energy providers. Many factors contribute to rising electricity rates, such as inflation, tariffs, the cost of energy generation, aging power lines, government regulations, and environmental compliance. For residents, the key issue is whether they will bear higher electricity costs linked to nearby data centers, particularly when states have offered discounted rates to attract those facilities.

It is very difficult to pinpoint what portion of the rising costs is attributable to data centers. In looking at electricity rate increases from 2019 to 2024, a study undertaken by the Lawrence Berkeley National Laboratory argued that a considerable amount of the rise was due to the costs of improving electrical wires and poles, as well as "wildfires, storms, and natural gas exposure." In addition, research by energy consulting company Energy +Environmental Economics found that "data centers generate sufficient revenue to cover their costs and, in many instances, generated surplus revenue, providing a potential net benefit to other ratepayers."

In their benefit agreements, companies should explain how they plan to meet the cooling and heating needs of data centers and what costs they will bear as opposed to what they expect from local utility companies. Several firms already engage in some type of cost-sharing, but the level varies from state to state. The Public Utilities Commission of Ohio recently passed a measure "requiring large new data center customers to pay for a minimum of 85% of their subscribed electricity usage–regardless of actual consumption–for up to 12 years." Other companies are utilizing colocation energy sources found near their data centers to provide power for those facilities.

Water usage

Water utilization is an important consideration in data centers. As our Brookings colleague Joe Kane has noted, data centers can require considerable amounts of water (https://www.brookings.edu/articles/ai-data-centers-and-water/) . Water is a scarce resource in many parts of the U.S., and CBAs need to outline data center needs, how their consumption could affect other businesses, and the impact on

residents. Local officials need to make sure that water will be available for all other activities and priorities. In instances where the irrigation system is eroded, AI companies should work with local communities to mitigate the challenges and partner on projects that address waning water usage. They should also deploy closed-loop cooling systems↗ that reduce water utilization over evaporation models.

Noise levels and light pollution

Because cooling units are often located on the top or sides of data centers, these facilities can be noisy and disruptive to those who live nearby. Residents in several areas have complained about high noise levels as well as light pollution. Due to security concerns, most data centers are very well lit to make sure their physical perimeter is well-protected and the electronic equipment is not harmed. Companies need to specify what the projected noise and light levels are, what the impact might be on nearby homes and businesses, and what they plan to do to mitigate nuisances to local inhabitants. AI companies should submit to noise and pollutant studies, so communities have a broad and transparent understanding of these issues.

Environmental hazard monitoring

Companies can help local communities monitor environmental hazards by setting up appropriate testing and measurement tools as well as engaging in site reviews that ensure compliance with state and local laws. This will enable appropriate tracking of air and water contaminants and make sure data centers are not contributing to problems associated with these risk factors. Such reviews should also be done after construction, once the data center is fully operational. By taking a proactive stance on environmental hazards, firms can help communities deal with these matters and assuage residents that their concerns are taken seriously.

AI companies will face a key challenge related to environmental remediation: The federal charge to expedite and possibly override environmental compliance. President Trump's AI Action Plan ↗ details these actions, which could encourage companies and states to pursue faster timelines for building and opening data centers. Environmental hazard monitoring should not be compromised–or pose threats to data center

development. Leaders must establish clear baselines for monitoring potential environmental impacts while assuring communities against public health threats.

Workforce training

Assessing the job creation and workforce development gains of data centers is crucial to their success. Many communities are suffering from shortages of electricians, welders, pipefitters, plumbers, and other trades workers. Since locales need them to construct data centers, companies can train these individuals to work on their facilities while increasing the local supply of workers in the trades. Having requirements for businesses to rely on local labor would help communities develop their own talent and create a pool of workers that would benefit the entire area. To go further, AI companies could collaborate with community colleges to invest in their trades curriculum and use AI-enabled content for licensing and recertification of existing trades workers.

As noted in the Cleveland example ↗, benefit agreements can create apprenticeships, internships, and mentorships to establish career paths for young people. Youth unemployment is more than double ↗ the national level in the United States, and with the advent of AI and emerging technologies, entry-level jobs are at risk. Companies can mitigate some of these barriers by developing programs that help young workers, create pathways to employment, and possibly lead to working in one of the more lucrative technology jobs at the local data center.

Recently, Microsoft launched a TechSpark program ↗ that provides professional development opportunities for local communities, and other firms have launched similar initiatives. Microsoft has trained 34,600 individuals in 46 communities over the past two years, offering one example of how companies can enable residents to benefit from the digital economy.

Health and well-being services

Many have compared the data center boom to coal mining, which had a plethora of long-term adverse impacts on the health and well-being of workers and residents, some of which are still being mitigated ↗ in coal states like West Virginia. Although

many environmental concerns are often treated as pre-construction issues, companies should remain committed to the long-term health and well-being of communities affected by data centers.

CBAs should specify how firms will support local communities, including by sponsoring annual wellness days or improving local health departments' capacity to use AI-powered health dashboards. Most cities already have mobile health outreach programs, and companies could provide financial support for these services. Given that health and scientific discovery are among the more significant reasons for increased data center development, it makes sense for AI companies to get more involved in supporting the well-being of residents and ensuring that data centers enable high-compute advances in health.

Digital access for the underserved

As Nicol Turner Lee has noted in her book "Digitally Invisible: How the Internet is Creating a New Underclass (https://www.brookings.edu/books/digitally-invisible/)," digital access remains a challenge in several communities across America. Up to 22% ↗ of Americans lack broadband access at home, and many others suffer from low broadband speeds; these families may not be able to benefit from AI in areas that improve quality of life, including health, education, finance, and employment.

A community investment fund can include money to support digital access. For example, a data center developer in Huntsville, Alabama, worked with local leaders on projects that "spurred broadband expansions ↗ that improved internet access for rural residents." In that case, the community leveraged data center development to expand digital access and extend broadband services to underserved areas. To further support AI adoption, companies can work with national and community-based organizations to improve AI literacy and advance AI applications in education and health care. It is imperative that these plans extend beyond the construction phase to ensure that data center investments leave lasting improvements in community connectivity and awareness.

Public dashboard tracking key metrics

To make sure communities have the information they need to evaluate data center impact, community benefit agreements should include a public dashboard that tracks key metrics, such as job creation, tax revenues, electricity utilization, water usage, and workforce development. These dashboards could be hosted on town, county, and city websites to ensure accountability for data center developers and allow officials, residents, and reporters to determine whether data centers meet their stated goals.

These areas could form the basis of a CBA template that includes challenges for government, community, and industry stakeholders to solve together. The formation of a community advisory board could also be useful in managing these projects from conceptualization to implementation.

CONCLUSION

The data center boom is just underway. Companies are justifying it because these facilities are the backbone of AI and other emerging technologies. Public fears have weakened and, in some instances, stalled support for data center construction and operations.

This paper is intended to address the list of public concerns and play a critical role in finding ways for the various stakeholders to work toward more consensus and compromise. State and local leaders should consider this list when negotiating or searching for ways to engage their constituents in productive conversations on proposals.

Well-crafted community benefit agreements can address public concerns and mitigate known problems of data centers. This includes enumerating the costs and benefits of these facilities and making clear what local communities should expect in terms of corporate support, government investment, and community engagement. Greater transparency on each of these fronts would help assuage the worries of the American public.

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From the Office of the President & CEO

Fiber Broadband Association
3050 K Street NW, Suite 400
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January 21, 2026

The Honorable Roger Williams
Chair
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U.S. House of Representatives
Washington, DC 20515

The Honorable Nydia Velázquez
Ranking Member
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Washington, DC 20515

The Honorable Jake Ellzey
Chair
Subcommittee on Rural Development, Energy, and Supply Chains
Committee on Small Business
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The Honorable Kelly Morrison
Ranking Member
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Committee on Small Business
U.S. House of Representatives
Washington, DC 20515

Re: Letter for the Record, January 21, 2026, Subcommittee Hearing: "*Empowering Rural America Through Investment in Innovation*"

Dear Chairs Williams and Ellzey and Ranking Members Velázquez and Morrison,

The **Fiber Broadband Association (FBA)** is the nation's largest and only trade association representing the full fiber broadband ecosystem, including service providers, manufacturers, industry experts, and deployment specialists. FBA appreciates the Subcommittee's focus on how investment in innovation can strengthen rural economies. For rural small businesses, access to modern, high-capacity broadband infrastructure increasingly determines whether innovation is possible at all. As essential services move online and technologies such as artificial intelligence (AI) reshape commerce, agriculture, health care, and education, **reliable fiber connectivity is no longer optional – it is a prerequisite for economic participation, and U.S. competitiveness.**

For rural communities, the stakes are significant. As AI becomes foundational to both the economy and national security, data computation and high throughput reliable communications capacity are central to economic competitiveness. Fiber is the only broadband infrastructure capable of meeting the bandwidth, latency, and reliability requirements of advanced computing at scale. It is physically superior to all other methods of transmission technologies and remains the only scalable pathway for transporting the massive volumes of data required by AI systems. Even the most advanced semiconductors, power generation, and cloud architecture cannot deliver their full economic value without sufficient underlying

connectivity. Simply put, **AI cannot scale without fiber, and U.S. leadership in AI depends on the strength and reach of America's fiber networks**.[1]

This reliance is becoming increasingly evident as AI-driven data centers place unprecedented demands on national infrastructure. Facilities optimized for Large Language Models (LLMs) require dramatically higher optical connectivity – often several times greater than traditional hyperscale data centers. While urban data center markets face growing constraints related to land availability, power access, and construction timelines, fiber remains the most scalable input. Without accelerated fiber deployment, the United States risks creating a structural bottleneck that slows AI development, increases costs, and widens geographic disparities in who benefits from the innovation economy.[2]

At the same time, **this challenge presents a significant opportunity for rural America**. Rural broadband providers and electric cooperatives already possess many of the assets needed to support distributed computing, including extensive fiber routes, accessible land, established power relationships, and deep community trust. These strengths position rural providers as valuable partners in expanding national digital capacity, particularly as the growing data-processing demands require more distributed and resilient infrastructure across regions. Leveraging existing rural infrastructure allows new facilities and technology upgrades to be deployed more efficiently, creating stable revenue opportunities for rural providers while strengthening the resilience of the nation's broader technological ecosystem.[3]

The benefits of fiber deployment extend well beyond infrastructure. High-capacity, symmetrical fiber networks improve quality of life and economic performance in rural communities by enabling reliable access to telehealth, remote education, cloud-based services, precision agriculture, and AI-enabled workforce training. The economic evidence is clear: rural communities with high broadband adoption consistently outperform those with limited access. Studies shows that rural counties with robust broadband use experience more than **200 percent higher business growth, 44 percent higher GDP growth, and 18 percent higher per-capita income growth** than similarly situated counties with low adoption.[4] These communities also see higher rates of self-employment, reflecting broadband's role in lowering barriers to entrepreneurship and expanding market access for small businesses. In Beltrami County, Minnesota, for example, near universal fiber access has supported rapid business expansion,

[1] Cresse, P. (2025, February). *Accelerating AI With Fiber: Systems and Strategies*. Fiber Broadband Association

[2] *Id*

[3] Fiber Broadband Association Middle Mile Working Group. (2025, November). *Opportunities for Rural Providers in the Age of Distributed AI and Edge Compute*.

[4] Weinstein, A., Erouart, M., & Dewbury, A. (2025, May). *Beyond Connectivity: The Role of Broadband in Rural Economic Growth and Resilience*. Center on Rural Innovation, at 3.

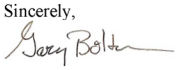
including one aviation manufacturer that grew from $400,000 to $4 million in annual revenue, while the broader local economy outperformed state and national trends. Conversely, communities lacking adequate broadband infrastructure experience higher business closures, job losses, population decline, and long-term economic stagnation.[5]

The policy implications are clear. If Congress seeks to support rural innovation, small business growth, and workforce opportunity, it must ensure that fiber deployment keeps pace with national demand. This includes permitting reform, streamlined access to rights-of-way and public lands, capital-friendly deployment policies, and modern investment frameworks that provide regulatory certainty and support long-term infrastructure financing. The scale of the challenge is substancial: by 2029, the U.S. is projected to required nearly twice the amount of long-haul fiber mileage currently deployed to support anticipated AI demand. [6] Meeting this need will require intentional policy choices, predictable funding environments, and a regulatory approach aligned with the realities of AI-era infrastructure.

FBA urges the Subcommittee to recognize that **fiber policy is economic policy, rural policy, and AI policy**. Strategic investment in fiber accelerates small business competitiveness, strengthens supply chains, expands workforce participation, reduces geographic inequality, and ensures that rural communities are not left behind as AI becomes central to American innovation. Rural America has the assets, expertise, and willingness to lead – but it requires infrastructure that match that ambition.

Thank you for the opportunity to submit this testimony for the record and for the Subcommittee and Full Committee's continued commitment to ensuring that the benefits of American innovation reach every community.

Sincerely,



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[5] *Id.*

[6] Fiber Broadband Association. (2025, June). *The Underappreciated Need to Enable AI and Data Center Growth: Increased and More Strategic Fiber Interconnections*.


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Executive Summary—Levelized Cost of Energy Version 17.0[1]

The results of our Levelized Cost of Energy ("LCOE") analysis reinforce what we observe across the Power, Energy & Infrastructure Industry—sizable and well-capitalized companies that can take advantage of supply chain and other economies of scale, and that have strong balance sheet support to weather fluctuations in the macro environment, will continue leading the build-out of new renewable energy assets. This is particularly true in a rising LCOE environment like what we have observed in this year's analysis. Amplifying this observation, and not overtly covered in our report, are the complexities related to currently observed demand growth and grid-related constraints, among other factors. Key takeaways from Version 17.0 of Lazard's LCOE include:

1. Low End LCOE Values Increase; Overall Ranges Tighten

   Despite high end LCOE declines for selected renewable energy technologies, the low ends of our LCOE have increased for the first time ever, driven by the persistence of certain cost pressures (e.g., high interest rates, etc.). These two phenomena result in tighter LCOE ranges (offsetting the significant range expansion observed last year) and relatively stable LCOE averages year-over-year. The persistence of elevated costs continues to reinforce the central theme noted above—sizable and well-capitalized companies that can take advantage of supply chain and other economies of scale, and that have strong balance sheet support to weather fluctuations in the macro environment, will continue leading the build-out of new renewable energy assets.

2. Baseload Power Needs Will Require Diverse Generation Fleets

   Despite the sustained cost-competitiveness of renewable energy technologies, diverse generation fleets will be required to meet baseload power needs over the long term. This is particularly evident in today's increasing power demand environment driven by, among other things, the rapid growth of artificial intelligence, data center deployment, reindustrialization, onshoring and electrification. As electricity generation from intermittent renewables increases, the timing imbalance between peak customer demand and renewable energy production is exacerbated. As such, the optimal solution for many regions is to complement new renewable energy technologies with a "firming" resource such as energy storage or new/existing and fully dispatchable generation technologies (of which CCGTs remain the most prevalent). This observation is reinforced by the results of this year's marginal cost analysis, which shows an increasing price competitiveness of existing gas-fired generation as compared to new-build renewable energy technologies. As such, and as has been noted in our historic reports, the LCOE is just the starting point for resource planning and has always reinforced the need for a diversity of energy resources, including but not limited to renewable energy.

3. Innovation Is Critical to the Energy Transition

   Continuous innovation across technology, capital formation and policy is required to fully enable the Energy Transition, which we define to include a generation mix that is diverse and advanced enough to meet the ongoing reshaping of our energy economy. The Energy Transition will also require continued maturation of selected technologies not included in our analysis (e.g., carbon capture, utilization and sequestration ("CCUS"), long duration energy storage, new nuclear technologies, etc.). While the results of this year's LCOE reinforce our previous conclusions—the cost-competitiveness of renewables will lead to the continued displacement of conventional generation and an evolving energy mix—the timing of such displacement and composition of such mix will be impacted by many factors, including those outside of the scope of our LCOE (e.g., grid investment, permitting reform, transmission queue reform, economic policy, continued advancement of flexible load and locally sited generation, etc.).

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(1) This analysis has been compiled using U.S.-focused data.

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Executive Summary—Levelized Cost of Storage Version 9.0[1]

The results of our Levelized Cost of Storage ("LCOS") analysis reinforce what we observe across the Power, Energy & Infrastructure Industry—energy storage system ("ESS") applications are becoming more valuable, well understood and, by extension, widespread as grid operators begin adopting methodologies to value these resources leading to increased transaction activity and infrastructure classification for the ESS asset class. Key takeaways from Version 9.0 of Lazard's LCOS include:

1. Increased LCOS Variability

   While we saw incremental declines in the low end LCOS as compared to last year's analysis, the high end increased more noticeably, resulting in a wider range of LCOS outcomes across the operational parameters analyzed. The decline on the low end was, in part, driven by a noticeable decline in cell prices resulting from increased manufacturing capacity in China and decreased mineral pricing. However, this was offset by significant increases in engineering, procurement and construction ("EPC") pricing driven, in part, by high demand, increased timeline scrutiny, skilled labor shortages and prevailing wage requirements. Also notable is the increased impact of economies of scale benefits in procurement, mirroring the observations we have seen in the LCOE in recent years.

2. The Power of the IRA Is Clear

   Despite the significant increases in wholesale pricing for lithium carbonate and lithium hydroxide observed from 2022 to 2023, the IRA's grant of ITC eligibility for standalone ESS assets kept LCOS v8.0 values relatively neutral as compared to LCOS v7.0. One year later, for this year's LCOS v9.0, ITC implementation, including the application of energy community adders, is fully underway and the impacts are clear. The ITC, along with lower cell pricing and technology improvements, is leading to an increasing trend of oversizing battery capacity to offset future degradation and useful life considerations, which is not only extending useful life expectations but is also increasing residual value and overall project returns. While the ITC and energy community adder are prevalent, the domestic content adder remains uncertain, notwithstanding the various domestic manufacturing announcements. The lack of clarity related to qualifying for local content is leading to longer lead times and higher contingencies. Adding to this overall complexity is the recently proposed increase of Section 301 import tariffs on lithium-ion batteries, which many believe will lead to increased domestic battery supply but with uncertain costs results.

3. Lithium-Ion Batteries Remain Dominant

   Lithium-ion batteries remain the most cost competitive short-term (i.e., 2 – 4-hour) storage technology, given, among other things, a mature supply chain and global market demand. Lithium-ion, however, is not without its challenges. For example, safety remains a concern for utilities and commercial & industrial owners, particularly in urban areas, and longer-duration lithium-ion use cases can have challenging economic profiles. As such, industry participants have started progressing non-lithium-based technology solutions, including for longer-duration use cases and applications. Such technologies are targeting new market segments, including industrial applications, data center deployments and ultra-long duration applications in regions with high penetration of intermittent renewable energy. However, the development of long duration energy storage still requires clear demonstration of the commercial operation of these technologies, market maturation (including the development of stronger incentives for long duration projects that could capture capacity revenues in merchant and bilateral markets) and manufacturing scale to realize (long-promised) cost reductions, all resulting in greater willingness of insurance and financing participants to underwrite these projects.

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Executive Summary—Levelized Cost of Hydrogen Version 4.0[1]

Hydrogen continues to be regarded as a potential solution for industrial processes that will be difficult to decarbonize through other existing technologies or alternatives. Hydrogen production in the U.S. primarily comes from fossil fuels through steam-methane reforming ("SMR") and methane splitting processes resulting in "gray" hydrogen. The cost of the equipment (i.e., the "electrolyzer") and the source of the electricity (i.e., wind- and solar-derived electricity for "green" hydrogen, nuclear-derived electricity for "pink" hydrogen, etc.) continue to have the greatest impact on the levelized cost of hydrogen production. Key takeaways from Version 4.0 of Lazard's Levelized Cost of Hydrogen ("LCOH") analysis include:

1. A Maturing Industry Drives Declining Costs

   Observable declines in the results of our LCOH analysis indicate that the hydrogen electrolyzer industry is continuing to mature and will likely scale over time. Proton Exchange Membrane ("PEM") and Alkaline electrolyzers are the dominant technologies, but their higher costs relative to currently available alternatives (e.g., renewables + BESS, dispatchable gas-fired generation, etc.) hinder significant market expansion. Notably, there is a considerable price disparity across the market for electrolyzer equipment, which would be more overtly pronounced had this report included electrolyzers manufactured in China given the significantly lower price expectations. Despite this price disparity, Western-supplied electrolyzers and related equipment remain competitive given the greater level of performance validation and freedom from the potential risks of tariff and trade implications.

2. Uncertainty Around IRA Implementation

   Implementation challenges for hydrogen projects vary dramatically by markets and use cases. In the U.S., project developers are waiting for final guidance from the Treasury Department on the IRA 45(V) tax credit to provide clarity on which projects qualify for the production subsidy (up to $3 per kilogram of hydrogen). A key concern for project developers is how the production costs for green hydrogen will be impacted by hourly matching requirements which would stipulate that renewable power production must occur in the same hour as hydrogen production. Hourly matching requirements would likely lead to an increase in the results of our LCOH due to higher renewable power development costs and lower electrolyzer utilization rates. Final guidance from the Treasury Department may impact the competitiveness and adoption rate for green hydrogen relative to alternatives such as "blue" hydrogen (i.e., hydrogen produced from fossil fuels with CCUS).

3. Use Case Analysis Is Critical

   While the scope of our LCOH remains focused on the cost of production, we plan to broaden the LCOH in the coming years to evaluate various use cases (similar to the expansion of our LCOS analysis and the related "Value Snapshots"). We continue to see growing interest from key hydrogen off-takers in the chemicals industry (e.g., ammonia for use in fertilizer) and demand is expected to continue increasing for fuels produced from clean hydrogen to help decarbonize transportation sectors (e.g., maritime). In addition, several companies in hard-to-abate industrial sectors (e.g., steel, construction materials, etc.) are considering hydrogen as an alternative to fossil fuels for some heat-generating applications. Although the technology is broadly available, using hydrogen for power generation (or blending it with natural gas) will likely require capital-intensive upgrades to current generation assets, storage facilities and pipelines to protect the legacy infrastructure and avoid leakages.

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Introduction

Lazard's Levelized Cost of Energy analysis addresses the following topics:

- Comparative LCOE analysis for various generation technologies on a $/MWh basis, including sensitivities for U.S. federal tax subsidies, fuel prices, carbon pricing and cost of capital
- Illustration of how the LCOE of onshore wind, utility-scale solar and hybrid projects compare to the marginal cost of selected conventional generation technologies
- Illustration of how the LCOE of onshore wind, utility-scale solar and hybrid projects, plus the cost of firming intermittency in various regions, compares to the LCOE of selected conventional generation technologies
- Historical LCOE comparison of various technologies
- Illustration of the historical LCOE declines for onshore wind and utility-scale solar
- Appendix materials, including:
  - Deconstruction of the LCOE for various generation technologies by capital cost, fixed operations and maintenance ("O&M") expense, variable O&M expense and fuel cost
  - An overview of the methodology utilized to prepare Lazard's LCOE analysis
  - A summary of the assumptions utilized in Lazard's LCOE analysis

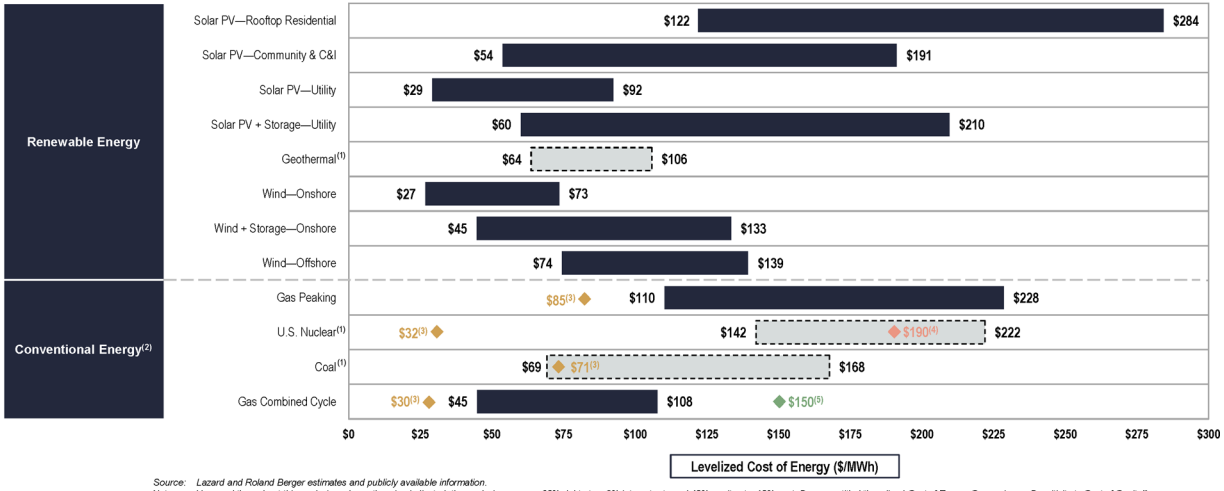
Other factors would also have a potentially significant effect on the results contained herein, but have not been examined in the scope of this current analysis. These additional factors, among others, may include: implementation and interpretation of the full scope of the IRA; economic policy, transmission queue reform, network upgrades and other transmission matters, congestion, curtailment or other integration-related costs; permitting or other development costs, unless otherwise noted; and costs of complying with various environmental regulations (e.g., carbon emissions offsets or emissions control systems). This analysis is intended to represent a snapshot in time and utilizes a wide, but not exhaustive, sample set of Industry data. As such, we recognize and acknowledge the likelihood of results outside of our ranges. Therefore, this analysis is not a forecasting tool and should not be used as such, given the complexities of our evolving Industry, grid and resource needs. Except as illustratively sensitized herein, this analysis does not consider the intermittent nature of selected renewables energy technologies or the related grid impacts of incremental renewable energy deployment. This analysis also does not address potential social and environmental externalities, including, for example, the social costs and rate consequences for those who cannot afford distributed generation solutions, as well as the long-term residual and societal consequences of various conventional generation technologies that are difficult to measure (e.g., airborne pollutants, greenhouse gases, etc.)

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Levelized Cost of Energy Comparison—Version 17.0

Selected renewable energy generation technologies remain cost-competitive with conventional generation technologies under certain circumstances



Source: *Lazard and Roland Berger estimates and publicly available information.*

Note: Here and throughout this analysis, unless otherwise indicated, the analysis assumes 60% debt at an 8% interest rate and 40% equity at a 12% cost. See page titled "Levelized Cost of Energy Comparison—Sensitivity to Cost of Capital" for cost of capital sensitivities.

(1) Given the limited public and/or observable data available for new-build geothermal, coal and nuclear projects the LCOE presented herein reflects Lazard's LCOE v14.0 results adjusted for inflation and, for nuclear, are based on then-estimated costs of the Vogtle Plant. Coal LCOE does not include cost of transportation and storage.

(2) The fuel cost assumptions for Lazard's LCOE analysis of gas-fired generation, coal-fired generation and nuclear generation resources are $3.45/MMBTU, $1.47/MMBTU and $0.85/MMBTU respectively, for year-over-year comparison purposes. See page titled "Levelized Cost of Energy Comparison—Sensitivity to Fuel Prices" for fuel price sensitivities.

(3) Reflects the average of the high and low LCOE marginal cost of operating fully depreciated gas peaking, gas combined cycle, coal and nuclear facilities, inclusive of decommissioning costs for nuclear facilities. Analysis assumes that the salvage value for a decommissioned gas or coal asset is equivalent to its decommissioning and site restoration costs. Inputs are derived from a benchmark of operating gas, coal and nuclear assets across the U.S. Capacity factors, fuel, variable and fixed operating expenses are based on upper- and lower-quartile estimates derived from Lazard's research. See page titled "Levelized Cost of Energy Comparison—New Build Renewable Energy vs. Marginal Cost of Existing Conventional Generation" for additional details.

(4) Represents the illustrative midpoint LCOE for Vogtle nuclear plant units 3 and 4 based on publicly available estimates. Total operating capacity of ~2.2 GW, total capital cost of ~$31.5 billion, capacity factor of ~97%, operating life of 60 – 80 years and other operating parameters estimated by Lazard's LCOE v14.0 results adjusted for inflation. See Appendix for more details.

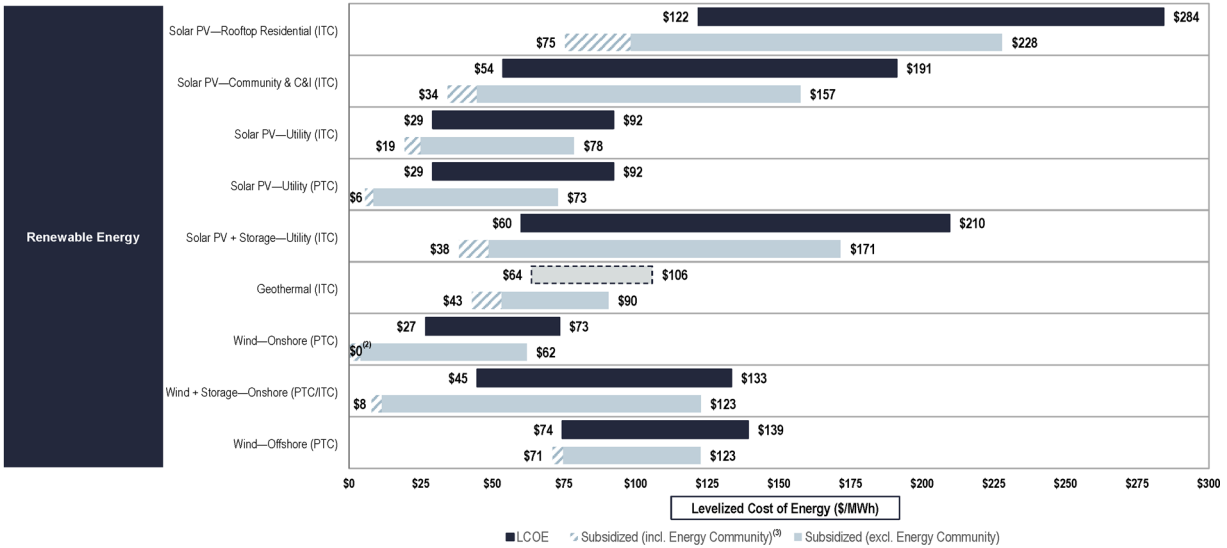
(5) Reflects the LCOE of the observed high case gas combined cycle inputs using a 20% blend of green hydrogen by volume (i.e., hydrogen produced from an electrolyzer powered by a mix of wind and solar generation and stored in a nearby salt cavern). No plant modifications are assumed beyond a 2% increase to the plant's heat rate. The corresponding fuel cost is $6.66/MMBTU, assuming ~$5.25/kg for green hydrogen (unsubsidized PEM). See LCOH—Version 4.0 for additional information.

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Levelized Cost of Energy Comparison—Sensitivity to U.S. Federal Tax Subsidies(1)

The Investment Tax Credit ("ITC"), Production Tax Credit ("PTC") and Energy Community adder, among other provisions in the IRA, are important components of the LCOE for renewable energy technologies



Source: *Lazard and Roland Berger estimates and publicly available information.*

Note: Unless otherwise indicated, this analysis does not include other state or federal subsidies (e.g., domestic content adder, etc.). The IRA is comprehensive legislation that is still being implemented and remains subject to interpretation—important elements of the IRA are not included in our analysis and could impact outcomes.

(1) This sensitivity analysis assumes that projects qualify for the full ITC/PTC, have a capital structure that includes sponsor equity, debt and tax equity and assumes the equity owner has taxable income to monetize a portion of the tax credits.

(2) Results at this level are driven by Lazard's approach to calculating the LCOE and selected inputs (see Appendix A for further details). Lazard's LCOE analysis assumes, for year-over-year reference purposes, 60% debt at an 8% interest rate and 40% equity at a 12% cost (together implying an after-tax IRR/WACC of 7.7%). Implied IRRs at this level for Wind—Onshore (PTC) is 13% (i.e., the value of the PTC and Energy Community adder result in an implied IRR greater than the assumed 12%).

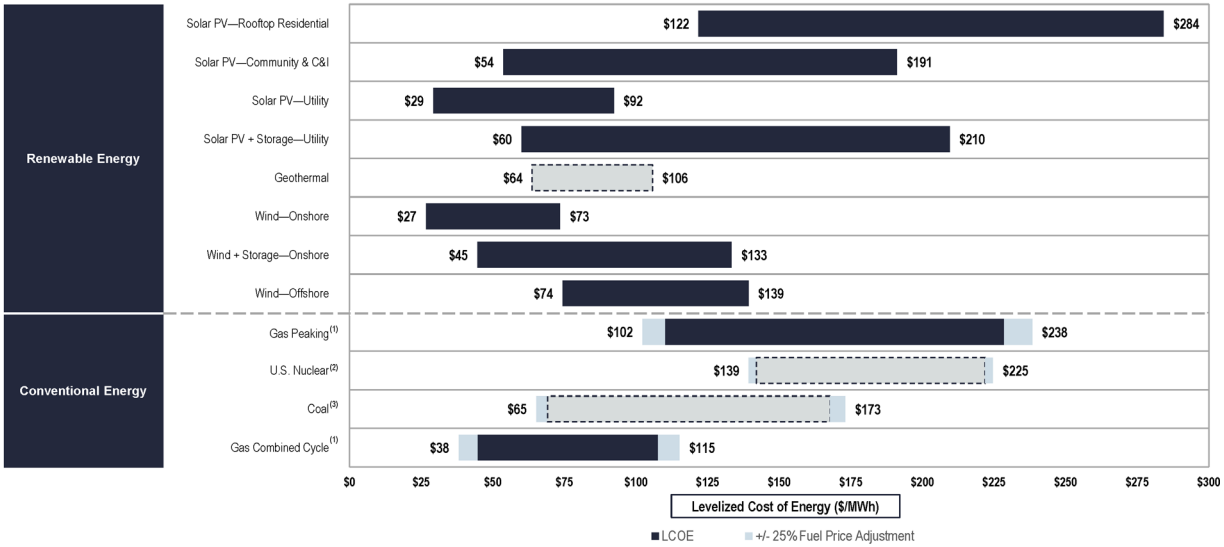
(3) This sensitivity analysis assumes that projects qualify for the full ITC/PTC and also includes an Energy Community adder of 10% for ITC projects and $3/MWh for PTC projects.

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Levelized Cost of Energy Comparison—Sensitivity to Fuel Prices

Variations in fuel prices can materially affect the LCOE of conventional generation technologies, but direct comparisons to "competing" renewable energy generation technologies must take into account issues such as dispatch characteristics (e.g., baseload and/or dispatchable intermediate capacity vs. peaking or intermittent technologies)



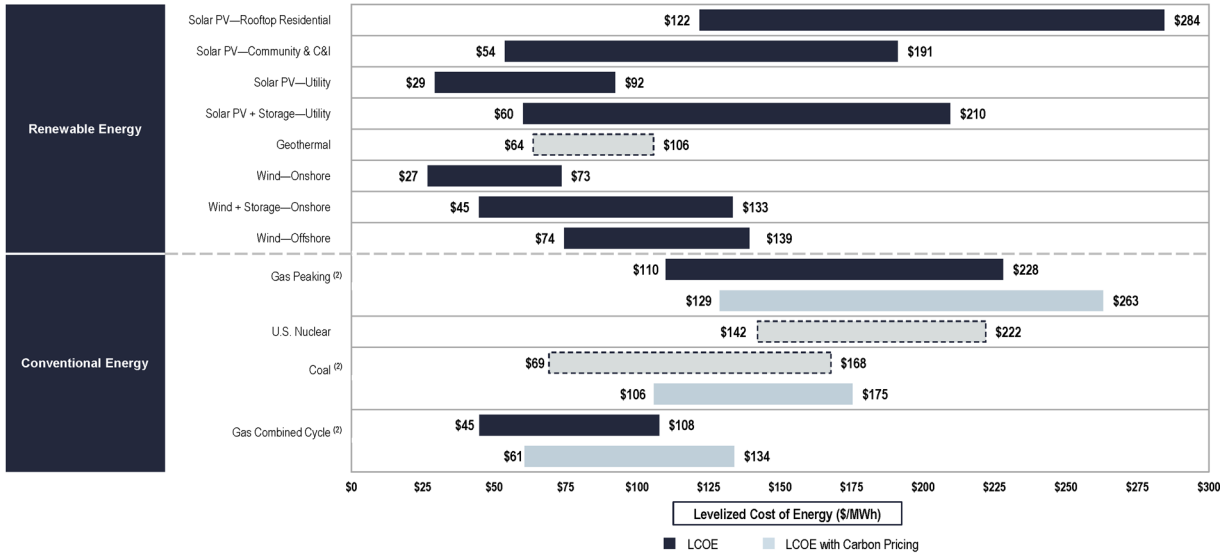
Source: *Lazard and Roland Berger estimates and publicly available information.*
Note: Unless otherwise noted, the assumptions used in this sensitivity correspond to those used in the LCOE analysis as presented on the page titled "Levelized Cost of Energy Comparison—Version 17.0".
(1) Assumes a fuel cost range for gas-fired generation resources of $2.59/MMBTU – $4.31/MMBTU (representing a sensitivity range of ± 25% of the $3.45/MMBTU used in the LCOE).
(2) Assumes a fuel cost range for nuclear generation resources of $0.64/MMBTU – $1.06/MMBTU (representing a sensitivity range of ± 25% of the $0.85/MMBTU used in the LCOE).
(3) Assumes a fuel cost range for coal-fired generation resources of $1.10/MMBTU – $1.84/MMBTU (representing a sensitivity range of ± 25% of the $1.47/MMBTU used in the LCOE).

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Levelized Cost of Energy Comparison—Sensitivity to Carbon Pricing

Carbon pricing is one avenue for policymakers to address carbon emissions; a carbon price range of $40 – $60/Ton[1] of carbon would increase the LCOE for certain conventional generation technologies, as indicated below



Source: *Lazard and Roland Berger estimates and publicly available information.*
Note: Unless otherwise noted, the assumptions used in this sensitivity correspond to those used in the LCOE analysis as presented on the page titled "Levelized Cost of Energy Comparison—Version 17.0".
(1) In November 2023, the U.S. Environmental Protection Agency proposed a $204/Ton social cost of carbon.
(2) The low and high ranges reflect the LCOE of selected conventional generation technologies including an illustrative carbon price of $40/Ton and $60/Ton, respectively.

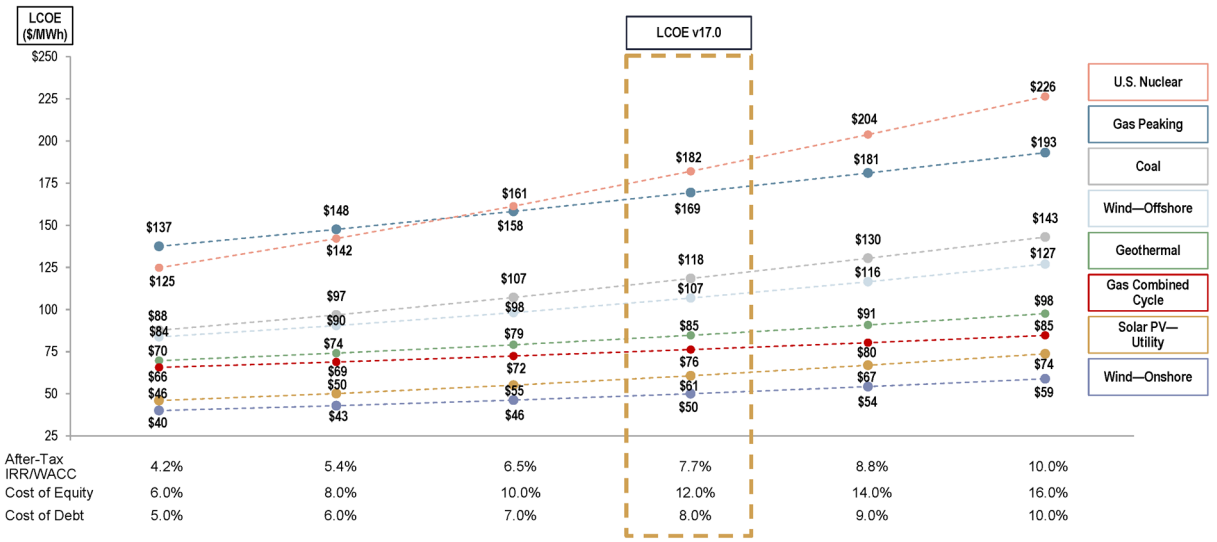
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Levelized Cost of Energy Comparison—Sensitivity to Cost of Capital

A key consideration in determining the LCOE for utility-scale generation technologies is the cost, and availability, of capital[1]—in practice, this dynamic is particularly significant because the cost of capital for each asset is directly correlated to its specific operational characteristics and the resulting risk/return profile

Average LCOE[2]



After-Tax IRR/WACC	4.2%	5.4%	6.5%	7.7%	8.8%	10.0%
Cost of Equity	6.0%	8.0%	10.0%	12.0%	14.0%	16.0%
Cost of Debt	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%

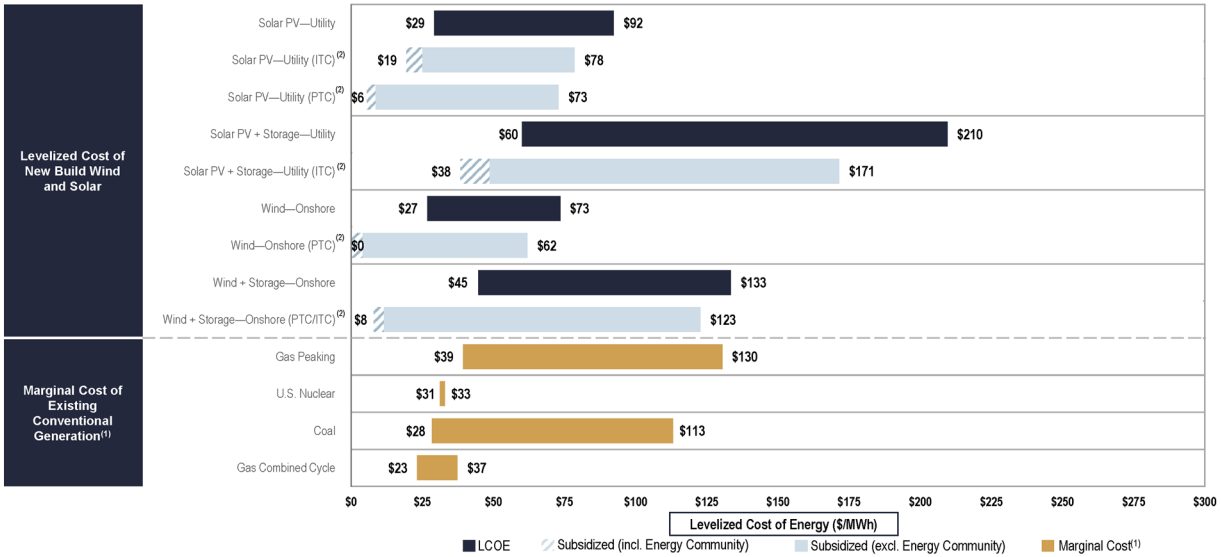
Source: *Lazard and Roland Berger estimates and publicly available information.*
Note: Analysis assumes 60% debt and 40% equity. Unless otherwise noted, the assumptions used in this sensitivity correspond to those used on the page titled "Levelized Cost of Energy Comparison—Version 17.0".
(1) Cost of capital as used herein indicates the cost of capital applicable to the asset/plant and not the cost of capital of a particular investor/owner.
(2) Reflects the average of the high and low LCOE for each respective cost of capital assumption.

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Levelized Cost of Energy Comparison—New Build Renewable Energy vs. Marginal Cost of Existing Conventional Generation

Certain renewable energy generation technologies have an LCOE that is competitive with the marginal cost of selected existing conventional generation technologies—notably, as incremental, intermittent renewable energy capacity is deployed and baseload gas-fired generation utilization rates increase, this gap closes, particularly in low gas pricing and high energy demand environments



Source: *Lazard and Roland Berger estimates and publicly available information.*
Note: Unless otherwise noted, the assumptions used in this sensitivity correspond to those used on page titled "Levelized Cost of Energy Comparison—Version 17.0".
(1) Reflects the marginal cost of operating fully depreciated gas, coal and nuclear facilities, inclusive of decommissioning costs for nuclear facilities. Analysis assumes that the salvage value for a decommissioned gas or coal asset is equivalent to its decommissioning and site restoration costs. Inputs are derived from a benchmark of operating gas, coal and nuclear assets across the U.S. Capacity factors, fuel, variable and fixed O&M are based on upper- and lower-quartile estimates derived from Lazard's research.
(2) See page titled "Levelized Cost of Energy Comparison—Sensitivity to U.S. Federal Tax Subsidies" for additional details.

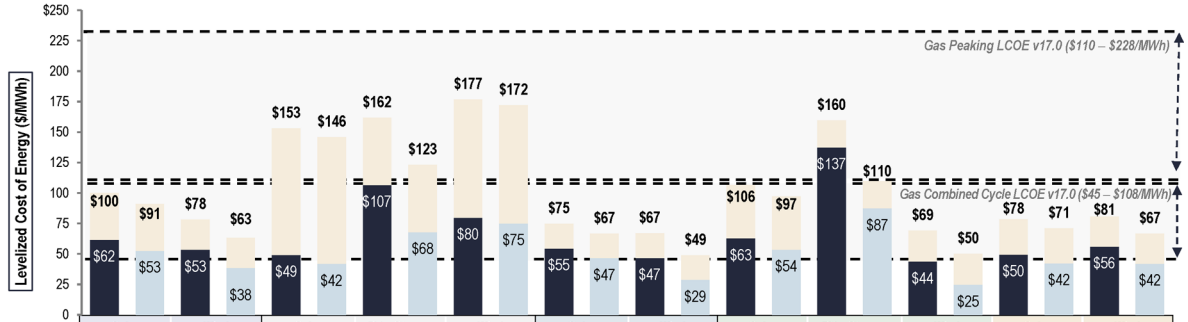
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Levelized Cost of Energy Comparison—Cost of Firming Intermittency

The incremental cost to firm[1] intermittent resources varies regionally—as such is defined by the relevant reliability organizations using the current effective load carrying capability ("ELCC")[2] values and the current cost of adding new firming resources

LCOE Including Levelized Firming Cost ($/MWh)[3]



	Solar	Wind	Solar	PV + Storage	Wind	Solar	Wind	Solar	PV + Storage	Wind	Solar	Wind
ELCC	39%	26%	8%	51%[4]	14%	57%	19%	42%	72%[4]	21%	38%	25%
Capacity Factor	18%	34%	23%	23%	23%	21%	39%	18%	18%	42%	23%	33%
Resource Penetration	6%	25%	52%	52%	20%	1%	58%	7%	7%	7%	21%	44%
	MISO		CAISO			SPP		PJM			ERCOT	

■ LCOE[3] ■ Subsidized (excl. Energy Community)[3] ■ Firming Cost[1]

Source: *Lazard and Roland Berger estimates and publicly available information.*

Note: Total LCOE, including firming cost, does not represent the cost of building a 24/7 firm resource on a single project site, but, instead, the LCOE of a renewable resource and the additional costs required to achieve the resource adequacy requirement in the relevant reliability region based on the net cost of new entry ("Net CONE"). ISO ELCC data as of April 2024.

(1) Firming costs reflect the additional capacity needed to supplement the net capacity of the renewable resource (nameplate capacity * (1 – ELCC)) and the Net CONE of a new firm resource (capital and operating costs, less expected market revenues). Net CONE is assessed and published by grid operators for each regional market. Grid operators use a natural gas peaker as the assumed new resource in MISO ($8.22/kW-mo), SPP ($8.56/kW-mo) and PJM ($10.20/kW-mo). In CAISO, the assumed new resource is a 4-hour lithium-ion battery storage system ($18.92/kW-mo). For the PV + Storage cases in CAISO and PJM, assumed storage configuration is 50% of PV MW and 4-hour duration.

(2) ELCC is an indicator of the incremental reliability contribution of a given resource to the electricity grid based on its contribution to meeting peak electricity demand. For example, a 1 MW wind resource with a 15% ELCC provides 0.15 MW of capacity contribution and would need to be supplemented by 0.85 MW of additional firm capacity in order to represent the addition of 1 MW of firm system capacity.

(3) Reflects the average of the high and low of Lazard's LCOE v17.0 for each technology using the regional capacity factor, as indicated, to demonstrate the regional differences in project costs.

(4) For PV + Storage cases, the effective ELCC value is represented. CAISO and PJM assess ELCC values separately for the PV and storage components of a system. Storage ELCC value is provided only for the capacity that can be charged directly by the accompanying resource up to the energy required for a 4-hour discharge during peak load. Any capacity available in excess of the 4-hour maximum discharge is attributed to the system at the solar ELCC. ELCC values for storage range from 90% to 95% for CAISO and PJM.

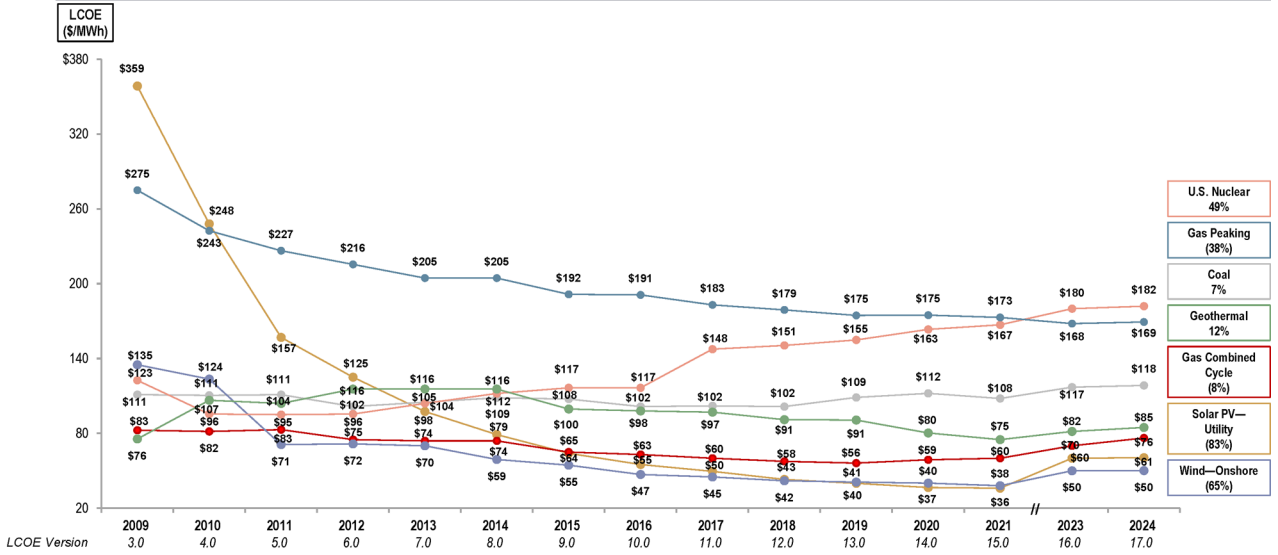
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Levelized Cost of Energy Comparison—Historical LCOE Comparison

Lazard's LCOE analysis indicates significant historical cost declines for utility-scale renewable energy generation technologies, which has begun to level out in recent years and slightly increased this year

Selected Historical Average LCOE Values(1)



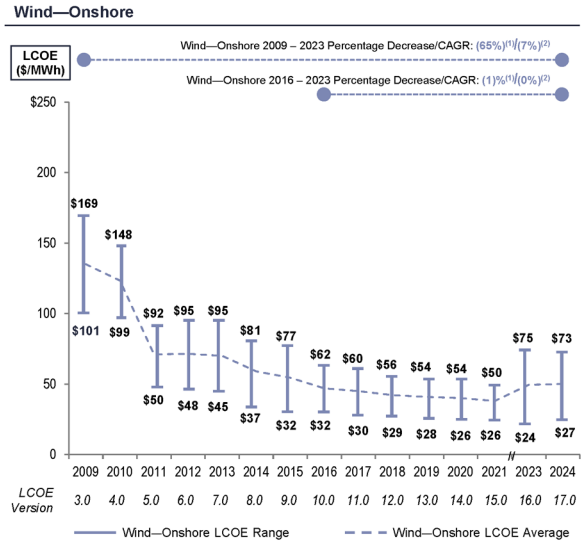
Source: *Lazard and Roland Berger estimates and publicly available information.*
(1) Reflects the average of the high and low LCOE for each respective technology in each respective year. Percentages represent the total decrease in the average LCOE since Lazard's LCOE v3.0.

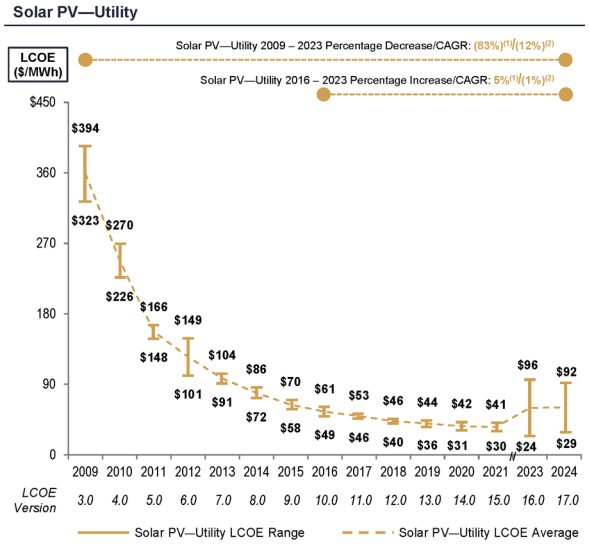
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Levelized Cost of Energy Comparison—Historical Renewable Energy LCOE

While the low end of the LCOE for both wind and solar has increased slightly, reflecting current market conditions, the average has remained nearly flat and the overall range has narrowed, reflecting, among other things, reconciliation of the supply chain challenges that were notable last year





Source: *Lazard and Roland Berger estimates and publicly available information.*
(1) Reflects the average percentage increase/(decrease) of the high end and low end of the LCOE range.
(2) Reflects the average compounded annual rate of decline of the high end and low end of the LCOE range.

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Introduction

Lazard's Levelized Cost of Storage analysis addresses the following topics:

- LCOS Analysis:
  - Comparative LCOS analysis for various energy storage systems on a $/MWh basis
  - Comparative LCOS analysis for various energy storage systems on a $/kW-year basis
- Energy Storage Value Snapshots:
  - Overview of potential revenue applications for various energy storage systems
  - Overview of the Value Snapshot analysis and identification of selected geographies for each use case analyzed
  - Results from the Value Snapshot analysis
- Appendix Materials, including:
  - An overview of the use cases and operational parameters of selected energy storage systems for each use case analyzed
  - An overview of the methodology utilized to prepare Lazard's LCOS analysis
  - A summary of the assumptions utilized in Lazard's LCOS analysis

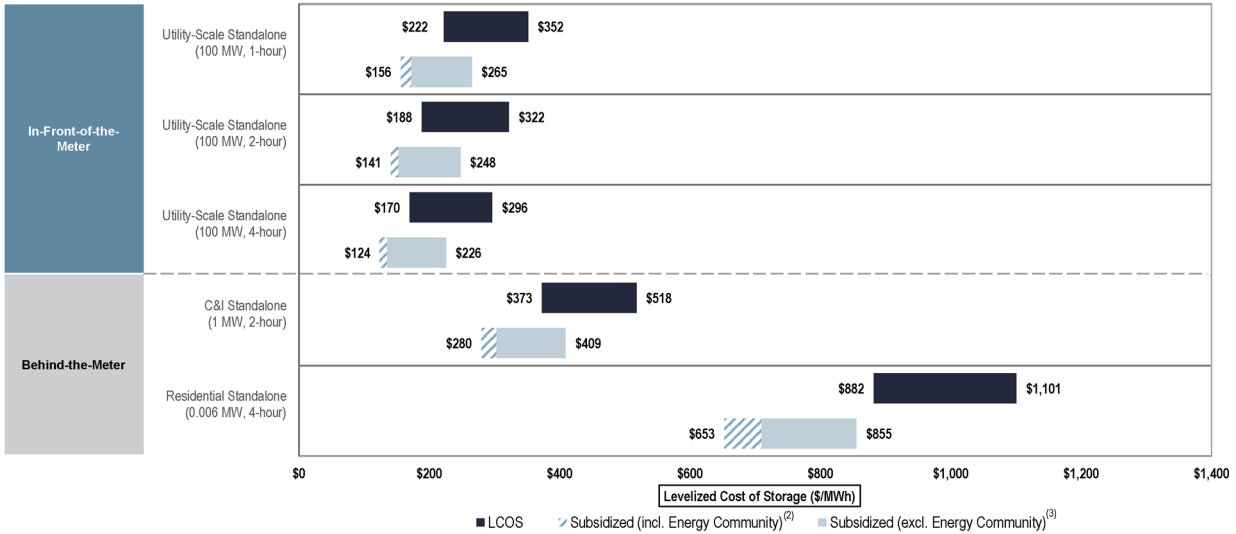
Other factors would also have a potentially significant effect on the results contained herein, but have not been examined in the scope of this current analysis. These additional factors, among others, may include: implementation and interpretation of the full scope of the IRA; economic policy, transmission queue reform, network upgrades and other transmission matters, congestion; curtailment or other integration-related costs; permitting or other development costs, unless otherwise noted; and costs of complying with various regulations (e.g., federal import tariffs or labor requirements). This analysis also does not address potential social and environmental externalities, as well as the long-term residual and societal consequences of various energy storage system technologies that are difficult to measure (e.g., resource extraction, end of life disposal, lithium-ion-related safety hazards, etc.). This analysis is intended to represent a snapshot in time and utilizes a wide, but not exhaustive, sample set of Industry data. As such, we recognize and acknowledge the likelihood of results outside of our ranges. Therefore, this analysis is not a forecasting tool and should not be used as such, given the complexities of our evolving Industry, grid and resource needs.

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Levelized Cost of Storage Comparison—Version 9.0 ($/MWh)

Lazard's LCOS analysis evaluates standalone energy storage systems on a levelized basis to derive cost metrics across energy storage use cases and configurations[1]



Source: *Lazard and Roland Berger estimates and publicly available information.*

Note: Here and throughout this section, unless otherwise indicated, the analysis assumes 20% debt at an 8% interest rate and 80% equity at a 12% cost, which is a different capital structure than Lazard's LCOE analysis. Capital costs are comprised of the storage module, balance of system and power conversion equipment, collectively referred to as the energy storage system, equipment (where applicable) and EPC costs. Augmentation costs are not included in capital costs in this analysis and vary across use cases due to usage profiles and lifespans. Charging costs are assessed at the weighted average hourly pricing (wholesale energy prices) across an optimized annual charging profile of the asset. See Appendix B for charging cost assumptions and additional details. The projects are assumed to use a 5-year MACRS depreciation schedule.

(1) See Appendix B for a detailed overview of the use cases and operation parameters analyzed in the LCOS.

(2) This sensitivity analysis assumes that projects qualify for the full ITC and have a capital structure that includes sponsor equity, debt and tax equity and also includes a 10% Energy Community adder.

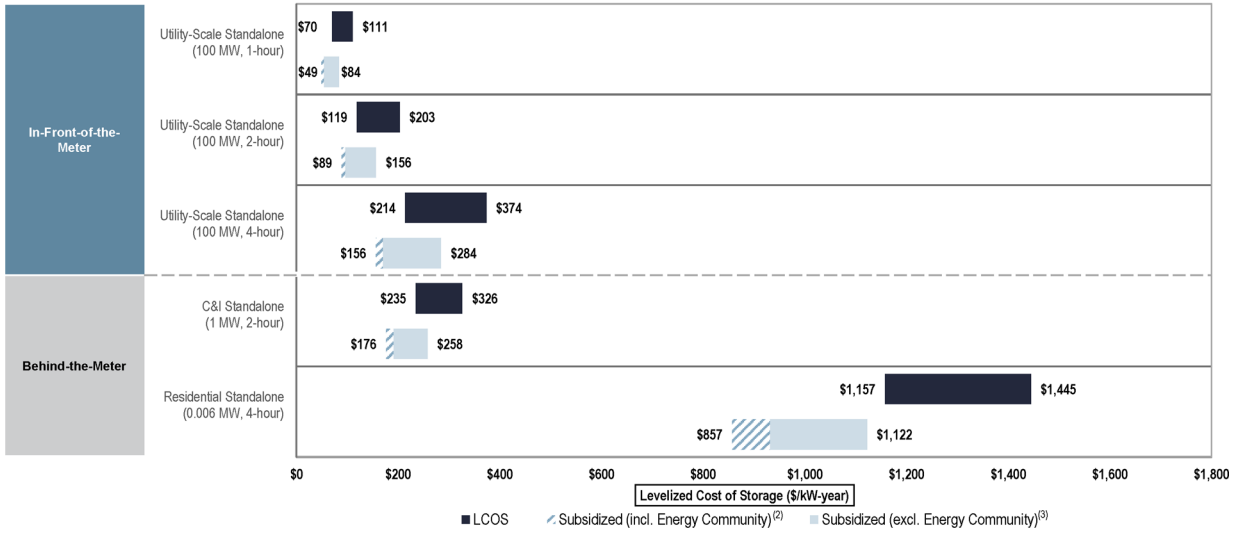
(3) This sensitivity analysis assumes that projects qualify for the full ITC and have a capital structure that includes sponsor equity, debt and tax equity.

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Levelized Cost of Storage Comparison—Version 9.0 ($/kW-year)

Lazard's LCOS analysis evaluates standalone energy storage systems on a levelized basis to derive cost metrics across energy storage use cases and configurations[1]



Source: *Lazard and Roland Berger estimates and publicly available information.*

Note: Here and throughout this section, unless otherwise indicated, the analysis assumes 20% debt at an 8% interest rate and 80% equity at a 12% cost, which is a different capital structure than that used in Lazard's LCOE analysis. Capital costs are comprised of the storage module, balance of system and power conversion equipment, collectively referred to as the energy storage system, equipment (where applicable) and EPC costs. Augmentation costs are not included in capital costs in this analysis and vary across use cases due to usage profiles and lifespans. Charging costs are assessed at the weighted average hourly pricing (wholesale energy prices) across an optimized annual charging profile of the asset. See Appendix B for charging cost assumptions and additional details. The projects are assumed to use a 5-year MACRS depreciation schedule.

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Value Snapshots—Revenue Potential for Selected Storage Use Cases

The numerous potential sources of revenue available to energy storage systems reflect the benefits provided to customers and the grid

- **The scope of revenue sources is limited to those captured by existing or soon-to-be commissioned projects—revenue sources that are not clearly identifiable or without publicly available data have not been analyzed**

			Use Cases[1]						
		Description	Utility-Scale Standalone	Utility-Scale PV + Storage	Utility-Scale Wind + Storage	Commercial & Industrial Standalone	Commercial & Industrial PV + Storage	Residential PV + Storage	Residential Standalone
Wholesale	Demand Response—Wholesale	• Manages high wholesale price or emergency conditions on the grid by calling on users to reduce or shift electricity demand				✓	✓		
Wholesale	Energy Arbitrage	• Storage of inexpensive electricity to sell later at higher prices (only evaluated in the context of a wholesale market)	✓	✓	✓				
Wholesale	Frequency Regulation	• Provides immediate (4-second) power to maintain generation-load balance and prevent frequency fluctuations	✓	✓	✓				
Wholesale	Resource Adequacy	• Provides capacity to meet generation requirements at peak load	✓	✓	✓				
Wholesale	Spinning/ Non-Spinning Reserves	• Maintains electricity output during unexpected contingency events (e.g., outages) immediately (spinning reserve) or within a short period of time (non-spinning reserve)	✓	✓	✓				
Utility	Demand Response—Utility	• Manages high wholesale price or emergency conditions on the grid by calling on users to reduce or shift electricity demand				✓	✓	✓	✓
Customer	Bill Management	• Allows reduction of demand charge using battery discharge and the daily storage of electricity for use when time of use rates are highest				✓	✓	✓	✓
Customer	Backup Power	• Provides backup power for use by residential and commercial customers during grid outages				✓	✓	✓	✓
Customer	Incentives	• Payments provided to residential and commercial customers to encourage the acquisition and installation of energy storage systems				✓	✓	✓	✓

Source: *Lazard and Roland Berger estimates, Enovation Analytics and publicly available information.*
(1) Represents the universe of potential revenue streams available to the various use cases. Does not represent the use cases analyzed in the Value Snapshots.

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Value Snapshot Case Studies—Overview

Lazard's Value Snapshots analyze the financial viability of illustrative energy storage systems designed for selected use cases

		Location	Description	Storage (MW)	Generation (MW)	Storage Duration (hours)	Revenue Streams
In-Front-of-the-Meter	1 Utility-Scale Standalone	CAISO[1] (SP-15)	Large-scale energy storage system	100	–	4	• Energy Arbitrage • Frequency Regulation • Resource Adequacy • Spinning/Non-Spinning Reserves
	2 Utility-Scale PV + Storage	ERCOT[2] (South Texas)	Energy storage system designed to be paired with large solar PV facilities	50	100	4	
	3 Utility-Scale Wind + Storage	ERCOT[2] (South Texas)	Energy storage system designed to be paired with large wind generation facilities	50	100	4	
Behind-the-Meter	4 Commercial & Industrial Standalone	PG&E[3] (California)	Energy storage system designed for behind-the-meter peak shaving and demand charge reduction for C&I energy users	1	–	2	• Demand Response—Utility • Bill Management • Incentives • Tariff Settlement, Demand Response Participation, Avoided Costs to Commercial Customer and Local Capacity Resource Programs
	5 Commercial & Industrial PV + Storage	PG&E[3] (California)	Energy storage system designed for behind-the-meter peak shaving and demand charge reduction services for C&I energy users	0.5	1	4	
	6 Residential Standalone	HECO[4] (Hawaii)	Energy storage system designed for behind-the-meter residential home use—provides backup power and power quality improvements	0.006	–	4	• Demand Response—Utility • Bill Management • Tariff Settlement • Incentives
	7 Residential PV + Storage	HECO[4] (Hawaii)	Energy storage system designed for behind-the-meter residential home use—provides backup power, power quality improvements and extends usefulness of self-generation	0.006	0.01	4	

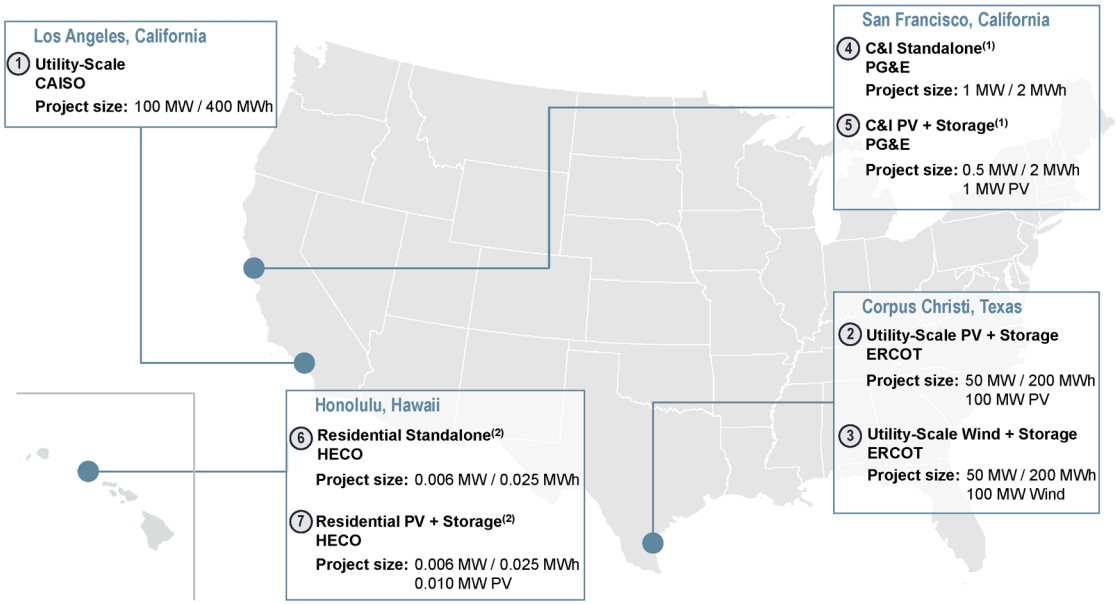
Source: *Lazard and Roland Berger estimates, Enovation Analytics and publicly available information.*
Note: Actual project returns may vary due to differences in location-specific costs, revenue streams and owner/developer risk preferences.
(1) Refers to the California Independent System Operator.
(2) Refers to the Electricity Reliability Council of Texas.
(3) Refers to the Pacific Gas & Electric Company.
(4) Refers to the Hawaiian Electric Company.

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Value Snapshot Case Studies—Overview (cont'd)

Lazard's Value Snapshots analyze the financial viability of illustrative energy storage systems designed for selected use cases



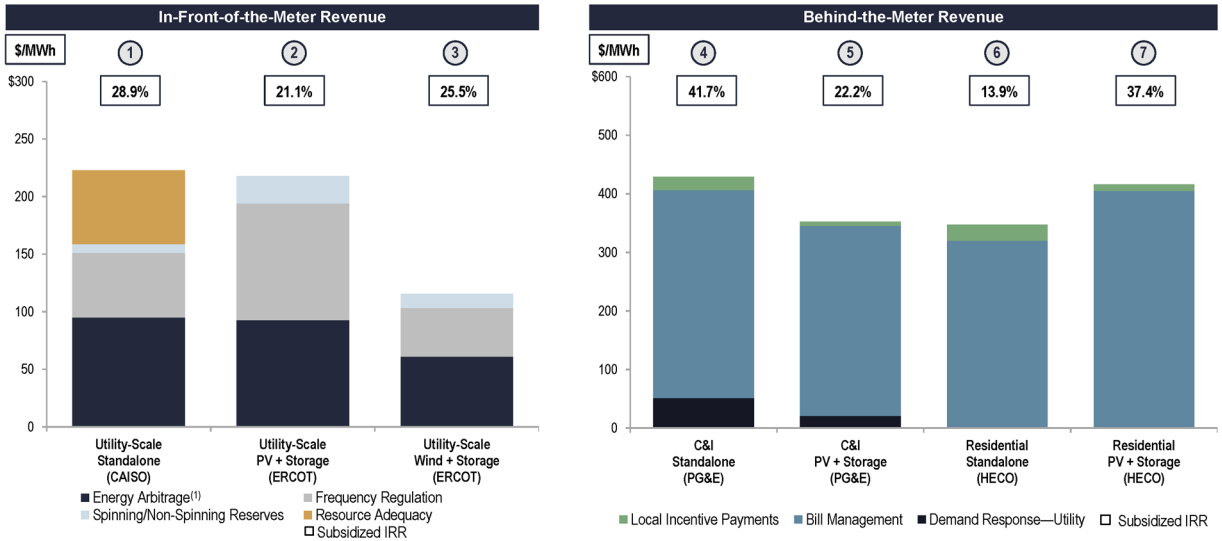
Source: *Lazard and Roland Berger estimates, Enovation Analytics and publicly available information.*
Note: Project parameters (i.e., battery size, duration, etc.) presented above correspond to the inputs used in the LCOS analysis.
(1) Assumes the project provides services under contract with PG&E.
(2) Assumes the project provides services under contract with HECO.

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Value Snapshot Case Studies—Results

Project economics evaluated in the Value Snapshot analysis continue to evolve year-over-year as costs change and the value of revenue streams adjust to reflect underlying market conditions, utility rate structures and policy developments



Source: *Lazard and Roland Berger estimates, Enovation Analytics and publicly available information.*

Note: Levelized costs presented for each Value Snapshot reflect local market and operating conditions (including installed costs, market prices, charging costs and incentives) and are different in certain cases from the LCOS results for the equivalent use case on the page titled "Levelized Cost of Storage Comparison—Version 9.0 ($/MWh)", which are more broadly representative of U.S. storage market conditions as opposed to location-specific conditions. Levelized revenues in all cases are gross revenues (not including charging costs). Subsidized levelized cost for each Value Snapshot reflects: (1) average cost structure for storage, solar and wind capital costs, (2) charging costs based on local wholesale prices or utility tariff rates and (3) all applicable state and federal tax incentives, including 30% federal ITC for solar and/or storage, $27.50/MWh federal PTC for wind and 35% Hawaii state ITC for solar and solar + storage systems. Value Snapshots do not include cash payments from state or utility incentive programs. Revenues for Value Snapshots (1) – (3) are based on hourly wholesale prices from the 365 days prior to December 15, 2023. Revenues for Value Snapshots (4) – (7) are based on the most recent tariffs, programs and incentives available as of December 2023.

(1) In previous versions of this analysis, Energy Arbitrage was referred to as Wholesale Energy Sales.

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Introduction

Lazard's Levelized Cost of Hydrogen analysis addresses the following topics:

- Comparative and illustrative LCOH analysis for various green and pink hydrogen production systems on a $/kg basis
- Comparative and illustrative LCOE analysis for natural gas peaking generation, a potential use case in the U.S. power sector, utilizing a 25% hydrogen blend on a $/MWh basis, including sensitivities for U.S. federal tax subsidies
- Appendix materials, including:
  - An overview of the methodology utilized to prepare Lazard's LCOH analysis
  - A summary of the assumptions utilized in Lazard's LCOH analysis

Note on Methodology:

- The analysis within includes storage costs paid to a third party but does not include any expenditures related to the transport, construction of pipeline or construction of storage
- This analysis does not include electrolyzers produced in China, which are currently priced at one third of the price of incumbent electrolyzers, as they struggle to penetrate the U.S. market due to lack of thorough testing and uncertainty around potential tariffs or other trade disruptions with China

Other factors would also have a potentially significant effect on the results contained herein, but have not been examined in the scope of this current analysis. These additional factors, among others, could include: implementation and interpretation of the full scope of the IRA; development costs of the electrolyzer and associated renewable energy generation facility; conversion, storage and transportation costs of the hydrogen once produced; additional costs to produce alternate products (e.g., ammonia); costs to upgrade existing infrastructure to facilitate the transportation of hydrogen (e.g., natural gas pipelines); electrical grid upgrades; costs associated with modifying end-use infrastructure/equipment to use hydrogen as a fuel source; potential value associated with carbon-free fuel production (e.g., carbon credits, incentives, etc.). This analysis also does not address potential environmental and social externalities, including, for example, water consumption and the societal consequences of displacing the various conventional fuels with hydrogen that are difficult to measure

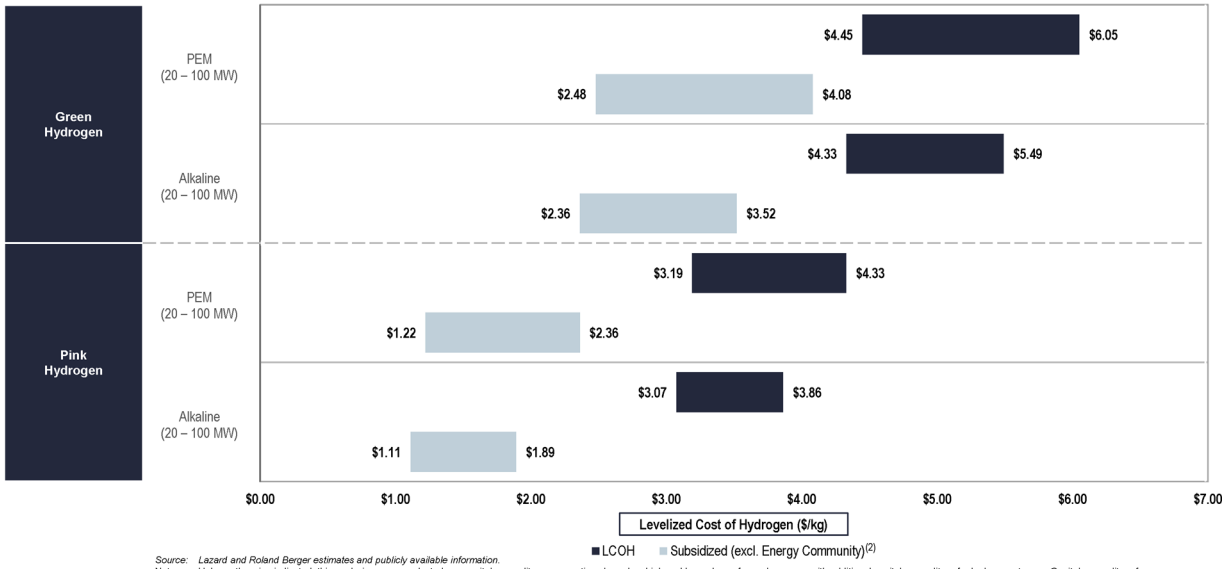
As a result of the developing nature of hydrogen production and its applications, it is important to have in mind the somewhat limited nature of the LCOH (and related limited historical market experience and current market depth). In that regard, we are aware that, as a result of our data collection methodology, some will have a view that electrolyzer cost and efficiency, plus electricity costs, suggest a different LCOH than what is presented herein. The sensitivities presented in our study are intended to address, in part, such views

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Levelized Cost of Hydrogen Comparison—Version 4.0 ($/kg)

Subsidized green and pink hydrogen can reach levelized production costs under $2/kg[1]—fully depreciated operating nuclear plants yield higher capacity factors and, when only accounting for operating expenses, pink hydrogen can reach production costs lower than green hydrogen



Source: *Lazard and Roland Berger estimates and publicly available information.*

Note: Unless otherwise indicated, this analysis assumes electrolyzer capital expenditure assumptions based on high and low values of sample ranges, with additional capital expenditure for hydrogen storage. Capital expenditure for underground hydrogen storage assumes $20/kg storage cost, sized at 120 Tons for green hydrogen and 200 Tons for pink hydrogen (size is driven by electrolyzer capacity factors). Pink hydrogen costs are based on marginal costs for an existing nuclear plant (see Appendix C for detailed assumptions).

(1) In the U.S., ~$2/kg is the cost to produce gray hydrogen using low-cost natural gas.

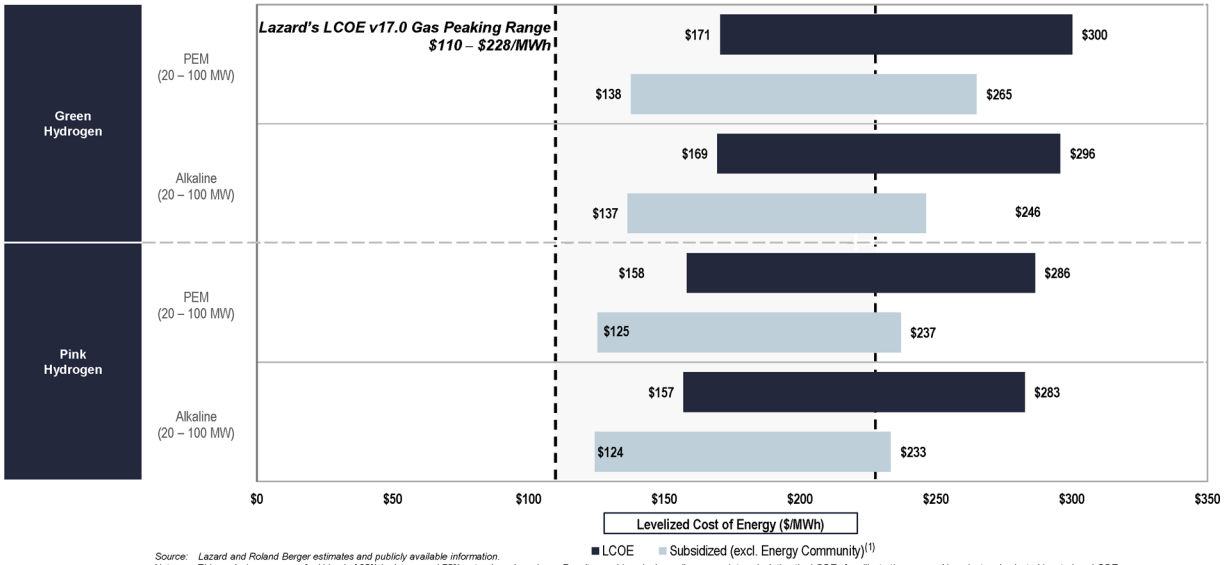
(2) This sensitivity analysis assumes that projects qualify for the hydrogen PTC but does not include subsidized electricity costs. This analysis assumes projects have a capital structure that includes sponsor equity, debt and tax equity. The IRA is comprehensive legislation that is still being implemented and remains subject to interpretation—important elements of the IRA are not included in our analysis and could impact outcomes.

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Levelized Cost of Energy Comparison—Gas Peaking with 25% Hydrogen Blend

While hydrogen-ready natural gas turbines are still being tested, preliminary results, including our illustrative LCOH analysis, indicate that a 25% hydrogen by volume blend is feasible and cost competitive



Source: *Lazard and Roland Berger estimates and publicly available information.*

Note: This analysis assumes a fuel blend of 25% hydrogen and 75% natural gas by volume. Results are driven by Lazard's approach to calculating the LCOE of an illustrative gas peaking plant and selected inputs (see LCOE Appendix for further details). Natural gas fuel cost is assumed to be $3.45/MMBtu, hydrogen fuel cost based on LCOH $/kg for case scenarios, assumes 8.8 kg/MMBtu for hydrogen. Analysis includes hydrogen storage costs for a maximum of 8-hour peak episodes for a maximum of 7 days per year, resulting in additional costs of $120/kW (green) and $190/kW (pink). Previous versions of this analysis sensitized only the cost of hydrogen—the current version sensitizes both the hydrogen production parameters and the gas peaking plant parameters.

(1) This sensitivity analysis assumes that projects qualify for the hydrogen PTC but does not include subsidized electricity costs. This analysis assumes projects have a capital structure that includes sponsor equity, debt and tax equity. The IRA is comprehensive legislation that is still being implemented and remains subject to interpretation—important elements of the IRA are not included in our analysis and could impact outcomes.

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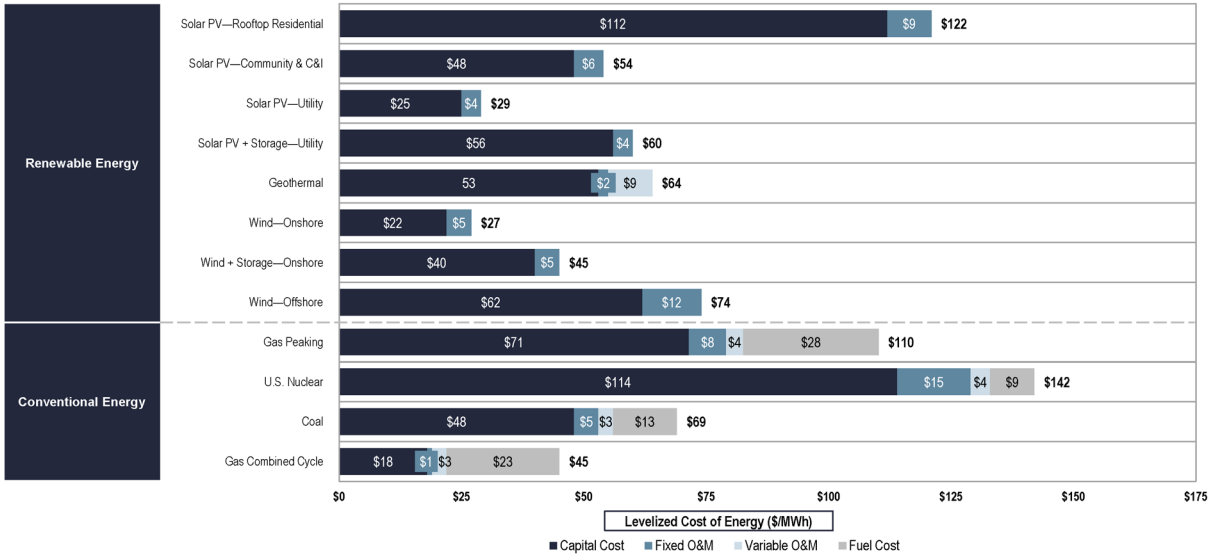
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Appendix

LCOE v17.0

Levelized Cost of Energy Components—Low End

Certain renewable energy generation technologies are already cost-competitive with conventional generation technologies; key factors regarding the continued cost decline of renewable energy generation technologies are the ability of technological development and Industry scale to continue lowering operating expenses and capital costs for renewable energy generation technologies



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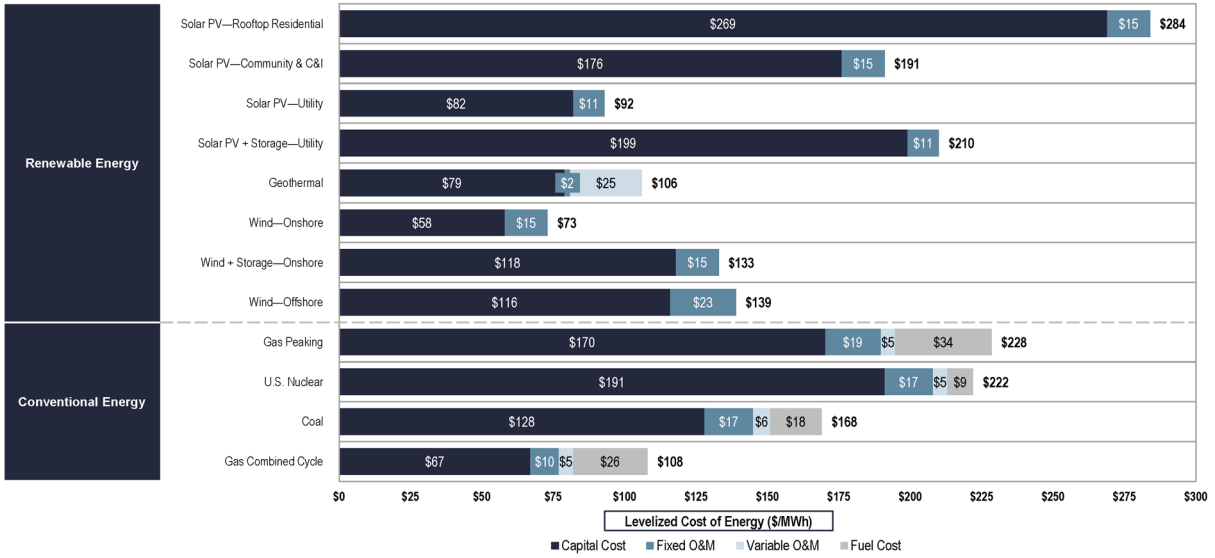
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Source: *Lazard and Roland Berger estimates and publicly available information.*
Notes: Figures may not sum due to rounding.

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Levelized Cost of Energy Components—High End

Certain renewable energy generation technologies are already cost-competitive with conventional generation technologies; key factors regarding the continued cost decline of renewable energy generation technologies are the ability of technological development and Industry scale to continue lowering operating expenses and capital costs for renewable energy generation technologies



Source: *Lazard and Roland Berger estimates and publicly available information.*
Notes: Figures may not sum due to rounding.

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Levelized Cost of Energy Comparison—Methodology

($ in millions, unless otherwise noted)

Lazard's LCOE analysis consists of creating a power plant model representing an illustrative project for each relevant technology and solving for the $/MWh value that results in a levered IRR equal to the assumed cost of equity (see subsequent "Key Assumptions" pages for detailed assumptions by technology)

Unsubsidized Onshore Wind — Low Case Sample Illustrative Calculations

Year [1]		0	1	2	3	4	5	6	7	20
Capacity (MW)	(A)		175	175	175	175	175	175	175	175
Capacity Factor	(B)		55%	55%	55%	55%	55%	55%	55%	55%
Total Generation ('000 MWh)	(A) x (B) = (C)*		843	843	843	843	843	843	843	843
Levelized Energy Cost ($/MWh)	***(D)***		***$24.4***	***$24.4***	***$24.4***	***$24.4***	***$24.4***	***$24.4***	***$24.4***	***$24.4***
Total Revenues	**(C) x (D) = (E)***		**$20.6**	**$20.6**	**$20.6**	**$20.6**	**$20.6**	**$20.6**	**$20.6**	**$20.6**
Total Fuel Cost	(F)		--	--	--	--	--	--	--	--
Total O&M	(G)*		3.5	3.6	3.7	3.7	3.8	3.9	4.0	5.5
Total Operating Costs	**(F) + (G) = (H)**		**$3.5**	**$3.6**	**$3.7**	**$3.7**	**$3.8**	$3.9	$4.0	$5.5
EBITDA	**(E) - (H) = (I)**		**$17.1**	**$17.0**	**$16.9**	**$16.8**	**$16.7**	**$16.7**	**$16.6**	**$15.1**
Debt Outstanding - Beginning of Period	(J)		$107.6	$105.5	$103.2	$100.7	$98.0	$95.1	$92.0	$9.9
Debt - Interest Expense	(K)		(8.6)	(8.4)	(8.3)	(8.1)	(7.8)	(7.6)	(7.4)	(0.8)
Debt - Principal Payment	(L)		(2.1)	(2.3)	(2.5)	(2.7)	(2.9)	(3.1)	(3.4)	(9.9)
Levelized Debt Service	(K) + (L) = (M)		($10.7)	($10.7)	($10.7)	($10.7)	($10.7)	($10.7)	($10.7)	($10.7)
EBITDA	**(I)**		$17.1	$17.0	$16.9	$16.8	$16.7	$16.7	$16.6	$15.1
Depreciation (MACRS)	(N)		(35.9)	(57.4)	(34.4)	(20.7)	(20.7)	(10.3)	0.0	0.0
Interest Expense	(K)		(8.6)	(8.4)	(8.3)	(8.1)	(7.8)	6.3	16.6	(0.8)
Taxable Income	**(I) + (N) + (K) = (O)**		**($27.4)**	**($48.8)**	**($25.8)**	**($11.9)**	**($11.8)**	**($7.6)**	**($7.4)**	**$14.3**
Federal Production Tax Credit Value	(P)		$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Federal Production Tax Credit Received	(P) x (C) = (Q)*		$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Tax Benefit (Liability)	**(O) x (tax rate) + (Q) = (R)**		**$11.0**	**$19.5**	**$10.3**	**$4.8**	**$4.7**	**$0.0**	**$0.0**	**$0.0**
Capital Expenditures		**($71.8)**	**($107.6)**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**
After-Tax Net Equity Cash Flow [2]	**(I) + (M) + (R) = (S)**	**($71.8) [3]**	**$17.3**	**$25.8**	**$16.5**	**$10.8**	**$10.7**	**$0.0**	**$0.0**	**($1.4)**
Cash Flow to Equity Investors	(S) x (% to Equity Investors)	($71.8)	$17.3	$25.8	$16.5	$10.8	$10.7	$6.4	$2.1	($1.4)
IRR For Equity Investors	**12.0%**									

Key Assumptions [4]	
Capacity (MW)	175
Capacity Factor	55%
Fuel Cost ($/MMBtu)	$0.00
Heat Rate (Btu/kWh)	0
Fixed O&M ($/kW-year)	$20.0
Variable O&M ($/MWh)	$0.0
O&M Escalation Rate	2.25%
Capital Structure	
Debt	60.0%
Cost of Debt	8.0%
Tax Investors	0.0%
Cost of Equity for Tax Investors	10.0%
Equity	40.0%
Cost of Equity	12.0%
Taxes and Tax Incentives:	
Combined Tax Rate	40%
Economic Life (years) [5]	20
MACRS Depreciation (Year Schedule)	5
PTC (+10% for Domestic Content)	$0.0
PTC Escalation Rate	1.5%
Capex	
EPC Costs ($/kW)	$1,025
Additional Owner's Costs ($/kW)	$0
Transmission Costs ($/kW)	$0
Total Capital Costs ($/kW)	$1,025
Total Capex ($mm)	$179
Cash Flow Distribution	
Portion to Tax Investors (After Return is Met)	1%

Technology-dependent

Levelized

Source: *Lazard and Roland Berger estimates and publicly available information.*

Note: Numbers presented for illustrative purposes only.

* Denotes unit conversion.

(1) Assumes half-year convention for discounting purposes.

(2) Assumes full monetization of tax benefits or losses immediately.

(3) Reflects initial cash outflow from equity investors.

(4) Reflects a "key" subset of all assumptions for methodology illustration purposes only. Does not reflect all assumptions.

(5) Economic life sets debt amortization schedule. For comparison purposes, all technologies calculate LCOE on a 20-year IRR basis.

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Levelized Cost of Energy—Key Assumptions

		Renewable Energy: Solar PV					
	Units	Rooftop Residential		Community and C&I		Utility	
		Low	High	Low	High	Low	High
Net Facility Output	MW	0.005		5		150	
Total Capital Cost	$/kW	$2,300	$4,150	$1,300	$2,900	$850	$1,400
Fixed O&M	$/kW-yr	$16.50	$20.00	$13.00	$20.00	$11.00	$14.00
Variable O&M	$/MWh	—		—		—	
Heat Rate	Btu/kWh	—		—		—	
Capacity Factor	%	20%	15%	25%	15%	30%	15%
Fuel Price	$/MMBTU	—		—		—	
Construction Time	Months	9		12		12	
Facility Life	Years	25		30		35	
Levelized Cost of Energy	$/MWh	$122	$284	$54	$191	$29	$92

Source: Lazard and Roland Berger estimates and publicly available information.

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Levelized Cost of Energy—Key Assumptions (cont'd)

		Renewable Energy					
	Units	Geothermal		Wind—Onshore		Wind—Offshore	
		Low	High	Low	High	Low	High
Net Facility Output	MW	250		250		1,000	
Total Capital Cost	$/kW	$4,860 – $6,280		$1,300 – $1,900		$3,750 – $5,750	
Fixed O&M	$/kW-yr	$14.50 – $15.75		$24.50 – $40.00		$60.00 – $91.50	
Variable O&M	$/MWh	$9.05 – $24.80		—		—	
Heat Rate	Btu/kWh	—		—		—	
Capacity Factor	%	90% – 80%		55% – 30%		55% – 45%	
Fuel Price	$/MMBTU	—		—		—	
Construction Time	Months	36		12		36	
Facility Life	Years	25		30		30	
Levelized Cost of Energy	$/MWh	$64 – $106		$27 – $73		$74 – $139	

Source: Lazard and Roland Berger estimates and publicly available information.

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Levelized Cost of Energy—Key Assumptions (cont'd)

		Renewable Energy: Hybrid Generation + Storage					
	Units	Solar PV + Storage—Utility			Wind + Storage—Onshore		
		Low		High	Low		High
Storage							
Power Rating	MW	50			50		
Duration	Hours	4			4		
Usable Energy	MWh	200			200		
90% Depth of Discharge Cycles/Year	%	350			350		
Roundtrip Efficiency	%	91%			88%		
Inverter Cost	$/kW	$30	-	$60	$30	-	$60
Total Capital Cost (excl. Inverter)	$/kWh	$249	-	$421	$249	-	$421
Storage O&M	$/kWh	$3.63	-	$8.18	$3.63	-	$8.18
Generation							
Capacity	MW	100			100		
Capacity Factor	%	30%			55%		
Project Life	Years	20			20		
Total Capital Cost	$/kW	$850	-	$1,400	$1,300	-	$1,900
Fixed O&M	$/kW	$11.00	-	$14.00	$24.50	-	$40.00
Extended Warranty Start	Year	3			3		
Warranty Expense % of Capital Costs	%	0.5%	-	1.5%	0.5%	-	1.5%
Charging Cost	$/MWh	$0.00			$0.00		
Unsubsidized LCOE	$/MWh	$60	-	$210	$45	-	$133

Source: Lazard and Roland Berger estimates and publicly available information.

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Levelized Cost of Energy—Key Assumptions (cont'd)

		Conventional Energy							
	Units	Gas Peaking (New Build)		U.S. Nuclear (New Build)		Coal (New Build)		Gas Combined Cycle (New Build)	
		Low	High	Low	High	Low	High	Low	High
Net Facility Output	MW	240 – 50		2,200		600		550	
Total Capital Cost	$/kW	$700 – $1,150		$8,765 – $14,400		$3,310 – $7,005		$850 – $1,300	
Fixed O&M	$/kW-yr	$10.00 – $17.00		$136.00 – $158.00		$40.85 – $94.35		$10.00 – $25.50	
Variable O&M	$/MWh	$3.50 – $5.00		$4.40 – $5.15		$3.10 – $5.70		$2.75 – $5.00	
Heat Rate	Btu/kWh	8,000 – 9,800		10,450		8,750 – 12,000		6,750 – 7,500	
Capacity Factor	%	15% – 10%		92% – 89%		85% – 65%		90% – 30%	
Fuel Price	$/MMBTU	$3.45		$0.85		$1.47		$3.45	
Construction Time	Months	24		69		60 – 66		24	
Facility Life	Years	20		40		40		20	
Levelized Cost of Energy	$/MWh	$110 – $228		$142 – $222		$69 – $168		$45 – $108	

Source: Lazard and Roland Berger estimates and publicly available information.

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Levelized Cost of Energy—Key Assumptions (cont'd)

		Marginal Cost of Selected Existing Conventional Generation							
	Units	Gas Peaking (Operating)		U.S. Nuclear (Operating)		Coal (Operating)		Gas Combined Cycle (Operating)	
		Low	High	Low	High	Low	High	Low	High
Net Facility Output	MW	240 – 50		2,200		600		550	
Total Capital Cost	$/kW	$0		$0		$0		$0	
Fixed O&M	$/kW-yr	$4.00 – $6.00		$102.40 – $109.50		$22.20 – $27.80		$9.50 – $12.60	
Variable O&M	$/MWh	$2.60 – $9.10		$3.00 – $3.50		$2.80 – $4.80		$1.00 – $2.00	
Heat Rate	Btu/kWh	10,875 – 12,575		10,400 – 10,400		10,350 – 11,175		7,075 – 7,550	
Capacity Factor	%	12% – 1%		96% – 96%		81% – 8%		80% – 41%	
Fuel Price	$/MMBtu	$2.60 – $2.90		$0.80 – $0.80		$1.70 – $4.60		$2.50 – $3.50	
Construction Time	Months	24		69		60		24	
Facility Life	Years	20		40		40		20	
Levelized Cost of Energy	$/MWh	$39 – $130		$31 – $33		$28 – $113		$23 – $37	

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LCOE

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LCOS v9.0

Energy Storage Use Cases—Overview

By identifying and evaluating selected energy storage applications, Lazard's LCOS analyzes the cost of energy storage for in-front-of-the-meter and behind-the-meter use cases

		Use Case Description	Technologies Assessed
In-Front-of-the-Meter	**Utility-Scale (Standalone)**	• Large-scale energy storage system designed for rapid start and precise following of dispatch signal • Variations in system discharge duration are designed to meet varying system needs (i.e., short-duration frequency regulation, longer-duration energy arbitrage[1] or capacity, etc.) – To better reflect current market trends, this analysis analyzes 1-, 2- and 4-hour durations[2]	• Lithium Iron Phosphate (LFP) • Lithium Nickel Manganese Cobalt Oxide (NMC)
Behind-the-Meter	**Commercial & Industrial (Standalone)**	• Energy storage system designed for behind-the-meter peak shaving and demand charge reduction for C&I users – Units are often configured to support multiple commercial energy management strategies and provide optionality for the system to provide grid services to a utility or the wholesale market, as appropriate, in a given region	• Lithium Iron Phosphate (LFP) • Lithium Nickel Manganese Cobalt Oxide (NMC)
	Residential (Standalone)	• Energy storage system designed for behind-the-meter residential home use—provides backup power and power quality improvements – Depending on geography, can arbitrage residential time-of-use ("TOU") rates and/or participate in utility demand response programs	• Lithium Iron Phosphate (LFP) • Lithium Nickel Manganese Cobalt Oxide (NMC)

Source: *Lazard and Roland Berger estimates and publicly available information.*
(1) For the purposes of this analysis, "energy arbitrage" in the context of storage systems paired with solar PV includes revenue streams associated with the sale of excess generation from the solar PV system, as appropriate, for a given use case.
(2) The Value Snapshot analysis only evaluates the 4-hour utility-scale use case.

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Energy Storage Use Cases—Illustrative Operational Parameters

Lazard's LCOS evaluates selected energy storage applications and use cases by identifying illustrative operational parameters[1]

- Energy storage systems may also be configured to support combined/"stacked" use cases

		A Project Life (Years)	B Storage (MW)[2]	Solar/ Wind (MW)	Battery Degradation (per annum)	C Storage Duration (Hours)	B x C = D Nameplate Capacity (MWh)[3]	E 90% DOD Cycles/ Day[4]	F Days/ Year[5]	D x E x F = G Annual MWh[6]	A x G = H Project MWh
In-Front-of-the-Meter	Utility-Scale (Standalone)	20	100	–	2.6%	1	100	1	350	31,500	630,000
		20	100	–	2.6%	2	200	1	350	63,000	1,260,000
		20	100	–	2.6%	4	400	1	350	126,000	2,520,000
Behind-the-Meter	Commercial & Industrial (Standalone)	20	1	–	2.6%	2	2	1	350	630	12,600
	Residential (Standalone)	20	0.006	–	1.9%	4	0.025	1	350	8	158

= "Usable Energy"[7]

Source: *Lazard and Roland Berger estimates and publicly available information.*
Note: Operational parameters presented herein are applied to Value Snapshot and LCOS calculations. Annual and Project MWh in the Value Snapshot analysis may vary from the representative project.
(1) The use cases herein represent illustrative current and contemplated energy storage applications.
(2) Indicates power rating of system (i.e., system size).
(3) Indicates total battery energy content on a single, 100% charge, or "usable energy". Usable energy divided by power rating (in MW) reflects hourly duration of system. This analysis reflects common practice in the market whereby batteries are upsized in year one to 110% of nameplate capacity (e.g., a 100 MWh battery actually begins project life with 110 MWh).
(4) "DOD" denotes depth of battery discharge (i.e., the percent of the battery's energy content that is discharged). A 90% DOD indicates that a fully charged battery discharges 90% of its energy. To preserve battery longevity, this analysis assumes that the battery never charges over 95%, or discharges below 5%, of its usable energy.
(5) Indicates number of days of system operation per calendar year.
(6) Augmented to nameplate MWh capacity as needed to ensure usable energy is maintained at the nameplate capacity, based on Year 1 storage module cost.
(7) Usable energy indicates energy stored and available to be dispatched from the battery.

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Levelized Cost of Storage Comparison—Methodology

Lazard's LCOS analysis consists of creating a power plant model representing an illustrative project for each relevant technology and solving for the $/MWh value that results in a levered IRR equal to the assumed cost of equity (see subsequent "Key Assumptions" page for detailed assumptions by technology)

Subsidized Utility-Scale (100 MW / 200 MWh)—Low Case Sample Calculations

Year(1)		*0*	*1*	*2*	*3*	*4*	*5*	*20*
Capacity (MW)	(A)		100	100	100	100	100	100
Available Capacity (MW)		110	109	106	103	100	110	102
Total Generation ('000 MWh)(2)	(B)*		63	63	63	63	63	63
Levelized Storage Cost ($/MWh)	***(C)***		***$178***	***$178***	***$178***	***$178***	***$178***	***$178***
Total Revenues	**(B) x (C) = (D)***		**$11.2**	**$11.2**	**$11.2**	**$11.2**	**$11.2**	**$11.2**
Total Charging Cost(3)	(E)		(4.4)	(4.5)	(4.6)	(4.7)	(4.8)	(6.3)
Total O&M, Warranty, & Augmentation(4)	(F)*		(0.3)	(0.3)	(0.6)	(0.6)	(4.3)	(0.8)
Total Operating Costs	**(E) + (F) = (G)**		($4.7)	($4.8)	($5.2)	($5.3)	($9.1)	($7.1)
EBITDA	**(D) - (G) = (H)**		**$6.5**	**$6.4**	**$5.9**	**$5.8**	**$2.1**	**$4.1**
Debt Outstanding - Beginning of Period	(I)		$11.7	$11.4	$11.2	$10.9	$10.5	$1.1
Debt - Interest Expense	(J)		(0.9)	(0.9)	(0.9)	(0.9)	(0.8)	(0.1)
Debt - Principal Payment	(K)		(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(1.1)
Levelized Debt Service	(J) + (K) = (L)		(1.2)	(1.2)	(1.2)	(1.2)	(1.2)	(1.2)
EBITDA	**(H)**		$6.5	$6.4	$5.9	$5.8	$2.1	$4.1
Depreciation (5-yr MACRS)	(M)		(9.9)	(15.9)	(9.5)	(5.7)	(5.7)	0.0
Interest Expense	(J)		(0.9)	2.8	0.0	(0.0)	0.0	0.0
Taxable Income	**(H) + (M) + (J) = (N)**		**($4.4)**	**($6.6)**	**($3.6)**	**$0.1**	**($3.6)**	**$4.1**
Tax Benefit (Liability)	**(N) x (Tax Rate) = (O)**		**$0.9**	**$1.4**	**$0.8**	**($0.0)**	**$0.8**	**($0.9)**
Federal Investment Tax Credit (ITC)	**(P)**		**$17.5**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**
Capital Expenditures		**($46.7)**	**($11.7)**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**
After-Tax Net Equity Cash Flow	**(H) + (L) + (O) + (P) = (Q)**	**($46.7)**(7)	**$23.7**	**$6.6**	**$5.5**	**$4.6**	**$1.7**	**$2.1**
IRR For Equity Investors		**12.0%**						

Key Assumptions(5)	
Power Rating (MW)	100
Duration (Hours)	2
Usable Energy (MWh)	200
90% Depth of Discharge Cycles/Day	1
Operating Days/Year	350
Charging Cost ($/kWh)	$0.064
Fixed O&M Cost ($/kWh)	$1.30
Fixed O&M Escalator (%)	2.5%
Charging Cost Escalator (%)	1.87%
Efficiency (%)	91%
Capital Structure	
Debt	20.0%
Cost of Debt	8.0%
Equity	80.0%
Cost of Equity	12.0%
Taxes	
Combined Tax Rate	21.0%
Contract Term / Project Life (years)	20
MACRS Depreciation Schedule	5 Years
Federal ITC - BESS	30%
Capex	
Total Initial Installed Cost ($/kWh)(6)	$292
Extended Warranty (% of Capital Cost)	0.7%
Extended Warranty Start Year	3
Total Capex ($mm)	$58

Use-case specific Global assumptions

Source: *Lazard and Roland Berger estimates and publicly available information.*
Note: Numbers presented for illustrative purposes only.
* Denotes unit conversion.
(1) Assumes half-year convention for discounting purposes.
(2) Total Generation reflects (Cycles) x (Available Capacity) x (Depth of Discharge) x (Duration). Note for the purpose of this analysis, Lazard accounts for Degradation in the Available Capacity calculation.
(3) Charging Cost reflects (Total Generation) / [(Efficiency) x (Charging Cost) x (1 + Charging Cost Escalator)].
(4) O&M costs include general O&M (BESS plus any relevant Solar PV or Wind O&M, escalating annually at 2.5%), augmentation costs (incurred in years needed to maintain usable energy at original storage module cost) and warranty costs (0.7% of equipment, starting in year 3).
(5) Reflects a "key" subset of all assumptions for methodology and illustration purposes only. Does not reflect all assumptions.
(6) Initial Installed Cost includes Inverter costs, Module cost, Balance-of-System cost and EPC cost.
(7) Reflects initial cash outflow from equity sponsor.

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Levelized Cost of Storage—Key Assumptions

	Units	Utility-Scale Standalone (100 MW / 100 MWh)		Utility-Scale Standalone (100 MW / 200 MWh)		Utility-Scale Standalone (100 MW / 400 MWh)		C&I Standalone (1 MW / 2 MWh)		Residential Standalone (0.006 MW / 0.025 MWh)	
		Low	High	Low	High	Low	High	Low	High	Low	High
Power Rating	MW	100		100		100		1		0.006	
Duration	Hours	1.0		2.0		4.0		2.0		4.2	
Usable Energy	MWh	100		200		400		2		0.025	
90% Depth of Discharge Cycles/Day	#	1		1		1		1		1	
Operating Days/Year	#	350		350		350		350		350	
Project Life	Years	20		20		20		20		20	
Annual Storage Output	MWh	31,500		63,000		126,000		630		8	
Lifetime Storage Output	MWh	630,000		1,260,000		2,520,000		12,600		158	
Initial Capital Cost—DC	$/kWh	$220	$311	$159	$282	$160	$282	$318	$430	$984	$1,406
Initial Capital Cost—AC	$/kW	$30	$60	$30	$60	$30	$60	$45	$80	$0	
EPC Costs	$/kWh	$34	$129	$31	$116	$29	$110	$59	$159	$0	
Total Initial Installed Cost	M $	$25	$44	$38	$80	$76	$157	$1		$0	
Storage O&M	$/kWh	$3.7	$8.5	$2.9	$7.8	$2.8	$7.7	$5.5	$11.2	$0.0	
Extended Warranty Start	Year	3		3		3		3		3	
Warranty Expense % of Capital Costs	%	0.50%	1.50%	0.50%	1.50%	0.50%	1.50%	0.50%	1.50%	0.00%	
Investment Tax Credit	%	30.00%	40.00%	30.00%	40.00%	30.00%	40.00%	30.00%	40.00%	30.00%	40.00%
Charging Cost	$/MWh	$58		$64		$51		$129		$325	
Charging Cost Escalator	%	1.97%		1.97%		1.97%		1.97%		1.97%	
Efficiency of Storage Technology	%	91%	88%	91%	88%	91%	88%	91%	88%	91%	88%
Levelized Cost of Storage	$/MWh	$222	$352	$188	$322	$170	$296	$373	$518	$882	$1,101

Source: *Lazard and Roland Berger estimates and publicly available information.*
Note: All cases were modeled using 90% depth of discharge and 10% overbuild. Wholesale charging costs reflect weighted average hourly wholesale energy prices across a representative charging profile of a standalone storage asset participating in wholesale revenue streams. Escalation is derived from the EIA's "AEO 2022 Energy Source–Electric Price Forecast (20-year CAGR)".

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LCOH v4.0

Levelized Cost of Hydrogen Comparison—Methodology

($ in millions, unless otherwise noted)

Lazard's LCOH analysis consists of creating a model representing an illustrative project for each relevant technology and solving for the $/kg value that results in a levered IRR equal to the assumed cost of equity (see subsequent "Key Assumptions" page for detailed assumptions by technology)

Unsubsidized Green PEM—High Case Sample Illustrative Calculations

Year (1)			*1*	*2*	*3*	*4*	*5*	*25*
Electrolyzer size (MW)	(A)		20	20	20	20	20	20
Electrolyzer input capacity factor (%)	(B)		55%	55%	55%	55%	55%	55%
Total electric demand (MWh) (2)	(A) x (B) = (C)*		96,360	96,360	96,360	96,360	96,360	96,360
Electric consumption of H2 (kWh/kg) (3)	(D)		61.87	61.87	61.87	61.87	61.87	61.87
Total H2 output ('000 kg)	(C) / (D) = (E)		1,558	1,558	1,558	1,558	1,558	1,558
Levelized Cost of Hydrogen ($/kg)	***(F)***		***$7.37***	***$7.37***	***$7.37***	***$7.37***	***$7.37***	***$7.37***
Total Revenues	**(E) x (F) = (G)***		**$11.47**	**$11.47**	**$11.47**	**$11.47**	**$11.47**	**$11.47**
Warranty / insurance	(H)		--	--	($0.5)	($0.5)	($0.5)	($0.6)
Total O&M	(I)*		(5.3)	(5.4)	(5.4)	(5.4)	(5.4)	(5.8)
Total Operating Costs	**(H) + (I) = (J)**		**($5.3)**	**($5.4)**	**($5.8)**	**($5.8)**	**($5.9)**	($6.3)
EBITDA	**(G) - (J) = (K)**		**$6.1**	**$6.1**	**$5.6**	**$5.6**	**$5.6**	**$5.1**
Debt Outstanding - Beginning of Period	(L)		$18.1	$17.9	$17.6	$17.3	$17.0	$1.6
Debt - Interest Expense	(M)		($1.4)	($1.4)	($1.4)	($1.4)	($1.4)	($0.1)
Debt - Principal Payment	(N)		($0.2)	($0.3)	($0.3)	($0.3)	($0.3)	($1.6)
Levelized Debt Service	(M) + (N) = (O)		($1.7)	($1.7)	($1.7)	($1.7)	($1.7)	($1.7)
EBITDA	**(K)**		$6.1	$6.1	$5.6	$5.6	$5.6	$5.1
Depreciation (MACRS)	(P)		(6.5)	(11.1)	(7.9)	(5.7)	(4.0)	0.0
Interest Expense	(M)		(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(0.1)
Taxable Income	**(K) + (P) + (M) = (Q)**		**($1.8)**	**($6.4)**	**($3.7)**	**($1.4)**	**$0.2**	**$5.0**
Tax Benefit (Liability)	**(Q) x (tax rate) = (R)**		**$0.4**	**$1.3**	**$0.8**	**$0.3**	**($0.0)**	**$2.9**
Capital Expenditures		**($27)** (4)	**($18.1)**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**
After-Tax Net Equity Cash Flow	**(K) + (O) + (R) = (S)**		**$4.8**	**$5.8**	**$4.7**	**$4.2**	**$3.9**	**$6.3**
IRR For Equity Investors		**12.0%**						

Key Assumptions (5)	
Electrolyzer size (MW)	20.00
Electrolyzer input capacity factor (%)	55%
Lower heating value of hydrogen (kWh/kgH2)	33
Electrolyzer efficiency (%)	58.0%
Levelized penalty for efficiency degradation (kWh/kg)	4.4
Electric consumption of H2 (kWh/kg)	61.87
Warranty / insurance	1.0%
Total O&M	5.34
O&M escalation	2.00%
Capital Structure	
Debt	40.0%
Cost of Debt	8.0%
Equity	60.0%
Cost of Equity	12.0%
Taxes and Tax Incentives:	
Combined Tax Rate	21%
Economic Life (years) (6)	25
MACRS Depreciation (Year Schedule)	7-Year MACRS
Capex	
EPC Costs ($/kW)	$2,265
Additional Owner's Costs ($/kW)	$0
Transmission Costs ($/kW)	$0
Total Capital Costs ($/kW)	$2,265
Total Capex ($mm)	$45

Source: *Lazard and Roland Berger estimates and publicly available information.*
Note: Numbers presented for illustrative purposes only.
* Denotes unit conversion.
(1) Assumes half-year convention for discounting purposes.
(2) Total Electric Demand reflects (Electrolyzer Size) x (Electrolyzer Capacity Factor) x (8,760 hours/year).
(3) Electric Consumption reflects (Heating Value of Hydrogen) x (Electrolyzer Efficiency) + (Levelized Degradation).
(4) Reflects initial cash outflow from equity investors.
(5) Reflects a "key" subset of all assumptions for methodology illustration purposes only. Does not reflect all assumptions.
(6) Economic life sets debt amortization schedule.

Technology-dependent
Levelized

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Levelized Cost of Hydrogen—Key Assumptions

		Green Hydrogen						Pink Hydrogen					
	Units	PEM			Alkaline			PEM			Alkaline		
		Low		High	Low		High	Low		High	Low		High
Capacity	MW	100	–	20	100	–	20	100	–	20	100	–	20
Total Capex	$/kW	$1,063	–	$1,975	$1,100	–	$1,831	$1,133	–	$2,045	$1,170	–	$1,901
Electrolyzer Stack Capex	$/kW	$341	–	$862	$269	–	$562	$341	–	$862	$269	–	$562
Plant Lifetime	Years	25			25			25			25		
Stack Lifetime	Hours	60,000			67,500			60,000			67,500		
Heating Value	kWh/kg H_2	33			33			33			33		
Electrolyzer Utilization	%	90%			90%			90%			90%		
Electrolyzer Capacity Factor	%	55%			55%			95%			95%		
Electrolyzer Efficiency	% LHV[1]	65%			67%			65%			67%		
Operating Costs													
Annual Hydrogen Produced	MT	8,681	–	1,736	8,902	–	1,780	14,205	–	2,841	14,568	–	2,914
Process Water Costs	$/kg H_2	$0.005			$0.005			$0.005			$0.005		
Annual Energy Consumption	MWh	481,800	–	96,360	481,800	–	96,360	788,400	–	157,680	788,400	–	157,680
Net Electricity Cost	$/MWh	$48.00			$48.00			$35.00			$35.00		
Warranty & Insurance (% of Capex)	%	1.0%			1.0%			1.0%			1.0%		
Warranty & Insurance Escalation	%	1.0%			1.0%			1.0%			1.0%		
O&M (% of Capex)	%	1.5%			1.5%			1.5%			1.5%		
Annual Inflation	%	2.0%			2.0%			2.0%			2.0%		
Capital Structure													
Debt	%	40%			40%			40%			40%		
Cost of Debt	%	8%			8%			8%			8%		
Equity	%	60%			60%			60%			60%		
Cost of Equity	%	12%			12%			12%			12%		
Tax Rate	%	40%			40%			40%			40%		
WACC	%	9.1%			9.1%			9.1%			9.1%		
Levelized Cost of Hydrogen	$/kg	$4.45	–	$6.05	$4.33	–	$5.49	$3.19	–	$4.33	$3.07	–	$3.86
Subsidized Levelized Cost of Hydrogen	$/kg	$2.48	–	$4.08	$2.36	–	$3.52	$1.22	–	$2.36	$1.11	–	$1.89
Memo: Natural Gas Equivalent Cost	*$/MMBTU*	*$39.05*	–	*$53.10*	*$38.00*	–	*$48.20*	*$28.00*	–	*$38.00*	*$27.00*	–	*$33.90*
Memo: Natural Gas Equivalent Cost (Subsidized Hydrogen)	*$/MMBTU*	*$21.80*	–	*$35.85*	*$20.75*	–	*$30.95*	*$10.75*	–	*$20.70*	*$9.70*	–	*$16.60*

Source: Lazard and Roland Berger estimates and publicly available information.
(1) "LHV" refers to the lower heating value of the electrolyzer.

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Lazard's LCOE+ will continue to evolve over time, and we appreciate that there can, and will be, varied views regarding the specifics of our analyses. Accordingly, we would be happy to discuss any of our underlying assumptions and analyses in further detail—and, to be clear, we welcome these discussions as we try to improve our studies over time. In that regard, the studies remain our attempt to contribute in a differentiated and impactful manner to the Energy Transition. Importantly, the Energy Transition is broader in scope than the deployment of renewable energy generation and a cross-sector focus is critical (e.g., energy efficiency, renewable fuels, decarbonization of industry/supply chain, etc.).

More generally, Lazard remains committed to our Power, Energy & Infrastructure Group clients, who remain our highest priority. In that regard, we believe that we have the greatest allocation of resources and effort devoted to this sector of any investment bank. Further, we have an ongoing and intense focus on strategic issues that require long-term commitment and planning. Accordingly, Lazard strives to maintain its preeminent position as a thought leader and leading advisor to clients on their most important matters, especially in this Industry.

If you have any questions regarding this memorandum or Lazard's LCOE+, please feel free to contact any member of the Lazard Power, Energy & Infrastructure Group, including those listed below.

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March Investor Presentation

NextEra Energy



March 2025

Cautionary Statements and Risk Factors That May Affect Future Results

This presentation includes forward-looking statements within the meaning of the federal securities laws. Actual results could differ materially from such forward-looking statements. The factors that could cause actual results to differ are discussed in the Appendix herein and in NextEra Energy's SEC filings.

Non-GAAP Financial Information

This presentation refers to certain financial measures that were not prepared in accordance with U.S. generally accepted accounting principles. Reconciliations of those historical non-GAAP financial measures to the most directly comparable GAAP financial measures can be found in the Appendix herein.

Other

See Appendix for definition of Adjusted Earnings expectations.

NextEra Energy is powered by two industry-leading companies, strengthened by a common platform

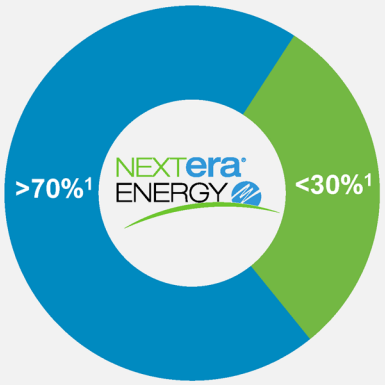


1. As of December 31, 2024
2. FPL and NextEra Energy Resources portfolio as of December 31, 2024; includes XPLR Infrastructure's portfolio reflected at NextEra Energy's ownership share

Our capital investment strategy is focused on long-term, consistent revenues and superior returns

FPL

Rate-regulated return on capital invested in a constructive regulatory environment



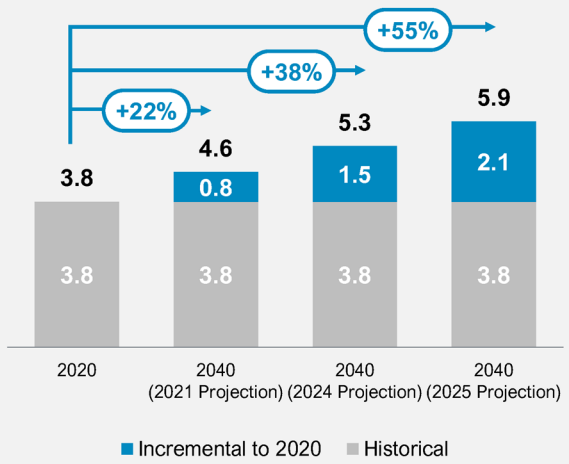
NEXTera ENERGY RESOURCES

Primarily long-term contracted investments with A- counterparty credit rating on average

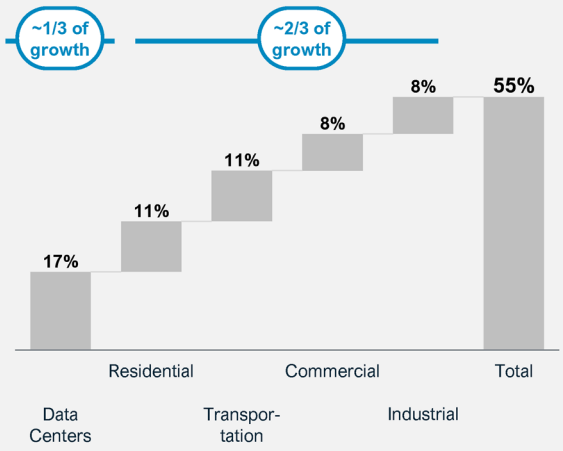
1. Based on regulated to unregulated mix required under credit agency methodology; regulated portion is primarily FPL as well as other regulated assets
2. Excludes regulated assets

Demand forecast growth continues to accelerate

U.S. Power Demand (thousand TWh)[1]

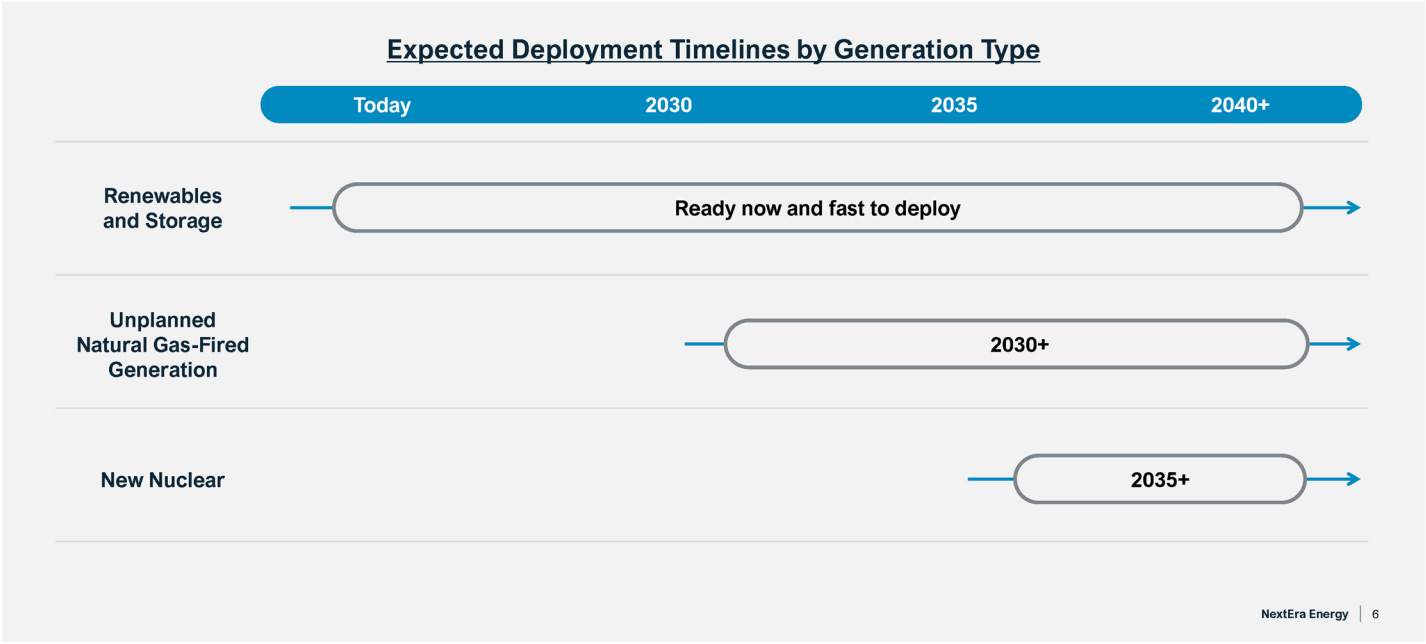


Growth by Sector[2]



1. Sources: Historical: Energy Information Administration. Forecast: IHS Outlook and McKinsey
2. Source: Goldman Sachs

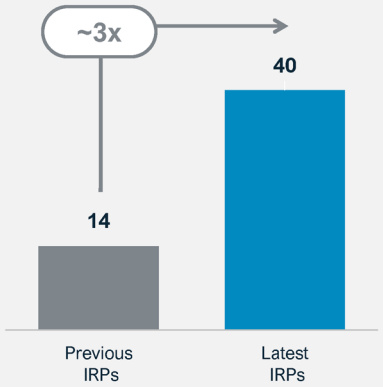
Neither gas nor nuclear have supply chains running at scale – it is expected to take 5+ years to get natural gas plants built and running and nuclear is 10+ years away



Natural gas-fired generation cannot meet demand in the near term and is a longer-term, more expensive solution

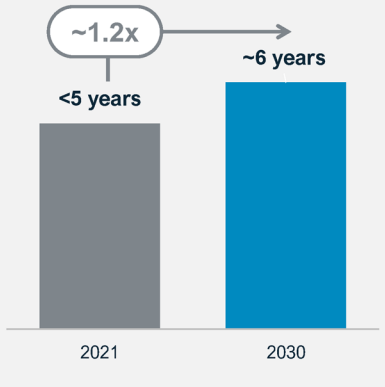
Rising Demand

10-Year New Natural Gas Generation Growth in IRPs[1]
GW



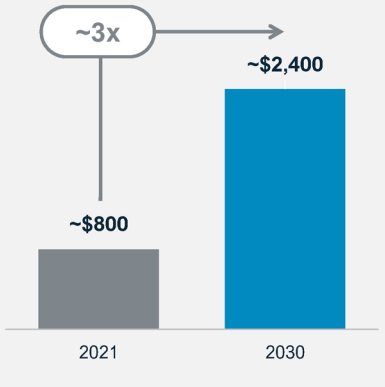
Longer Build Times

New Natural Gas Combined Cycle Build Time[2]
Years



Higher CapEx

New Natural Gas Combined Cycle CapEx[2]
$/kW

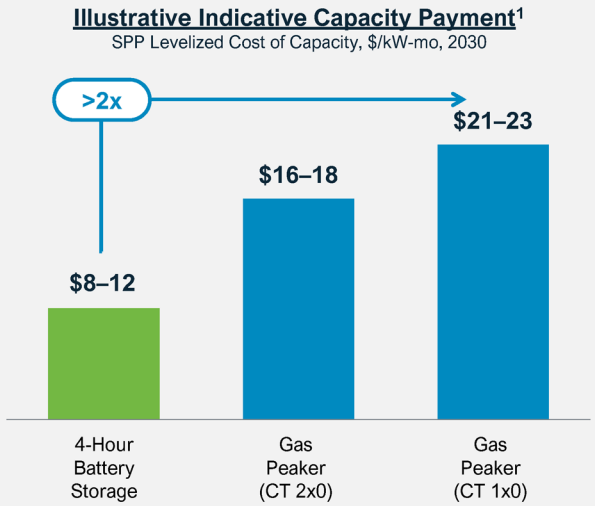


1. Compares latest and previous vintage IRP demand and supply plans for 21 large load serving entities representing ~20% of U.S. load in 2025
2. Internal estimates

Storage offers compelling speed-to-market and cost advantages as capacity needs grow across the U.S.

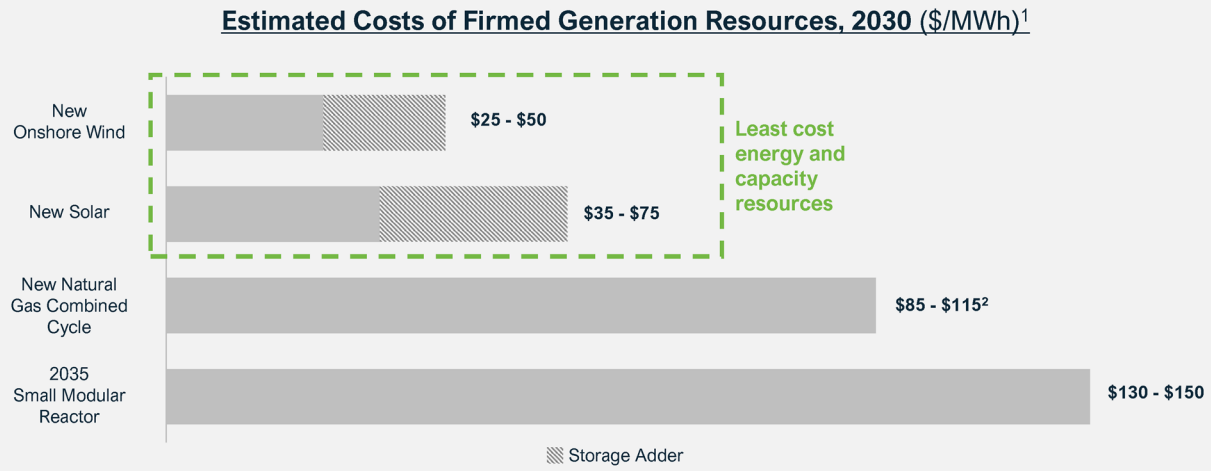
Comparing Capacity Resources

	Battery Storage	Gas Peaker
Meets capacity needs	✓	✓
Equipment availability	~12 months	~4 years
Location Flexibility	Existing site and grid	New gas supply and lateral line
Cost trends	→	→



1. Internal estimates

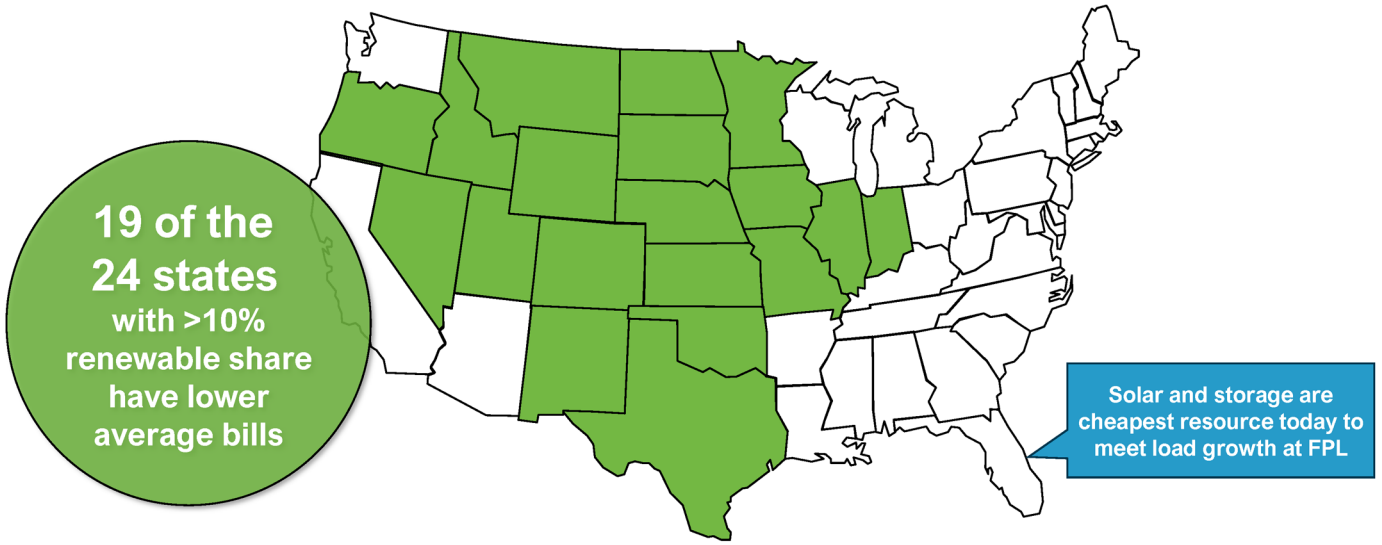
Renewables and storage are the most cost-effective energy and capacity solutions, and are ready now



1. WoodMac levelized cost of electricity as of December 2024 adjusted for renewable energy credits
2. WoodMac levelized cost of electricity adjusted for 2030 internal capital expenditure estimate and higher utilization for low end of the range

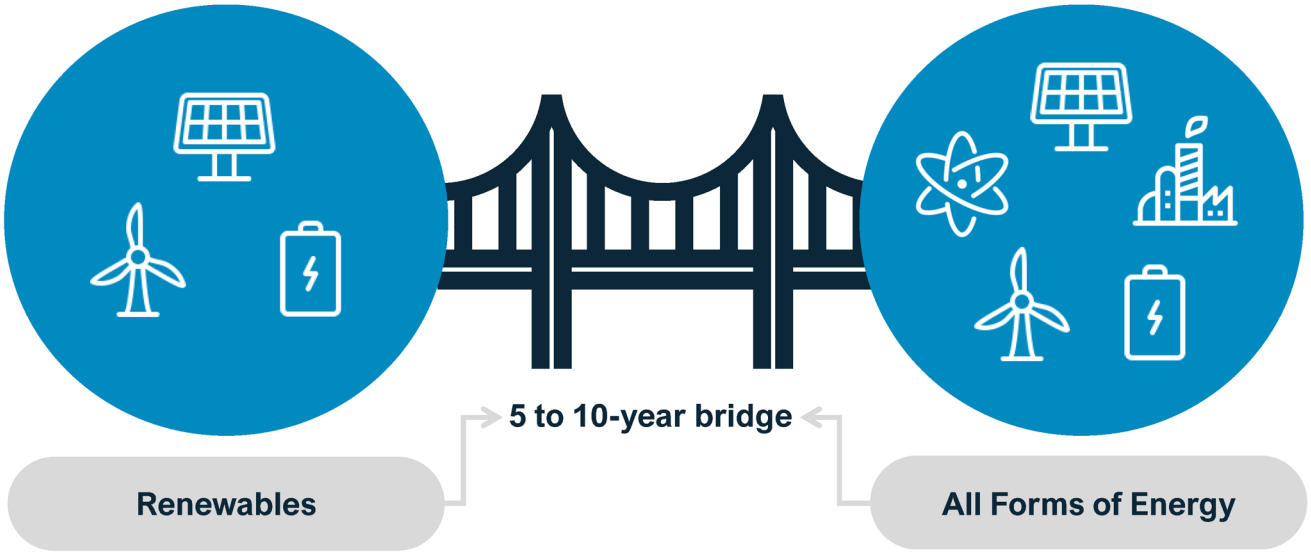
Americans are paying lower electric rates in states where renewable penetration is higher

State Renewable Share and Electric Rates vs. National Averages[1]



1. Renewable share and electric rates by region and US averages represent gen-weighted 2024 data; generation data retrieved from EIA-923 Power Plant Operations report, and rates retrieved from EIA-861 Retail Sales of Electricity to Ultimate Customers

While we work to rebuild the gas and nuclear supply chains, America needs renewables to bridge the gap



We have expertise developing and operating all technologies

Wind, Solar, Storage Fleet
40 GW[1]



- World leader in renewables and storage
- Solar and wind better than top-decile O&M cost per MWh[2]
- Fleet-wide remote operations control center
- ~330 projects in operations and backlog with A average credit rating[3]

Nuclear Fleet
6 GW[1]



- One of the top performing large fleets in the industry
- Industry leader in O&M cost per MWh with and without fuel
- Top decile in capacity factor and forced loss
- Most technologically innovative and centrally-run fleet in the U.S.

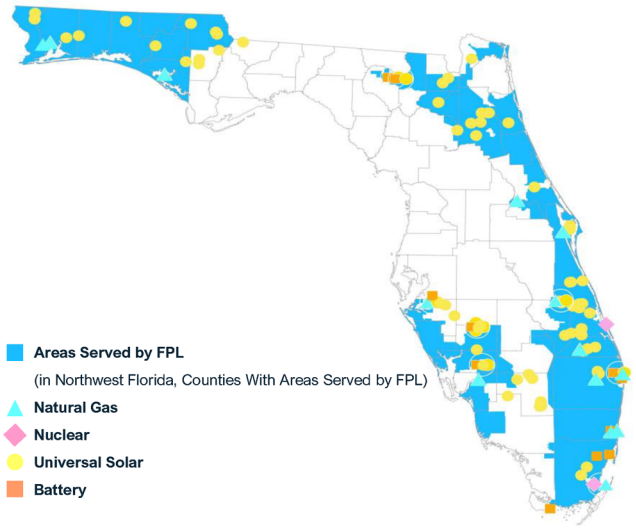
Fossil Fleet
27 GW[1]



- One of the largest gas fleets in the U.S.
- Industry-leading low EFOR[4] and heat rate
- Industry-first remote operations control center
- Better than top-decile O&M cost per MWh

1. FPL and NextEra Energy Resources portfolio as of December 31, 2024; includes XPLR Infrastructure's portfolio reflected at NextEra Energy's ownership share
2. O&M costs are reported on a net generation basis and include operations and maintenance expenses excluding environmental, utilities and interconnect; industry site benchmarks reflect independent studies' analysis of individual sites through year-end 2023 and extrapolated for 2024 adjusting for CPI
3. Reflects Energy Resources' operating portfolio and backlog as of January 24, 2025; S&P weighted average credit rating
4. Equivalent forced outage rate

As the nation's leading electric utility, FPL is well positioned to power Florida's economy into the future

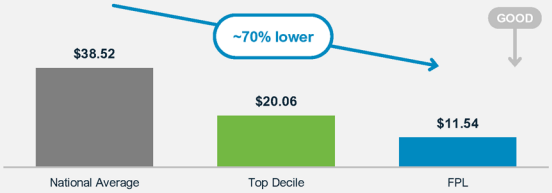


- **Largest electric utility in the U.S. with over 6.0 MM customer accounts**
- **~36 GW in operation[1]**
- **Making smart capital investments for the benefit of customers**
- **Delivering superior value for our customers**

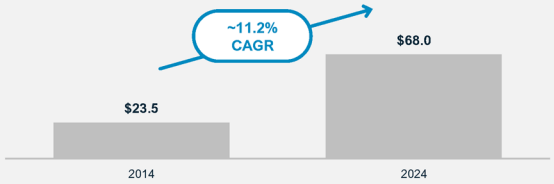
1. As of December 31, 2024

FPL has experienced strong growth, and we continue to deliver for our customers

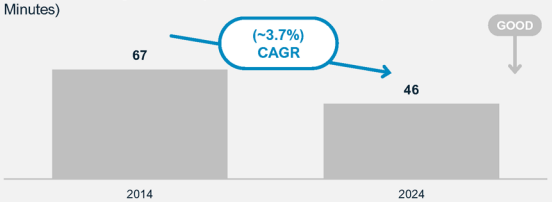
Operational Cost Effectiveness[1] ($/MWh Non-Fuel O&M)



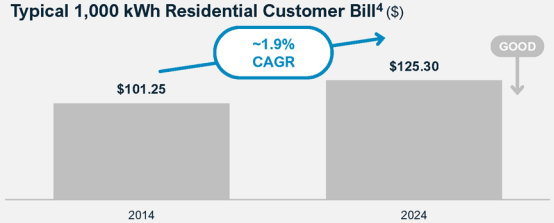
Regulatory Capital Employed Growth[3] ($B)



System Average Interruption Duration Index (SAIDI)[2] (Average Outage Minutes)

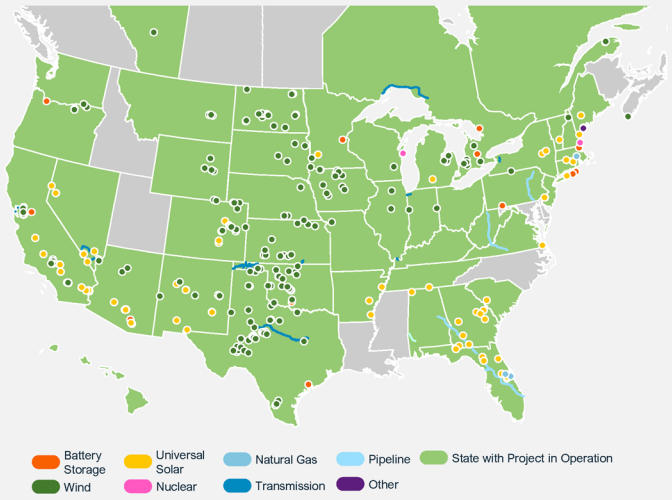


Typical 1,000 kWh Residential Customer Bill[4] ($)

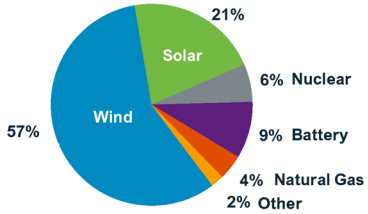


1. FERC Form 1 non-fuel O&M; Industry 2023; Excludes injuries and damages, pensions and benefits and other power supply expenses; FPL excludes one-time storm impacts; Includes holding companies with >100k customers and utility-owned generation
2. System average interruption duration index as reported to the Florida Public Service Commission
3. Excludes accumulated deferred income taxes; 13-month average; Includes retail rate base, wholesale rate base, clause-related investments and AFUDC projects
4. Reflects yearly FPL average bill; excludes FPL Northwest Florida

NextEra Energy Resources is the leading North American clean energy company



~37 GW[1] of generation and storage in operation



World leader in wind, solar and storage

More than 25 GW[2] backlog and ~300 GW[2] pipeline of renewables and storage

NextEra Energy Transmission is a leading competitive transmission company

Note: Totals may not foot due to rounding
1. Energy Resources' portfolio as of December 31, 2024; includes XPLR Infrastructure's portfolio reflected at NextEra Energy's ownership share
2. Backlog as of January 24, 2025, pipeline as of March 18, 2025

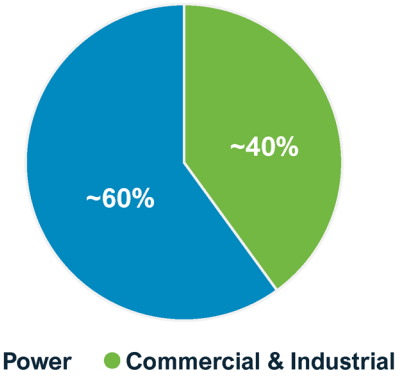
We are the #1 originator for U.S. power and commercial & industrial customers

20% market share in renewables and storage origination[1]

25+ years serving power customers

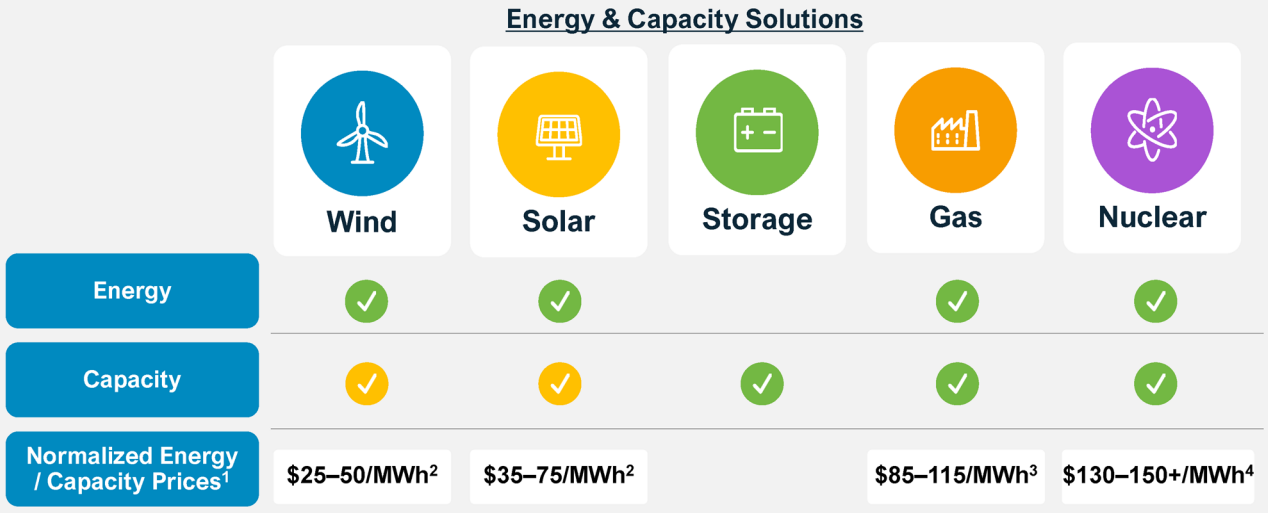
15 years serving commercial & industrial customers

NextEra Energy Resources' 2020–2024 Signed PPAs



1. Using WoodMac origination data as of year-end 2022 for 3rd party signed contracts and Energy Resources internal data on Energy Resources signed contracts

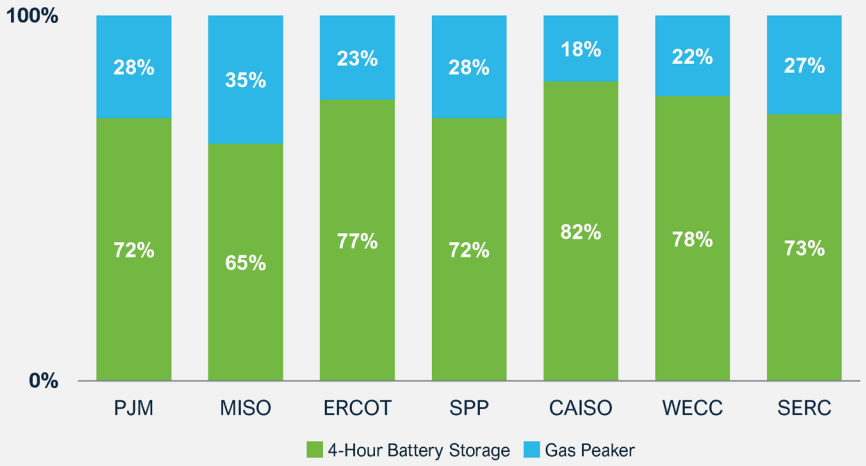
All forms of energy are required to meet demand and customer needs



1. WoodMac levelized cost of electricity as of December 2024 adjusted for renewable energy credits
2. Includes storage adder
3. WoodMac levelized cost of electricity adjusted for 2030 internal capital expenditure estimate and higher utilization for low end of the range
4. Nth-of-a-Kind technology

In most U.S. markets, 4-hour battery storage deployments can cover >70% of the generation provided by a typical gas peaker

Generation Needs Satisfied by Dispatchable Resources[1,2,3]



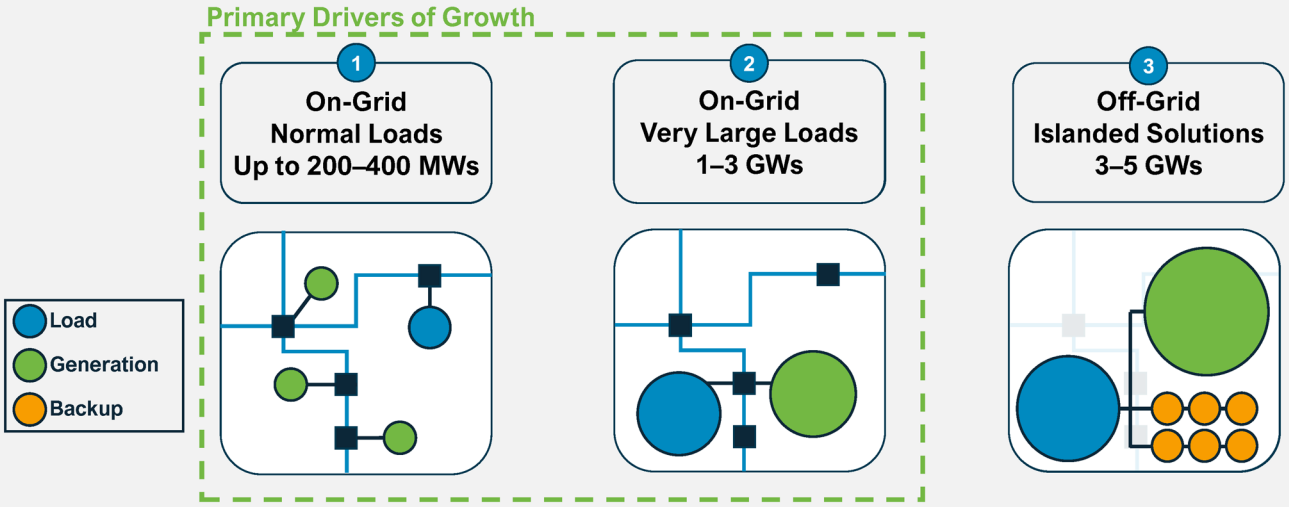
Levelized Cost of Capacity[4]

4-Hr: $8–12/kW-mo

1x0: $21–23/kW-mo
2x0: $16–18/kW-mo

1. 2023 hourly generation data from Hitachi Energy Velocity
2. Portion of 2023 gas peaker dispatch that could be covered by 4-hr battery storage and considers operational constraints of charging
3. Run time for gas peaker and battery storage is normalized to 100% of nameplate. (i.e. 6 hours of 50% nameplate -> 3 hours of 100% nameplate)
4. Internal estimates; SPP levelized cost of capacity, $/kW-month, 2030

We are equipped to serve the full range of customer needs



We expanded from a replacement demand cycle into growth demand cycle

Old World	New World
Replacement linked to coal retirements	Supporting large new loads
Demanding carbon free energy	Needing all forms of energy
Commoditized request for proposals	Bilateral trusted partners
Renewable energy certificates	Energy and capacity

We believe our scale, experience and technology will continue to give customers certainty that we will deliver cost-effective power solutions

We are well positioned to win…

- **Experience of building ~6x more** MWs in last 5 years than any Top 10 Utility
- **Utility Experience**
- **Trusted Relationships** of 25+ years
- **Proprietary Technology**
- **~300 GW of Pipeline** across technologies[1]

…across all types of load growth

1. **On-Grid: Normal Loads**
2. **On-Grid: Very Large Loads**
3. **Off-Grid: Islanded Solutions**

1. Pipeline as of March 18, 2025

Energy Resources' proprietary data and technology supports our ability to create projects with the most value and improve our development success rate

Data and Technology



Prospect

- Evaluating 30+ MM land clusters per night on ~100 attributes
- Remote sensing equipment yields 3x spatial resolution vs industry for project siting



Design

- Full energy system supply and demand capacity optimization
- AI based dispatch optimization matches generation to load



Develop & Construct

- Solar panel allocation algorithm optimizes >200 MM scenarios to deploy ~20 MM solar panels annually
- Largest drone fleet in the industry completing 145,000 flights annually



Operate

- Top decile O&M performance enabled by state of the art monitoring and generative AI
- Over 20 GW of gas generation operated from a first-of-its-kind Fleet Control Center



Transmission Planning

- Proprietary digital twin of the US power grid, enabling multi-value planning and benefit calculations
- Geospatial routing capability using 50 nationwide datasets and over 3 trillion pixels of information

We believe we have the opportunity to develop 36.5 to 46.5 GW of new renewables and storage through 2027

NextEra Energy Resources Development Program[1]

As of January 24, 2025; GW

	2024–2025 COD & Backlog	2024–2025 Expectations	2026–2027 Backlog	2026–2027 Expectations	2024–2027 Expectations
Wind	2.9	3.5–4.4	2.5	5.5–7.1	9.0–11.5
Solar	7.2	7.4–8.3	7.1	11.1–14.1	18.5–22.4
Energy Storage	3.1	2.6–3.5	4.0	5.2–7.2	7.8–10.7
Wind Repowering[2]	0.6	0.6–0.9	0.5	0.6–1.0	1.2–1.9
Total	**13.8**	14.1–17.1	14.1	22.4–29.4	36.5–46.5
Build-Own-Transfer	0.4		–		

Renewables and storage backlog stands at more than 25 GW[3], which supports our long-term growth expectations

Note: Totals may not foot due to rounding

1. GW capacity expected to be owned and/or operated by NextEra Energy Resources; backlog defined as assets with signed long-term power purchase agreements, build-own-transfer projects with long-term O&M agreements and assets with expected long-term agreements including power hedging and/or the sale of environmental attributes; all projects are subject to development and construction risks
2. Includes repowering expectations for XPLR Infrastructure's wind assets, reflected at NextEra Energy's expected ownership share
3. As of January 24, 2025; includes ~3.4 GW for post-2027 delivery

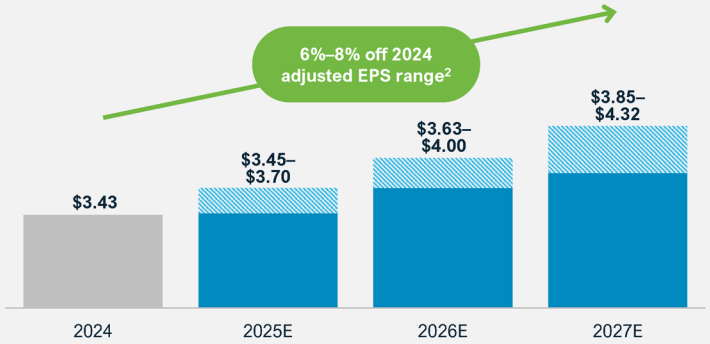
NextEra Energy is the quintessential “all forms of energy” company

- America’s No.1 electricity provider
- Owner and operator of America’s largest natural gas fleet
- Owner of largest U.S. electric utility with one of lowest bills in nation
- One of the largest nuclear operators in the U.S.
- A world leader in battery storage
- World’s No.1 generator of electricity from wind and sun
- America’s leading competitive transmission provider
- America’s power sector leader in data science and technology

We plan to invest ~$120 billion in American energy infrastructure over the next four years

NextEra Energy remains well positioned to continue our strong adjusted earnings per share growth

NextEra Energy's Financial Expectations[1]



- Expect 6 to 8% annual growth rate through 2027, off the 2024 adjusted EPS expectations range[2]
- From 2023 to 2027 expect compound annual growth in operating cash flow to be at or above our adjusted EPS growth rate
- Continue to expect ~10% annual dividend per share growth through at least 2026[3]

We will be disappointed if we are not able to deliver financial results at or near the top end of our adjusted EPS expectations ranges through 2027

1. Subject to our caveats
2. 2024 adjusted EPS range of $3.23–$3.43
3. Off a 2024 base; dividend declarations are subject to the discretion of the board of directors of NextEra Energy

Appendix

NextEra Energy's credit metrics remain on track

NextEra Energy Credit Metrics

S&P	A- Range	Downgrade Threshold	Actual 2024[1]	Target 2025
FFO/Debt	13%–23%	18%	19.1%	>18%

Moody's	Baa Range	Downgrade Threshold	Actual 2024	Target 2025
CFO Pre-WC/Debt	13%–22%	17%	19.4%	>17%

Fitch	A Midpoint	Downgrade Threshold	Actual 2024[1]	Target 2025
Debt/FFO + Interest	3.5x	4.3x	4.1x	<4.3x

1. Preliminary based on NextEra Energy's calculations and application of each credit rating agency's respective methodologies for financial statement adjustments and ratio calculations; see 'Financial Strength' tab of NextEra Energy's Fixed Income Investors website for adjustment details

Reconciliation of GAAP Net Income to Adjusted Earnings Attributable to NextEra Energy, Inc.

(Twelve Months Ended December 31, 2024)

(millions, except per share amounts)	FPL	Energy Resources	Corporate & Other	NextEra Energy, Inc.
Earnings (Loss) Per Share				
Attributable to NextEra Energy, Inc. (assuming dilution)	**$ 2.21**	**$ 1.12**	**$ 0.04**	**$ 3.37**
Adjustments - pretax:				
Net losses (gains) associated with non-qualifying hedges	-	-	(0.45)	(0.45)
Change in unrealized losses (gains) on equity securities held in NEER's nuclear decommissioning funds and OTTI - net	-	(0.05)	-	(0.05)
Differential membership interests – related	-	-	-	-
XPLR Infrastructure investment gains - net	-	0.55	-	0.55
Less related income tax expense (benefit)	-	(0.11)	0.12	0.01
Adjusted Earnings (Loss) Per Share	**$ 2.21**	**$ 1.51**	**$ (0.29)**	**$ 3.43**

Definitional Information

NextEra Energy, Inc. Adjusted Earnings Expectations (including subsidiaries as applicable)

This presentation refers to adjusted earnings per share expectations. NextEra Energy does not provide a quantitative reconciliation of forward-looking adjusted earnings per share to earnings per share, the most directly comparable GAAP financial measure, because certain information needed to reconcile these measures is not available without unreasonable efforts due to the inherent difficulty in forecasting and quantifying these measures. These items include, but are not limited to, the effects of non-qualifying hedges and unrealized gains and losses on equity securities held in NextEra Energy Resources, LLC's nuclear decommissioning funds and other than temporary impairments. These items could significantly impact GAAP earnings per share. Adjusted earnings expectations assume, among other things: normal weather and operating conditions; positive macroeconomic conditions in the U.S. and Florida; supportive commodity markets; current forward curves; public policy support for wind and solar development and construction; market demand and transmission expansion to support wind and solar development; market demand for pipeline capacity; access to capital at reasonable cost and terms; no adverse litigation decisions; and no changes to governmental policies or incentives.

Cautionary Statement And Risk Factors That May Affect Future Results

This presentation contains "forward-looking statements" within the meaning of the safe harbor provisions of the Private Securities Litigation Reform Act of 1995. Forward-looking statements are not statements of historical facts, but instead represent the current expectations of NextEra Energy, Inc. (together with its subsidiaries, NextEra Energy) regarding future operating results and other future events, many of which, by their nature, are inherently uncertain and outside of NextEra Energy's control. Forward-looking statements in this presentation include, among others, statements concerning adjusted earnings per share expectations and future operating performance and statements concerning future dividends. In some cases, you can identify the forward-looking statements by words or phrases such as "will," "may result," "expect," "anticipate," "believe," "intend," "plan," "seek," "potential," "projection," "forecast," "predict," "goals," "target," "outlook," "should," "would" or similar words or expressions. You should not place undue reliance on these forward-looking statements, which are not a guarantee of future performance. The future results of NextEra Energy and its business and financial condition are subject to risks and uncertainties that could cause actual results to differ materially from those expressed or implied in the forward-looking statements, or may require it to limit or eliminate certain operations. These risks and uncertainties include, but are not limited to, those discussed in this presentation and the following: effects of extensive regulation of NextEra Energy's business operations; inability of NextEra Energy to recover in a timely manner any significant amount of costs, a return on certain assets or a reasonable return on invested capital through base rates, cost recovery clauses, other regulatory mechanisms or otherwise; impact of political, regulatory, operational and economic factors on regulatory decisions important to NextEra Energy; effect of any reductions or modifications to, or elimination of, governmental incentives or policies that support clean energy projects or the imposition of additional tax laws, tariffs, duties, policies or other costs or assessments on clean energy or equipment necessary to generate, store or deliver it; impact of new or revised laws, regulations executive orders, interpretations or constitutional ballot and regulatory initiatives on NextEra Energy; capital expenditures, increased operating costs and various liabilities attributable to environmental laws, regulations and other standards applicable to NextEra Energy; effects on NextEra Energy of federal or state laws or regulations mandating new or additional limits on the production of greenhouse gas emissions; exposure of NextEra Energy to significant and increasing compliance costs and substantial monetary penalties and other sanctions as a result of extensive federal, state and local government regulation of its operations and businesses; effect on NextEra Energy of changes in tax laws, guidance or policies as well as in judgments and estimates used to determine tax-related asset and liability amounts; impact on NextEra Energy of adverse results of litigation; impacts of NextEra Energy of allegations of violations of law; effect on NextEra Energy of failure to proceed with projects under development or inability to complete the construction of (or capital improvements to) electric generation, storage, transmission and distribution facilities, natural gas and oil production and transportation facilities or other facilities on schedule or within budget; impact on development and operating activities of NextEra Energy resulting from risks related to project siting, planning, financing, construction, permitting, governmental approvals and the negotiation of project development agreements, as well as supply chain disruptions; risks involved in the operation and maintenance of electric generation, storage, transmission and distribution facilities, natural gas and oil production and transportation facilities, and other facilities; effect on NextEra Energy of a lack of growth, slower growth or a decline in the number of customers or in customer usage; impact on NextEra Energy of severe weather and other weather conditions; threats of terrorism and catastrophic events that could result from geopolitical factors, terrorism, cyberattacks or other attempts to disrupt NextEra Energy's business or the businesses of third parties; inability to obtain adequate insurance coverage for protection of NextEra Energy against significant losses and risk that insurance coverage does not provide protection against all significant losses; a prolonged period of low natural gas and oil prices, disrupted production or unsuccessful drilling efforts could impact NextEra Energy's natural gas and oil production and transportation operations and cause NextEra Energy to delay or cancel certain natural gas and oil production projects and could result in certain assets becoming impaired;

Cautionary Statement And Risk Factors That May Affect Future Results (cont.)

risk of increased operating costs resulting from unfavorable supply costs necessary to provide full energy and capacity requirements services; inability or failure to manage properly or hedge effectively the commodity risk within its portfolio; effect of reductions in the liquidity of energy markets on NextEra Energy's ability to manage operational risks; effectiveness of NextEra Energy's risk management tools associated with its hedging and trading procedures to protect against significant losses, including the effect of unforeseen price variances from historical behavior; impact of unavailability or disruption of power transmission or commodity transportation operations on sale and delivery of power or natural gas; exposure of NextEra Energy to credit and performance risk from customers, hedging counterparties and vendors; failure of counterparties to perform under derivative contracts or of requirement for NextEra Energy to post margin cash collateral under derivative contracts; failure or breach of NextEra Energy's information technology systems; risks to NextEra Energy's retail businesses from compromise of sensitive customer data; losses from volatility in the market values of derivative instruments and limited liquidity in over-the-counter markets; impact of negative publicity; inability to maintain, negotiate or renegotiate acceptable franchise agreements; occurrence of work strikes or stoppages and increasing personnel costs; NextEra Energy's ability to successfully identify, complete and integrate acquisitions, including the effect of increased competition for acquisitions; environmental, health and financial risks associated with ownership and operation of nuclear generation facilities; liability of NextEra Energy for significant retrospective assessments and/or retrospective insurance premiums in the event of an incident at certain nuclear generation facilities; increased operating and capital expenditures and/or reduced revenues at nuclear generation facilities resulting from orders or new regulations of the Nuclear Regulatory Commission; inability to operate any of NextEra Energy's owned nuclear generation units through the end of their respective operating licenses or planned license extensions; effect of disruptions, uncertainty or volatility in the credit and capital markets or actions by third parties in connection with project-specific or other financing arrangements on NextEra Energy's ability to fund its liquidity and capital needs and meet its growth objectives; defaults or noncompliance related to project-specific, limited-recourse financing agreements; inability to maintain current credit ratings; impairment of liquidity from inability of credit providers to fund their credit commitments or to maintain their current credit ratings; poor market performance and other economic factors that could affect NextEra Energy's defined benefit pension plan's funded status; poor market performance and other risks to the asset values of nuclear decommissioning funds; changes in market value and other risks to certain of NextEra Energy's assets and investments; effect of inability of NextEra Energy subsidiaries to pay upstream dividends or repay funds to NextEra Energy or of NextEra Energy's performance under guarantees of subsidiary obligations on NextEra Energy's ability to meet its financial obligations and to pay dividends on its common stock; the fact that the amount and timing of dividends payable on NextEra Energy's common stock, as well as the dividend policy approved by NextEra Energy's board of directors from time to time, and changes to that policy, are within the sole discretion of NextEra Energy's board of directors and, if declared and paid, dividends may be in amounts that are less than might be expected by shareholders; XPLR Infrastructure, LP's inability to access sources of capital on commercially reasonable terms could have an effect on its ability to consummate future acquisitions and on the value of NextEra Energy's limited partner interest in XPLR Operating Partners, LP; effects of disruptions, uncertainty or volatility in the credit and capital markets on the market price of NextEra Energy's common stock; and the ultimate severity and duration of public health crises, epidemics and pandemics, and its effects on NextEra Energy's business. NextEra Energy discusses these and other risks and uncertainties in its annual report on Form 10-K for the year ended December 31, 2024 and other Securities and Exchange Commission (SEC) filings, and this presentation should be read in conjunction with such SEC filings. The forward-looking statements made in this presentation are made only as of the date of this presentation and NextEra Energy undertakes no obligation to update any forward-looking statements.

Loudoun County
VIRGINIA

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January 17, 2026

To the Chair and Members of the House Committee on Small Business

Thank you for the opportunity to submit testimony regarding the impact of data center development on rural communities.

I am the Ashburn District Supervisor serving on the Loudoun County, VA Board of Supervisors, and I have also been recently elected by my peers to serve a second term as the Vice Chair of the Board. We are a nine-person, bipartisan Board, each elected for four-year terms, and we are the senior governing body of the county. I am also the Chair of the Environment, Energy and Land Use Committee for both the National Association of Counties (NACo) and the Virginia Association of Counties (VACo).

My testimony today is my own and does not represent the views or positions of any of the above bodies or their members.

As you probably know, Loudoun County, VA is home to the highest concentration of data centers in the world with about 200 data centers within the 30-square mile area of eastern Loudoun County. There has not been a single day in the past 15 years when a data center was not under construction somewhere in our county. Data centers began coming to Loudoun County around 2000, attracted by our extensive underground fiber optic network laid in the mid-nineties by the Advanced Research Project Agency. This network has given Loudoun County the lowest latency rates in the world (i.e. fastest; latency is the time it takes for data to move between two points).

Recognizing this unique market advantage, in 2008 our Director of Economic Development began actively inviting data centers, a new type of IT entity at the time, to locate within the county. Until about 2020, that growth was largely centered in our eastern industrial park areas, was largely "by right" (construction allowed on a land parcel with only an administrative construction permitting process not requiring Board approval), required no more than normal Board land-use oversight, and had little direct impact on residential areas. This growth also occurred during a ten-year period of slight decline in the amount of load on our power grid because of grid technological advancements and greater grid efficiencies.

In 2020, that stable market underwent tectonic, historic change due to three simultaneous phenomenon: 1) the world experienced an exponential increase in demand for data largely as a permanent outcome of the COVID pandemic, 2) the increased demand for data led to an exponential increase in demand for power to process that data, and finally, 3) artificial intelligence (AI), with its tenfold increase in required power within each of thousands of data racks inside a typical data center, burst onto the IT scene.

The result, just five years later, is not just historic; it's the beginning of a new era representing the world's second Industrial Revolution, and Loudoun County is at the nexus of that revolution. In 2018, Loudoun County had about 13 million square feet of data centers. We now have about 47 million square feet with another 65 million theoretically in the pipeline. In 2018, Loudoun County power demand was about 1.0 Gw. It is now 5.33 Gw.

As one can imagine, this historic growth in data centers and power demand has presented real, highly complex and often urgent challenges for the Loudoun County Board of Supervisors. In November, 2023, following a briefing I gave to VACo members on the history of data centers in Loudoun County, I recognized that, as an elected official in the county at the forefront of a global technological revolution, I had an obligation to learn all I could about how we got here, who the stakeholders are, what the key factors of growth and change are, and what kinds of decisions will be required of the Loudoun County Board of Supervisors going forward. I have captured the results of my two years of past and ongoing research in a white paper, a slide deck and in a one-page primer for local county officials summarizing the pros and cons of data centers in their community and listing 15 best practices for those bodies to consider when approached by data centers. These can be downloaded at www.Loudoun.gov/Ashburn.

I offer Committee Members this top-line overview of key themes:

Empower, Don't Encroach on Local Land-Use and Taxing Authority.

This is perhaps the most critical lesson we've learned, and it's one I share frequently when speaking on panels and with local elected officials from around the nation: every data center development is unique within each community. Only local elected officials understand the complex considerations and impact such development will have on their constituents, their homes, their economy and their quality of life. With the exponential growth of data centers and their demands on local power grids, community resistance to data centers has grown. This, in turn, appears now to be influencing many state and federal officials to consider measures to wrest local land use control and local taxing authority away from local jurisdictions. Let me state plainly such actions would very likely prove a disaster with enormous unforeseen consequences. Rather than wresting land-use and local taxation authority from local jurisdictions, state and federal legislators should, instead, empower local jurisdictions by providing them with proven best practices for data center land use, taxation methods, and electric utility planning. They should support tax incentives encouraging appropriate data center development for the benefit of all. In this fast-moving, historic market environment, a federal- or state-mandated "one size fits all" approach to the problem will almost certainly have dire consequences for local communities. Moreover, such initiatives will ultimately likely stymie responsible data center growth and sustainable power grid development.

Data Center Pros and Cons.

Pros:

1. **Tax Revenue.** Depending on each local jurisdiction's taxing authority, data centers can potentially offer local jurisdictions a major source of revenue. Loudoun County real property taxes are about 25% lower than all but one of the D.C. Metro area jurisdictions, and that one also has a large data center presence. We have lowered our real property tax rate every year for the past six years. Data center tax revenue represents about 38% of our operating budget. Our county enjoys a AAA bond rating from all three credit agencies, one of only about 50 of the 3,069 counties in the nation to have achieved that rank.

2. **Infrastructure.** Data centers put very few kids in schools and very few cars on the road. It costs Loudoun County about $.04 in infrastructure costs for every $1.00 of tax revenue received from data centers. That number is $.25/$1.00 of revenue for non-data center commercial taxpayers, and it's about breakeven for residences.

3. **Jobs.** Data centers can be an excellent source of new jobs for a community, particularly in those collateral goods and services businesses serving ongoing data center operations. They have also proven to be strong community partners to Loudoun County's nonprofit community.

Cons: The downside of data center development within a community is most often experienced when a community fails to adequately address one or more of the six key data center development considerations we have learned in Loudoun County form the basis of responsible data center growth:

1. Sight
2. Setback
3. Sound
4. Emissions
5. Power
6. Water

Best Practices.

Using the key considerations list above, local elected officials can develop sound, community-specific land-use performance standards and responsibly determine when data center development is appropriate within their community. Similarly, state and federal governmental bodies can also use the list to develop a set of best practices to inform and empower local jurisdictions not familiar with data center development to enable them to make better, more appropriate land-use and taxation decisions. Here are the standards we have implemented or are contemplating now in Loudoun County:

Sight.

a. 30% fenestration (windows, faux or real) on any principal facade facing a major roadway or residential neighborhood.
b. Berms, tree screening, vegetation facing residential or small business neighbors.
c. Building step back above 45 feet to add elevation variability.
d. Downlighting and other measures to reduce light pollution at night.
e. Height limitations as desired by the community. Data centers range from 45'-100' in height.

Setback.

a. 500' minimum setback from any adjacent residence.
b. Consider a building elevation step back above 45' of building elevation.

Sound.

a. Require a pre- and post-construction noise study measuring both dBA and dBc noise levels. One is noise within human hearing range, and one is low frequency vibration.
b. For perceivable noise, set a maximum of 55 dB at the sending property line.
c. If the data center is air-cooled by rooftop fans, they are a major source of noise. They must be heavily screened to achieve the 55 dB limit above. If they are water cooled, the noise should not be a problem.

Emissions.

a. Require Tier IV EPA emission standards for all backup generators, whether diesel or natural gas.
b. Require Selective Catalytic Reduction (SCR) on all power generation sources, if required to achieve Tier IV standards, whether backup generators or baseload power sources such as natural gas turbines are used.

Power.

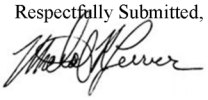
a. Determine where power is coming from, when it will be available, what is the utility power line routing, and how much power will be required. As a rough rule of thumb, every 1 million sq. ft. of data center will require about 150 Mw of power. A 230 Kv transmission line can deliver about 750 Mw of power at 5,000 amps, and a 500 Kv line can deliver about 2.1 Gw of power (temperature/distance dependent).
b. Determine how many substations will be required and where they will be located. They require about 10 acres each.
c. Consider GIS substations. They have fewer outside power structures and less visual impact, though they are more expensive.

Water.

a. Determine how much water the data center will require and whether the water-cooling system is a closed loop system that only occasionally requires charging, or an open loop system requiring continuous water usage.
b. Determine if wastewater is contaminated for either open or closed-loop systems.
c. **Note:** Loudoun County has not had major water issues with our data centers over the past 10 years as most of ours switched to air cooling. **However, that is changing. AI uses a large amount of water because the GPU chips use so much power, and water cooling is much more efficient than air cooling.**

Thank you for this opportunity to offer testimony related to such an important topic. I invite committee Members to contact me with follow up questions at Mike.Turner@Loudoun.gov.

Respectfully Submitted,



Mike Turner
Vice Chair/Ashburn District Supervisor
Loudoun County Board of Supervisors

Impacts of Data Centers on Rural Communities
Written Testimony for House Committee on Small Businesses Hearing on
Empowering Rural America Through Investment in Innovation
January 21, 2026

The rapid expansion of data centers across the United States, driven by the AI boom, presents one of the biggest environmental and social challenges of our generation, moving forward faster than regulators can keep up, while exacerbating existing societal challenges and creating new ones.

Communities across the United States are increasingly questioning the environmental, energy, and social consequences of rapid data center expansion.[1] Local organizers often confront opaque development processes, nondisclosure agreements, and a lack of accessible public data, making meaningful participation and oversight difficult.[2] Yet despite this, local action is brewing anywhere where these data centers are taking root.

Food & Water Watch recently led a letter calling for a moratorium on AI data centers, which was endorsed by over 230 organizations from across the country, to push back on efforts to expand the industry with little to no oversight.[3] We need a moratorium on data centers until there is adequate time and space to develop a regulatory regime that protects the public from massive and unsustainable consumption by data centers of energy and water resources, and skyrocking utility costs for families and small businesses.

Before the AI boom, fossil fuels were warming our climate to unsustainable levels, threatening our food, water, and public health. The AI driven data center frenzy is like dousing a fire with gasoline. It is significantly increasing demand for energy, driving fossil fuel pollution, while at the same time driving up electricity prices and straining water resources across the country. This is on top of the significant and long term impacts that AI is having on society including lost jobs, social instability, and furthering concentration of wealth at an unimaginable scale.

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[1] Hendrix, Justin. "Across the US, activists are organizing to oppose data centers." *Tech Policy Press.* September 14, 2025.
[2] Hendrix, Justin. "Across the US, activists are organizing to oppose data centers." *Tech Policy Press.* September 14, 2025; Media Justice. "The People Say No: Resisting Data Centers in the South." *Media Justice*. September 2025 at 11.
[3] Food & Water Watch, National Data Center Moratorium Now. 12/08/2025

According to the nonprofit Media Justice, roughly $200 billion in data center projects are underway across the U.S. South, making the region a major growth hub. Many county governments have struck deals with Big Tech despite significant resource demands, offering tax breaks, incentives, and even touting low unionization rates as an advantage to avoid organized labor opposition.[4] To meet rising energy needs, fossil fuel plants and nuclear reactors are being expanded or restarted across the South, with two large scale pipelines already under construction.[5] The Southern Environmental Law Center (SELC) has documented a surge of methane gas projects, including a proposal by the Transcontinental Gas Pipe Line Company to build one of the nation's largest methane pipelines from Virginia to Alabama.[6] Methane is a "super pollutant," posing severe risks to public health and the climate.[7]

Beyond air pollution, SELC notes that these projects are increasing electricity costs for Southern households, which already face some of the highest monthly bills in the country. Electricity rates have risen more than 33% since January 2020, and local governments are increasingly attributing these increases to data center demand.[8]

Illinois has emerged as a major data center hub, with expansion spreading beyond Chicago into rural areas in search of cheap land, water, and energy.[9] Similar trends are unfolding across the Midwest, where rezoning farmland for data centers raises environmental, land-use, and economic concerns.[10] The Wisconsin Farm Bureau Federation has warned that data center development threatens farmland preservation and long-term land values.[11] 'Farm lost is farmland lost forever' is a midwestern expression borne out of this crisis.[12]

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[4] Media Justice. "The People Say No: Resisting Data Centers in the South." *Media Justice.* September 2025 at 27.
[5] Media Justice. "The People Say No: Resisting Data Centers in the South." *Media Justice.* September 2025 at 1 and 6.
[6] Media Justice. "The People Say No: Resisting Data Centers in the South." *Media Justice.* September 2025 at 1 and 6.
[7] Gross, Liza. "New tool maps the health impacts of toxic air pollutants released with methane in super-emitter events." *Inside Climate News.* August 26, 2025; World Resources Insitute. "Next generation NDCs." Available at https://www.wri.org/ndcs/resources/methane-and-other-super-pollutants. Accessed November 2025.
[8] Media Justice. "The People Say No: Resisting Data Centers in the South." *Media Justice.* September 2025 at 26 and 12.
[9] Cosier, Susan. "As data centers proliferate across Illinois, communities grapple with how to supply necessary water." *Inside Climate News.* June 16, 2025; Adams, Andrew. "Pritzker touts Illinois' economic development at data center groundbreaking." *Capital News Illinois.* October 2, 2024.
[10] Underwood, Alexia. "As the data center boom ramps up in the rural midwest, what should communities expect?" *Inside Climate News.* October 28, 2025.
[11] Wisconsin Farm Bureau. "Data center impacts on agriculture." Available at https://wfbf.com/policy/current-issues/data-center-impacts-on-agriculture/. Accessed December 2025.
[12] Underwood, Alexia. "As the data center boom ramps up in the rural midwest, what should communities expect?" *Inside Climate News.* October 28, 2025.

In one rural Wisconsin village, residents faced a proposed third Microsoft data center that would have rezoned 245 acres.[13] Microsoft ultimately scrapped the plan in October after sustained local opposition, though it continues to invest over $7 billion in two nearby projects in Mount Pleasant, each requiring up to 8.4 million gallons of water annually.[14] The Alliance for the Great Lakes has cautioned that data centers could strain an unprepared water supply across the region, noting that Great Lakes states lack the legal authority to restrict groundwater withdrawals before environmental damage occurs.[15]

The administration has announced support for nearly limitless expansion of an unregulated new industry that is already disorienting our lives, which his recent executive order on AI will only exacerbate.[16] Impacts include AI algorithms pushing extremist rhetoric, the near elimination of whole job categories for those just entering the workforce, depletion and pollution of water, taking farm land, and disruption of communities across the country. The AI boom comes as the crypto rush remains in overdrive - another resource hungry industry, lacking in social utility, that creates economic instability while driving wealth concentration.

There has been extensive coverage of the date centers driving price increases, including recent coverage in the New York Times.[17] A Bloomberg analysis of wholesale electricity prices (the price paid by utilities to power plants) found that 70 percent of locations with year to year price increases were within 50 miles of significant data center activity while locations with year to year price decreases were much further from data centers.[18] One location near significant data center activity experienced a 267 percent increase in monthly wholesale prices in just one year.[19] The Department of Energy predicts that data centers will consume 12% of the nation's electricity by 2028, driving up rates across the board.[20]

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[13] Bria, Jones. "Microsoft Caledonia data center plans; residents voice frustration." *Fox6 Milwaukee.* September 24, 2025.
[14] Schulz, Joe. "Microsoft scraps plan for Caledonia data center site, working to find an alternate location." *Wisconsin Public Radio.* October 8, 2025; Casey, Evan. "Microsoft announces $4B investment in second data center in Racine county." *Wisconsin Public Radio.* September 18, 2025; Kaeding, Danielle. "Microsoft data centers will use up to 8.4 million gallons of water each year, records show." *Wisconsin Public Radio.* Updated September 18, 2025.
[15] https://greatlakes.org/wp-content/uploads/2025/08/AGL_WaterUse_Report_Aug2025_Factsheet.pdf
[16] Food & Water Watch, Trump's AI Order Seeks to Strip States' Rights to protect themselves; Will Mean more Polluting Data Centers. Dec 11, 2026
[17] Chen, David, "'The New Price of Eggs'The Political Shocks of Data Centers and Electric Bills," *New York Times*, November 30, 2025.
[18] Saul, Josh. "AI data centers are sending power bills soaring." *Bloomberg.* September 29, 2025.
[19] Saul, Josh. "AI data centers are sending power bills soaring." *Bloomberg.* September 29, 2025.
[20] Shehabi, Arman et al. Lawrence Berkeley National Laboratory. "2024 United States Data Center Energy Usage Report." December 2024.

In addition to higher electric bills, other harms of data center growth are becoming increasingly well documented and they are massive. They include:

- Huge increase in electricity use: A tripling of data centers in the next five years would result in data centers consuming as much electricity as over 28 million households.[21]

- Massive consumption of water: Tripling of data centers would require as much water as 18.5 million households just for cooling the servers, let alone the water required in powering them.[22]

- Severe climate impacts: 56% of the electricity used to power data centers comes from fossil fuels.[23] Data centers disproportionately use dirty energy with an average carbon footprint that is 48 percent higher than the grid-wide footprint,[24] Data centers that don't use fossil fuels suck up new renewable supplies of power, derailing plans to close coal and gas power plants.[25] With data centers projected to triple over the next 5 years, the climate impact will be significant.[26]

- Big job losses: AI is replacing jobs at an alarming rate with no planning for the impacts of this. According to an AI CEO, AI could wipe out half of all entry level white collar jobs in the next five years and spike unemployment by up to 20%.[27]

- Astronomical electricity bills: Generating more e-waste: Data centers use hardware to run AI (using microchips and processing, memory, and storage components).[28] These computing devices have a lifespan of 2-5 years and are often replaced with up-to-date versions,[21] effectively generating e-waste that attributed up to 5 million tons of annual e-waste by 2030 to the AI boom.[22]

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[21] Shehabi, A. et al. Lawrence Berkeley National Laboratory. "2024 United States Data Center Energy Usage Report." LBNL-2001637. December 2024 at 5 to 6; U.S. Energy Information Administration.
[22] Food & Water Watch. "A No Brainer: How AI's Energy and Water Footprints Threaten Climate Progress." March 2025 at 2.
[23] Guidi, Gianluca et al. Harvard University. "Environmental Burden of United States Data Centers in the Artificial Intelligence Era." Working Paper. November 2024 at abstract.
[24] Guidi, Gianluca et al. Harvard University. "Environmental Burden of United States Data Centers in the Artificial Intelligence Era." Working Paper. November 2024 at abstract.
[25] Volcovici, Valerie and Laila Kearney. "Data-center reliance on fossil fuels may delay clean-energy transition." *Reuters.* November 26, 2024.
[26] Shehabi, A. et al. Lawrence Berkeley National Laboratory. "2024 United States Data Center Energy Usage Report." LBNL-2001637. December 2024 at 5 to 6; U.S. Energy Information Administration (EIA). "Electricity consumption in U.S. homes varies by region and type of home." December 18, 2023. Available at https://www.eia.gov/energyexplained/use-of-energy/electricity-use-in-homes.php.
[27] VandeHei, Jim and Mike Allen. "Behind the Curtain: A white-collar bloodbath." *Axios*. May 28, 2025.
[28] Crownhart, Casey. "AI will add to the e-waste problem." *MIT Technology Review.* October 28, 2024.[21] De Vynck, Gerrit. "The AI boom may unleash a global surge in electronic waste." *Washington Post*. October 29, 2024.

- Turning towards unclean sources of energy: In order to try and meet the ever-rising energy demand spurred on by Big Tech and their AI-focused data centers, the current administration plans to delay the closure of coal power plants nationwide.[23] Big Tech has also outlined plans in collaborating with the nuclear industry[24] and Big Oil has boasted about implementing CCS for data centers.[25]

- Other destructive impacts: Other significant impacts include noise near data center operations,[26] damage to home appliances from strain on the grid,[27] security threats from AI,[28] political instability from deep fake videos and other fake news being spread,[29] anxiety, identity theft and fraud.[30]

Public resistance has proven effective and represents how a majority of people in the U.S. don't want data centers in their communities.[29] In collaborative efforts between local communities, grassroots groups, and formal organizations, according to Data Center Watch analysis, as of March 2025, local activism has delayed or blocked an estimated $64 billion in data center projects nationwide.[30]

Residents in financially stressed Charles City County, Virginia consistently organized for six months against a data center project that would've brought their county $140 million in tax revenue, about 20 times more than what the county makes in yearly real estate taxes. The community rallied behind their concerns for disrupting their lifestyle, wildlife, and waterways in addition to ceding their interests to corporate control. Before the county supervisors were able to vote for the project, the developer, Diode, pulled out without resistance.[31]

In October of 2025, White County, Indiana became the third community to approve a moratorium on data centers following months of public opposition on a local project that wouldve re-zoned nearly 300 acres of land.[32] Not even a month later and Stark county announced a similar one-year moratorium on large hypserscale data centers. County officials are looking to block large projects while they review guidelines and consider a potential future ban.[33]

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[29] Kramer (2025)
[30] Data Center Watch. "$64 billion of data center projects have been blocked or delayed amid local opposition." *Data Center Watch.* March 2025 at 1 and 2.
[31] Ress & Jones (2025).
[32] Ink Free News. "Three Indiana counties pass data center moratoriums." *Ink Free News.* Updated November 26, 2025.
[33] Pete, Joseph S. "Stark County puts moratorium on large data centers." *Indiana Economic Digest.* December 17, 2025.

St. Charles, Missouri became the first city in the U.S. to issue a one-year city-wide moratorium on data centers; the decision was unanimous amongst councilmembers.[34] This follows widespread pushback on the secretive "Project Cumulus" data center project from over 5,500 residents over environmental, utility, communal, and transparency concerns. The lack of information was so great that by the time the developers withdrew their proposals in response to community backlash, the end user was never disclosed.[35]

Corporate Greenwashing

In response to growing opposition, data center developers are taking steps to convince the public that they can mitigate the impacts of data centers through the adoption of carbon capture and storage and water trading schemes. In reality these programs can further drive up costs on consumers and tax payers, while doing little to nothing to address the real impacts of data centers.

Carbon capture and storage has failed to meaningfully reduce emissions. According to EPA, over 90% of captured CO2 is used for oil extraction, which could cost taxpayers hundreds of billions of dollars per year, with little to no government oversight. In 2022 EOR was used to produce an additional 88.2 million barrels of oil.[36] The U.S. The Environmental Protection Agency (EPA) says that 36.7 million metric tons of CO2 were "used" in EOR (although only 19 percent of that CO2 met the EPA's "sequestration" criteria).[37] That means that every ton of CO2 injected for EOR produces 2.4 barrels of oil, which when burned emits more CO2 than was injected.[38] In recent years, oil production per metric ton of CO2 used in EOR has increased.[39] A U.S. Geological Survey study of future EOR potential found that an average of 3.5 barrels of oil is produced per metric ton of CO2 "stored"; if burned, this oil would emit 1.5 tons of CO2 for every ton injected.[40]

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[34] Bassler, Hunter. "St. Charles becomes the 1st city in the nation to ban data center construction citywide for a year." *KSDK News?*. August 22, 2025.
[35] Bassler, Hunter and Laura Barczewski. "St. Charles data center dead for now after developers withdraw application, mayor says." *KSDK News?* August 18, 2025.
[36] Wallace, Matt. Advanced Resources International, Inc. (ARI). "U.S. CO2 EOR Survey Updated to End-of-Year 2022." March 13, 2024 at 8.
[37] U.S. Environmental Protection Agency (EPA). "Supply, Underground Injection, and Geologic Sequestration of Carbon Dioxide." November 5, 2024. Available at https://www.epa.gov/ghgreporting/supply-underground-injection-and-geologic-sequestrationcarbon-dioxide. Accessed November 2024.
[38] EPA. "Greenhouse Gas Equivalencies Calculator — Calculations and References." Available at https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator-calculations-and-references. Accessed February 2025.
[39] EPA. "Greenhouse Gas Equivalencies Calculator — Calculations and References." Available at https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator-calculations-and-references. Accessed February 2025.
[40] Warwick et al. (2022) at 1; EPA. "Greenhouse Gas Equivalencies Calculator — Calculations and References." Available at

We should be clear that the drive for a world dominated by AI, with data centers spread throughout our communities, is not inevitable, despite what its proponents want us to believe. The “AI boom” is really the vision and political agenda of the same billionaires bankrolling Trump and his allies in Congress, but we can stop it.

No program with an environmental and societal impact this significant should be allowed to advance without a clear regulatory framework that protects people and the environment and ensures that any benefits from AI flow to ordinary people and not just those with extreme wealth. It’s time to put the breaks on things. It’s time for a moratorium on new data centers.

Sincerely,



Jim Walsh
Policy Director
Food & Water Watch

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https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator-calculations-and-references. Accessed February 2025

Loudoun County, Virginia: Data Center Capital of the World

"A Strategy for a Changing Paradigm"

By
Ashburn Supervisor, Mike Turner
Loudoun County, VA Board of Supervisors
October 20, 2025 (Original Edition: July 1, 2024)

Author's Preface

The opinions and recommendations in this paper represent those of the author alone and in no way represent those of any other Board member, the Loudoun County Board of Supervisors or Loudoun County Staff. Furthermore, these opinions and recommendations have no legal authority nor are they in any way legally binding on any Loudoun County employee.

Summary of Updates Since the October 1st Edition

- Revises emissions information for natural gas turbine Selective Catalytic Reduction (SCR) systems. While SCR can reduce NOX by about 95% and CO by more than 85%, it may actually increase PM2.5 emissions, depending upon engine tuning, and the turbine produces CO_2. The CO_2 can only be reduced through Carbon Capture and Storage, technology largely unproven at scale and not widely used.

Executive Summary (citations included in applicable main body text)

- Loudoun County, VA, and particularly "Data Center Alley" in eastern Loudoun, has the highest concentration of data centers in the world with approximately 200 data centers built and 117 in the development pipeline. There has not been a single day in 15 years when a data center was not under construction in Loudoun County. We have more data centers than the next six U.S. markets combined.
- Two source documents guide and regulate Loudoun County's approval and placement of data centers: the Comprehensive Plan and the Zoning Ordinance. The Comprehensive Plan is a guide and details the Board of Supervisors' vision for land development over the next 20 years in the county. It is not legally binding. The Zoning Ordinance provides the legal basis for the Comprehensive Plan and is legally binding. Each parcel of land under the zoning ordinance allows certain types of development "by right," meaning such development does not need legislative approval from the county Board of Supervisors. Much of Loudoun County's data center development has been "by right."
- Key developmental milestones:
    - Late 1990's: U.S. government's Advanced Research Project (ARPA) establishes the Metropolitan Area Exchange-East (MAE-East) as a national internet hub. Extensive underground fiber optic network is laid giving Loudoun County the lowest (fastest) latency rates for moving data from point A to point B in the world. This latency advantage exists to the present day and represents a

significant market advantage for data centers located in Loudoun's "Data Center Alley."

- CY 2000: Loudoun County Zoning Administrator determines data centers should be treated as office parks, thereby making any data center development "by right" on land parcels that permit office parks.
- CY 2003: First mention of data centers in the Zoning Ordinance.
- CY 2008: Loudoun County Economic Development launches an aggressive marketing campaign touting our low latency rates to attract data centers to the county. "Data Center Alley" is born.
- CY 2019: County Comprehensive Plan updated fully for the first time in 18 years. Incorporates a wide range of data center performance criteria.
- CY 2022: A landmark year marking the start of a new era of constrained power for the worldwide data center market. After ten years of slightly declining power demand within the Dominion Energy service area, PJM, the northeast Regional Transmission Organization, of which Dominion Energy is a member, recognizes an impending exponential increase in power demand from Loudoun County's "Data Center Alley." Dominion Energy immediately imposes power constraints on "Data Center Alley" which remain in effect today. Loudoun County, VA becomes the constrained power "canary in the mine" for the world data center community.
- CY 2023: Loudoun County Zoning Ordinance updated for the first time in 20 years to align with the 2019 Comprehensive Plan. This increases local legislative oversight of data center applications, thereby limiting "by right" development for the first time.
- CY 2024: Joint Legislative Audit Review Committee releases long-awaited data center report to the Governor and General Assembly.
- CY 2025: The Loudoun County Board of Supervisors ends "by right" data center development in Loudoun County at a March 18th, 2025 Board meeting.[21]

- From 2021-2025, largely before the dawn of Artificial Intelligence (AI), Loudoun County's energy use increased 166%, from 2.0 Gw to 5.33 Gw of power consumption. Using a simple linear extrapolation over the next five years, without accounting for a likely tenfold increase in power required by AI, Loudoun will need 14.2 Gw of power. An independently commissioned Kimley-Horn report has confirmed a similar prediction, estimating 11.59 Gw of power will be needed by 2028. Loudoun County is currently receiving about 9.3 Gw of power, though only a portion of that reaches "data center alley." PJM and Dominion Energy plan to bring an additional 6.3 Gw into Loudoun County by 2028 to meet Loudoun's growing power demands, but it is unclear how much of this additional power will reach "Data Center Alley." None of this development addresses the vast increase in power demand anticipated for AI.
- Demand for data processing is growing exponentially worldwide. With that increase in demand for data processing comes a concomitant exponential increase in demand for electricity by the world's data centers. The electric utilities serving Northern Virginia

(PJM; Dominion Energy) will be unable to build sufficient grid infrastructure to meet the growing demand for power by the region's data centers. This conclusion, originally stated in the preface below in July 2024, was similarly arrived at in the December 2024 JLARC data center report to the Virginia Governor and General Assembly.

- The rapid increase in data center sector demand for power has resulted in a significant increase in constituent resistance to more data centers in their communities. It has also caused both PJM and Dominion Energy to slow or cancel the decommissioning of fossil fuel generation plants throughout the region. Given that the most recent U.N. climate change report indicates 2024 was likely the warmest year on record, this delay or cancellation of fossil-fuel plant decommissioning will likely add to community resistance to more data center development.
- The three key stakeholder groups critical to developing a new strategic paradigm for energy consumption amidst a worldwide data revolution are the data center sector, the electric utility sector and the constituent sector, represented by local, state and federal elected bodies. Heretofore, these groups have rarely collaborated. Systematic collaboration and communication between and among these groups will be essential going forward.
- Certain realities must be acknowledged if we are to successfully meet Loudoun County's energy challenges:
    - The 135-year-old paradigm of power generated by large, remote power plants and transmitted over hundreds of miles of transmission lines to end-user distribution locations will not solve Loudoun County's unique energy challenges.
    - The utilities will likely continue to slow or halt fossil fuel generation plant decommissioning. This will lead to increased community pressure on elected officials to oppose data center development and increased market pressure on data centers to develop onsite, regional or distributed energy networks with a greater reliance on low-carbon or carbon net-zero power.
    - Solar and wind power alone will not be sufficient to solve Loudoun County's data center energy needs.
    - Halting data center construction in Loudoun County will not solve the problem. AI will drive up energy demands for our existing data centers far in excess of Dominion Energy's and NOVEC's (Northern Virginia Electric Cooperative) capacity to meet that demand.
- Immediate steps available to PJM and Dominion Energy to begin to address rising power demand are 1) reconductoring new and existing transmission lines, and 2) considering the development of a regional High Voltage Direct Current (HVDC) network for the exclusive use of the Loudoun County data center sector.
- If, as this paper and the JLARC study predict, the power grid infrastructure in Loudoun County—even with its planned expansion—will be insufficient to meet the future energy demand of the county's data center market, there are only three possible future scenarios by which that demand can be reduced to manageable levels:

Scenario #1: Government-Imposed Energy Consumption Constraints. In this scenario, the Commonwealth of Virginia, the power utilities or both artificially constrain the energy use of high-energy consumers to ensure grid stabilization for all Virginia energy consumers. This scenario would likely cap continued data center development in Loudoun County and cause new data center development to take place in locations with much lower power constraints.

Scenario #2: Technological Breakthrough. A technological breakthrough occurs significantly reducing the power needed by AI and cloud-based computing. Such a development would stabilize the power grid and could enable the power utilities to meet the stabilized infrastructure needs of the industry. This scenario could lead to significant stranded costs and will likely prove only temporary as data centers fill up empty rack space with newer chips.

Scenario #3: Industry Conversion to Onsite Power. Faced with exponential market demand and possessed with almost unlimited resources to meet that demand, the data center industry rapidly develops the capacity to generate onsite, local or distributed energy power (microgrids) for its operations and, in so doing, significantly reduces its reliance on the regional power grid. Such a development would stabilize the grid and could enable the power utilities to meet the stabilized infrastructure needs of the industry. (Widespread microgrid development in Loudoun County is unlikely due to geographic constraints.) Additionally, this scenario could also lead to significant stranded costs.

- In the future, the three scenarios will likely occur simultaneously but in varying and fluctuating degrees based upon market and grid infrastructure conditions. The utilities have already begun delaying additions of large loads to the grid, and the JLARC study recommends codifying this in state code to allow delays for generation limits in addition to transmission limits (scenario #1). Meanwhile, new GPU chips are emerging that use significantly less power (scenario #2), and we already have examples of data centers in Loudoun County building advanced microgrids to reduce their dependence on grid power (scenario #3). All three scenarios will continue to develop for the foreseeable future.

- Stranded costs occur when a regulated utility, required by law to meet the energy demand of its customers, is forced to build new infrastructure to meet predicted, future demand for energy. If at any time during the infrastructure buildout process the predicted demand is not realized, stranded costs occur. The regulated utility has incurred the costs of the buildout, but the reduced consumer demand can no longer defray those costs. The utility must then absorb the costs or pass them on to residential and small commercial customers. A tool to insulate the utilities from stranded costs is the imposition of preemptive tariffs on high-energy consumers.

- While the 2024 JLARC study concludes it will be very difficult to meet the data center sector's unconstrained energy demand, it offers only two broad approaches to reduce that demand: 1) utilities should be allowed to delay large energy load additions to the grid while local jurisdictions impose performance standards to increase energy efficiency, and 2) the state should use the sales tax exemption to incentivize greater data center energy efficiencies. These approaches represent an acceptance of scenario #1 above as the only way to decrease energy demand. Approach #1 is occurring already

due to physical grid infrastructure limits that will exist for the foreseeable future. Approach #2 would fail to achieve data center energy efficiencies sufficient to adequately reduce stress on the power grid and would cause data centers to leave the Commonwealth.

- Microgrids generally comprise up to five key components:
    - A major power consumer (e.g. data center)
    - A baseload power source (onsite power capable of meeting the major consumer's power needs 24/7/365)
    - A backup power source (e.g. generators, gas turbines, energy storage units, etc.)
    - A connection to the regional power grid (optional)
    - A demand response management system to manage microgrid power sources and determine when and how the microgrid will interface, if at all, with the regional power grid
- There are currently six types of onsite power sources capable of practical application within the next five years:
    - Backup diesel generators
    - Long-Duration Energy Storage units or Battery Energy Storage Systems (BESS)
    - Natural gas turbines
    - Green hydrogen fuel cells
    - Blue hydrogen fuel cells
    - Small Modular Reactors/Advanced Nuclear Reactors (more than 50 variations)
- Only natural gas turbines or generators are immediately capable of delivering baseload, onsite power.
- Small modular reactors have the highest capacity factor (ability to deliver maximum power for the longest duration) and solar power has the lowest.
- Small Modular Reactors and Advanced Nuclear Reactors have the highest potential for delivering maximum, carbon net-zero power, but require at least 10 acres to produce 300 Mw. They also create new types of nuclear waste different than traditional light-water reactors and require onsite waste storage. These three factors would likely prohibit their use in Loudoun County with its very dense data center community located near residential areas.
- The data center industry is facing historic market demand and possesses virtually unlimited resources to meet that demand. History suggests that any market experiencing these two forces simultaneously will derive its own market-based solution. Loudoun County, through constant collaboration with the data center sector and local utilities, should strive to anticipate in what direction its data center community will choose to move. Towards that end, the county should develop precise performance

standards to 1) shape and manage future data center development, and 2) create significant incentives/disincentives to effect environmentally friendly and energy efficient design changes to existing data centers.

Preface

I was elected to the Loudoun County Board of Supervisors in November 2019 and took office in January 2020. For my entire tenure, our bipartisan Board has had to deal with two enduring and overarching issues: data center growth and housing. While the need for attainable housing in Loudoun County, the wealthiest county in America,[1] remains a critical issue, the explosion of data center growth in the past two years, both unprecedented and accelerating, has created urgent policy issues I believe our Board must now address.

This paper is intended to form the factual basis for a new policy regarding data center growth in Loudoun County. Stated simply—based on the data, logic and conclusions offered herein—the existing paradigm of power generation, transmission and consumption this nation has relied on for more than a century is simply not capable of providing sufficient power to Loudoun County data centers (and very likely Prince William County data centers) going forward. The demand from that sector of our market environment is too high, and that demand is accelerating rapidly to historic levels. This same conclusion was reached by the December, 2024 JLARC data center report submitted to the Virginia Governor and General Assembly:

> "Data center demand would drive immense increase in energy needs in Virginia, based on JLARC's independent forecast and other forecasts. Building enough infrastructure for unconstrained data center demand will be very difficult and meeting half that demand is still difficult."[2]

I suspect the data center sector and the power utilities will not agree with several of my conclusions expressed in this paper, and I both respect and value their feedback. However, having done the research on this issue, I believe we have all been considering these changes within the context of our historic organizational paradigms. The data centers' imperative is to meet market demand, and that's their focus. Dominion Energy and PJM, the Regional Transmission Organization (RTO) for the northeast power grid, are required by law to provide power to all customers, and that's their focus. And the Board of Supervisors is an elected body responsible for making land-use decisions and encouraging economic growth, and that has been our focus. But the post-COVID world since 2022 has seen a seismic increase in demand for data representing not an evolution, but a revolution of technological change now very likely to overwhelm our existing power infrastructure. Essentially, we've invented the airplane but just realized we haven't yet invented runways. This level of systemic change demands new paradigms at almost every level if we are to avoid an involuntary and likely painful landing.

This paper offers a summary of how we got here, presents data to capture the magnitude of the change we are all facing, acknowledges what I believe are the new realities of our current and future data center environment, and proposes the key elements of a new policy going forward. I

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[1] Ibeh, Kemi. "The Wealthiest County in the U.S. Is Not Where You Think." Fodor's Travel. January 23, 2024. https://www.fodors.com/world/north-america/usa/virginia/experiences/news/heres-where-the-wealthiest-u-s-county-actually-is

[2] Joint Legislative and Audit Review Commission. "Data Centers in Virginia, Commission Draft." Report to the Governor and the General Assembly of Virginia. December 9, 2024, pg. ii-iii. https://jlarc.virginia.gov/pdfs/reports/Rpt598-2.pdf

do not consider the ideas presented or the policy elements I'm proposing the only viable answers to the historic challenges we now face. But my overarching responsibility, and I believe the responsibility of the Loudoun County Board of Supervisors, is to protect the quality of life of our citizens, even if the decisions we make are controversial, politically fraught and decidedly unpopular. My purpose here is to start a conversation based not on our ungrounded hopes but on our fact-based needs. That is the only basis upon which we can, collectively and collaboratively, formulate a transformational strategy for Loudoun County. We are the nexus for the world data center community. We have both a profound responsibility and an historic opportunity to redefine and permanently reshape the digital world and the power infrastructure it relies on. And we must act now.

Introduction

As of this writing, Loudoun County, Virginia—and more precisely, eastern Loudoun County comprising approximately 30 square miles—is home to about 200 data centers. A recent independent analysis by consultant Kimley-Horn indicates there are another 117 data centers in Loudoun County's development pipeline, with presumably many of them "by right," not requiring approval by the Loudoun County Board of Supervisors.[3] Combined with the rest of Northern Virginia, we have three times more than the second highest concentration in America.[4] In 2024, The Joint Legislative Audit Review Commission stated that northern Virginia (Loudoun, Fairfax and Prince William Counties) energy capacity was 4.14 Gw[2] up from just 1.5 Gw in 2019[5]. That's a 176% increase in the need for electricity in Loudoun County in five years. If we apply just a linear extrapolation of that growth rate in power demand over the next five years—and that is probably an unrealistically conservative growth rate based on the preponderance of growth trends in power demand—that means by 2029 Loudoun County will require about 11.43 Gw of power. An independent analysis by Kimley-Horn arrived at an estimate of 11.59 Gw of power needed by 2028.[6] Those are remarkably similar, independent analyses, both of which do not bode well for the Loudoun County power grid.

Regarding actual data center construction growth, in 2020 we had about 21.5 million sq. ft. of permitted data centers in the county. In 2025, we have about 47 million sq. ft. of data centers permitted.[7] That's a 119% increase in five years. Moreover, we have at least an additional 40 million sq. ft. in the pipeline (application being reviewed or site plan submitted).

By every metric, the rate of data center growth in Loudoun County over the past 20 years has been among the highest of any community in the world, and that rate has accelerated exponentially since 2022. All indications suggest that growth will be accompanied by a commensurate increase in demand for power, unless outside factors—governmental action,

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[3] Kimley-Horn staff report to the Loudoun County Transportation and Land Use Committee. "Power Transmission Evaluation of Loudoun County, Virginia." October 17, 2024, item #9, Atch. 2, pg. 4. https://www.loudoun.gov/3432/Transportation-and-Land-Use-Committee

[4] United States Data Centers: Top 10 Locations in the USA - Dgtl Infra

[5] Abdulsalam, Sami. "Dominion Northern Virginia Area Immediate Need." Slide #2, "Data Center Alley Area Load Growth and Transmission System." Slide #3, "Dominion 2022 Load Forecast." Data interpolated from data center load forecast line (orange). June 7, 2022. https://www.pjm.com/-/media/committees-groups/committees/teac/2022/20220712/item-08---dominion-northern-virginia---immediate-need.ashx

[6] Op. Cit.

[7] Yearly data provided by the Loudoun County Commissioner of Revenue.

technological breakthroughs or increased use of onsite power—reduce the demands on the regional power grid to manageable levels.

Our county is at the edge of the frontier in data center development. The lessons we have learned as a community can serve as invaluable roadmaps for communities across the nation, ranging from those contemplating their first data center, to those with modest growth, to those with an established and thriving data center community.

At the same time, because of our uniqueness, many of the challenges we now face have no corollary outside of Loudoun County. Yes, our journey can be instructive to other communities still in the early to moderate growth cycles, but many of the issues our data center community, our utility companies and our local elected leaders are now facing have never before been encountered.

Three Key Stakeholder Groups

There are three core stakeholder groups in Loudoun County with an urgent interest in developing a comprehensive strategy for future data center sector growth: the data center community, the core utilities (electricity, gas, water), and local government representing our citizens who benefit from the data produced by our data centers.

Data Centers. This group involves not just data center owners and land developers, but the land-use attorneys representing them, construction companies, unions who provide labor, non-union laborers, and a wide range of corollary businesses that benefit from the construction, growth and increased impact of data centers on our society. All the members of this stakeholder group are primarily focused on enabling data centers to meet the rapidly increasing demand for data processing in our society. **Their market imperative is to continue to grow.** There are two broad types of data centers:

Hyperscale (Enterprise) Data Centers. Hyperscale (100 Mw or more) or enterprise data centers are generally owned and operated by a single owner and are extremely large with very high power demands. According to an August article in *Enterprise Storage Forum,*[8]a hyperscale data center is any data center with more than 10,000 sq. ft. of space and more than 5,000 servers. However, by this standard, just about every data center in Loudoun County, including most of our legacy data centers, would be considered hyperscale. For the purposes of this paper, I will distinguish between the two based on function. An enterprise data center is usually owned by a single entity and is designed to process enormous data loads at scale for just that entity or perhaps a handful of partners. According to a major colocation data center owner I talked to recently, hyperscale or enterprise data centers require significantly more power than colocation data centers as defined below. This trend is likely to

[8] Vyas, Kashyap. "Hyperscale Data Centers vs. Colocation Data Centers." Enterprise Storage Forum. August 24, 2023. https://www.enterprisestorageforum.com/cloud/hyperscale-vs-colocation/#:~:text=Hyperscale%20data%20centers%20meet%20enterprise%20data%20needs%20by,essential%20resources%2C%20allowing%20for%20cost-effective%20expansion%20and%20management.

accelerate significantly as hyperscale/enterprise data centers pick up more and more of the generative AI load worldwide.[9]

Colocation Data Centers. Colocation data centers are owned by a company that leases data rack space to tenant companies. It's a shared-space data center often hosting hundreds of clients who own and operate their own servers and infrastructure in an ideal data processing environment. The power requirements of a colocation data center have historically been much less than hyperscale/enterprise data centers. While this is likely to remain true, AI is also going to significantly increase the power demands of colocation data centers.[10]

Core Utilities. Though services like internet, phone, cable T.V. etc. can be considered utilities, for the purposes of this discussion, we will limit our focus to just the core utilities of electricity, water and gas. The principal core utility and the one facing the most urgent current demand in Loudoun County due to accelerating data center growth is power (electricity). However, our other two utilities could play increasingly important roles in the future. Submerged data racks using water cooling could significantly lower data center power needs but increase demand for closed, reclaimed water systems. Use of onsite gas-generated electricity is a viable future option and one already being used in Loudoun County. Rapid growth in these sectors would also require more resources. But this paper's principal focus will be on power. There are two major players and one currently minor player in the Loudoun County power space:

Dominion Energy. Dominion Energy is the largest supplier of electricity in the Commonwealth of Virginia and the predominant electricity provider in Loudoun County. It is an investor-owned utility and, **because we are a regulated state, is required by Virginia law to provide power to every customer it serves.** This is a critical point underlying the entire issue of data center growth in Loudoun County and will be addressed later.

PJM. According to the PJM website, "PJM is a Regional Transmission Organization (RTO) that coordinates the movement of wholesale electricity in all or parts of 13 states and the District of Columbia."[11] PJM monitors and regulates all the power companies in the northeast region, including Dominion Energy, to ensure the stability and resiliency of the entire northeast power grid. Northern Virginia, and specifically Loudoun County, are among PJM's largest customers due to our data centers. Approximately 60% of the PJM grid is carbon dioxide-producing, and about 40% is carbon-net-zero energy with about 82% of the carbon-net-zero portion being nuclear.[12] As we will note later in this paper, that ratio could change significantly in the years ahead.

Northern Virginia Electric Cooperative (NOVEC). According to their website, "NOVEC is a distribution electric cooperative. NOVEC purchases wholesale power

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[9] McKinsey & Company. "AI power: Expanding data center capacity to meet growing demand." October 29, 2024. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/ai-power-expanding-data-center-capacity-to-meet-growing-demand

[10] Ibid.

[11] https://www.pjm.com/about-pjm

[12] https://en.wikipedia.org/wiki/PJM_Interconnection

through the PJM marketplace."[13] As stated, NOVEC's principal function is to distribute electricity purchased by wholesale providers such as Dominion Energy. Generally, they provide power to residential customers and commercial businesses not powered directly by Dominion. At present, they are not a major player in the data center space in Loudoun County, but that could change in the near future as well.

Local Elected Officials Representing the Community. In Loudoun County, the senior elected body charged with land-use planning is the nine-member Board of Supervisors (BOS). The BOS works for the citizens of Loudoun County and must be responsive to their needs and concerns. No individual Supervisor may act alone; all proposed actions by the BOS require at least five votes to be implemented.

Regarding the BOS's role in land-use issues, the extent of BOS involvement in the decision-making process for land development depends on what type of land development is proposed. There are generally two types: "by right" and legislative.

"By Right." Every parcel of land in the county has permitted uses, and if a landowner decides to develop one of those permitted uses, s/he is not required to obtain BOS approval to develop that land unless they wish to change a "by right" use or add a new use.

Note: Loudoun County ended "by right" data center development by a 7-2 vote at a March 18, 2025 Board of Supervisors meeting. All new data centers in Loudoun County (except for 22 data centers "grandfathered" at the March 18th meeting) now require Board of Supervisors approval.

Legislative. If the landowner decides to modify the use of the land beyond what's permitted "by right," s/he must submit a legislative application to county staff and obtain final approval from the BOS.

The Roles of the Comprehensive Plan and the Zoning Ordinance. Key to understanding the planning environment within which these three stakeholders have been operating throughout the period of rapid data center growth is the relationship between the Loudoun County Comprehensive Plan and the Zoning Ordinance. Stated simply, the Comprehensive Plan is the Board of Supervisors' vision of how land should be developed in the county (plus the transportation infrastructure needed to support that vision). The Zoning Ordinance is the legally binding code landowners must abide by when developing their land, and it is used to implement the vision outlined in the Comprehensive Plan. The Comprehensive Plan is not legally enforceable; the Zoning Ordinance is.

These two documents should always be in alignment and updated every five years. Yet Loudoun County went from 2001 to 2019 without a complete update of its Comprehensive Plan and from 2003 to 2023 without a corresponding update of its Zoning Ordinance. These two decades precisely aligned with the growth, from inception to maturity, of the data center sector in Loudoun County, the largest such sector in the world today. The BOS finally updated the Comprehensive Plan in 2019, but due to COVID, it took four more years to update the Zoning Ordinance in December 2023. These four years of misalignment between the Comprehensive Plan and the Zoning Ordinance occurred just as data centers began exercising their "by right" development options. Additionally, PJM, Dominion, and Aurora Energy, a leading global advisor to energy investors, mark 2022 as the

[13] https://www.novec.com/About_NOVEC/index.cfm

year data center power demand began increasing rapidly.[14] This plan/ordinance misalignment could not have occurred at a worse time and seriously limited the Board's ability to manage data center growth as envisioned in the Comprehensive Plan.

How We Got Here: A Timeline of the Growth of the Loudoun County Data Center Sector

The following is a timeline of key events shaping the proliferation of data centers in Loudoun County:

- 1993 Update of 1972 Zoning Ordinance: No mention of data centers.
- 1990s (latter half): Metropolitan Area Exchange-East established in Loudoun County; AOL HQ comes to Ashburn in 1997 and expands on existing fiber optic network.
- 2000 Loudoun County Zoning Administrator determination: data centers are viewed as similar to office buildings in the 1993 Zoning Ordinance. Office parks are a hot trend.
- 2001: General Plan (land use) updated.
- 2003: Revised 1993 Zoning Ordinance passed to match the 2001 General Plan: First Mention of Data Centers in the Zoning Ordinance.
- 2008: Loudoun County Economic Development initiates marketing strategy to actively recruit data centers to build on land specifically permitting data centers.
- 2014: Zoning Ordinance Amendment (ZOAM) addressing data center sight, setback, sound.
- 2019: General Plan updated (land use).
- 2022: May-July: The Loudoun County Transportation and Land Use Committee (TLUC) holds a series of three meetings to inventory current and potential locations of data centers, obtain staff recommendations about how best to manage data center growth, and to determine the best process to implement a future data center Comprehensive Plan Amendment (CPAM)/Zoning Ordinance Amendment (ZOAM) to codify those managerial changes. Dominion announces new 500/230 Kv Wishing Star-Mars transmission line.
- 2022: July: PJM informs Dominion Energy it has underestimated power infrastructure needs. Dominion Energy informs "Data Center Alley" it will have less power available for at least five years. The power "constrained area" is created until new power lines can be built by 2027.[15] [16] PJM announces a new 500 Kv line from Doubs-Aspen.[17]
- 2023: Dominion Energy announces a new 500/230Kv transmission line along Route 7 in Loudoun County.[18] This line, the southern Wishing Star-Mars line and a third Golden-Mars line will be connected to form a loop to "Data Center Alley."

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[14] https://auroraer.com/company/about/

[15] RTO Insider LLC. "PJM Orders Dominion 'Immediate Need' Projects to Serve Load Jump in 'Data Center Alley'." June 16, 2024. https://www.rtoinsider.com/30472-pjm-orders-dominion-immediate-need-projects-load-jump-data-center-alley/

[16] Abdulsalam, Sami. "Data Center Planning and Need Assessment Update." PJM. January 10, 2023. https://www.pjm.com/-/media/committees-groups/committees/teac/2023/20230110/item-04---data-center-load-planning.ashx

[17] PJM. "Transmission Expansion Advisory Committee (TEAC) Recommendations to the PJM Board." PJM. Dec. 11, 2023. Slide 44, last entry in table. https://pjm.com/-/media/committees-groups/committees/teac/2023/20231205/20231205-pjm-teac-board-whitepaper-december-2023.ashx

[18] Kirby, Jess. "Lansdowne residents oppose Route 7 transmission line proposal." Loudoun Times Mirror. Oct. 5, 2023. https://www.loudountimes.com/news/lansdowne-residents-oppose-route-7-transmission-line-proposal/article_46190288-639f-11ee-9908-7722c63f7ffd.html

- 2023: Dec: Zoning Ordinance Rewrite (ZOR) to align with the 2019 Comprehensive Plan is approved by the BOS. This zoning ordinance rewrite established new, more restrictive construction and performance standards for data centers and attached Special Exceptions (SPEX) to data centers being built on Research and Development Park or Office Park land.
- 2023: Dec: PJM announces acceptance of a NextEra proposal to build a new 500Kv transmission line through western Loudoun County.[19] Public resistance is significant, and PJM later decides to build this line in existing right-of-way.
- 2024: Mar: The Loudoun County Board of Supervisors denies the construction of a 4.9 million sq. ft./600 Mw data center next to a residential neighborhood but approves the application when the applicant reduces its size to 1.3 million sq. ft., the "by right" permitted size, and retains the environmental proffers from the larger application.
- 2025: Mar: The Loudoun County Board of Supervisors ends "by right" data center development in Loudoun County by a 7-2 vote at a March 18, 2025 Board meeting.[20]

It's important to note here the strategy initiated in 2008 by the Loudoun County Economic Development Department had the full support of the Loudoun County Board of Supervisors and proved to be enormously successful.

- There has not been a single day in the past 15 years when a data center was not under some type of initial construction or expansion in Loudoun County.
- Loudoun County now has about 200 data centers, more than any other community on Earth.[21] An additional 117 data centers are in the development pipeline.[3]
- Loudoun County's data center market is greater than the next six U.S. markets combined.[22]

And the reasons why the Loudoun County BOS fully supported this program are easy to discern:

- Enormous tax revenue: In FY2025, Loudoun County estimated about $895M in data center real and personal property tax revenue. The county's entire operating budget was projected to be $940M.[23]
- As a result of data center tax revenue, Loudoun County has the lowest real property tax rate in NOVA; about 25% lower than our neighbors.[24]
- A data center costs the county $0.04 per $1 of tax revenue received, whereas normal businesses cost about $0.25 per $1 of revenue.[25]

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[19] Kirby, Jess. "PJM advances proposal for transmission line in western Loudoun." Loudoun Times Mirror. Dec. 13, 2023. https://www.loudountimes.com/0local-or-not/1local/pjm-advances-proposal-for-transmission-line-in-western-loudoun/article_c0202122-99e3-11ee-9896-b71271fc88fc.html

[20] Loudoun County Board of Supervisors business meeting minutes, March 18, 2025. file:///C:/Users/mike.turner/Downloads/Item%2007%20Data%20Center%20Standards%20&%20Locations%20CPAM-ZOAM%20Phase%201.pdf

[21] Zhang, Mary. "United States Data Centers: Top 10 Locations in the USA." Dgtl Infra. April 11, 2024. https://dgtlinfra.com/united-states-data-centers/

[22] Vogelsong, Sarah. "Virginia Has the Biggest Data Center Market in the World. Can It Also Decarbonize Its Grid?" Inside Climate News. May 24, 2024. https://insideclimatenews.org/news/24052024/virginia-data-center-market-electricity-demand/

[23] Loudoun County FY2025 Appropriations Resolution; Commissioner of Revenue. Available on request.

[24] "City of Alexandria Revenues." City of Alexandria. 2024. Pg. 7-19 table. https://www.alexandriava.gov/sites/default/files/2023-02/Section%2007%20Revenues%20FY24.pdf

[25] Northern Virginia Technology Council. "The Impact of Data Centers on Virginia's State and Local Economies 5th Biennial Report." April, 2024. Pg. 7. https://info.nvtc.org/acton/attachment/45522/f-

- Data centers put very few cars on the road.
- Data centers put very few kids in schools.

Thus, with the full and enthusiastic support of the Board of Supervisors and the visionary foresight of the Loudoun County Department of Economic Development, Loudoun County capitalized on its unique geography (Washington, D.C. and Dulles Airport), its role as a high-tech digital incubator and home of the internet, and its extensive fiber-optic infrastructure touting the lowest latency rates in the industry to become ground zero for historic digital development. Until 2022, though Dominion and the Department of Economic Development had cautioned for years infrastructure would have to be built to accommodate the rapid increase in demand for power, the future looked relatively unconstrained.

Then, in 2022, PJM informed Dominion Energy that Dominion's infrastructure predictions were significantly underestimating the growing power needs of Loudoun County's data center sector. In response, Dominion Energy established what is now known as the "constrained area" in Loudoun County and informed the data center sector they would have significant power constraints until 2027 when new transmission lines could be built. This deadline has now been pushed back to June 1, 2028.[26] This marked the start of a sobering new reality in Loudoun County: the rapid growth of four competing forces affecting the data center community and the larger Loudoun County community.

Four Accelerating, Co-Dependent, Conflicting Trends

There is no question four co-dependent, conflicting trends are going to dominate the Loudoun County data center landscape for the foreseeable future: 1) Rapidly increasing demand for data, 2) Rapidly increasing demand for power to process that data, 3) Rapidly increasing negative impacts on Virginia climate change initiatives, 4) Rapidly increasing local community resistance to changes in quality of life, changes to neighborhoods, and the proliferation of overhead transmission lines.

Increasing Demand for Data. As shown below, the years between 2016-2024 have seen staggering data center growth in Loudoun County:[27]

- In 2016, 8.8 million sq. ft. of permitted data center floor space
- In 2017, 10.1 million sq. ft. (14.7% increase)
- In 2018, 13.1 million sq. ft. (29.7% increase)
- In 2019, 18.3 million sq. ft. (39.7% increase)
- In 2020, 21.5 million sq. ft. (17.5% increase)
- In 2021, 26.4 million sq. ft. (22.8% increase)
- In 2022, 28.1 million sq. ft. (6.4% increase)
- In 2023, 31.9 million sq. ft. (13.5% increase)
- In 2024, 41.2 million sq. ft. (29.2% increase)
- In 2025, 47 million sq. ft. (14% increase)

1c3915e6-b8b1-4914-818e-9fae14877a3d/1/-/-/-/-/2024%20NVTC%20Data%20Center%20Report.pdf

[26] Kirby, Jess. "Dominion files SCC application for Route 7 transmission lines." Loudoun Times Mirror. April 8, 2024. https://www.loudountimes.com/0local-or-not/1local/dominion-files-scc-application-for-route-7-transmission-lines/article_85f0c24c-f607-11ee-b165-e343f9408d14.html

[27] Data provided by the Loudoun County Commissioner of the Revenue, May 31, 2024.

This steady increase in data center square footage is the result of the growth of our society's dependence on social media, "smart" device technology, personal computing and communication, and a host of other data-dependent advancements our society has come to depend on. And now, Artificial Intelligence (AI) is expected to increase the demand for data exponentially again. A January 2024 article by a major data center realty company suggests consumers and businesses will generate twice as much data in the next five years as was generated in the previous ten.[28] That's a statement with staggering implications. The article provides a stark prediction of the speed and magnitude of growth in the data center sector and also illustrates convergence of the three conflicting growth trends:

> "With the growing demands of AI, data center storage capacity is expected to grow from 10.1 zettabytes (ZB) in 2023 to 21.0 ZB in 2027, for a five-year compound annual growth rate of 18.5%[1]. Not only will this increased storage generate a need for more data centers, but generative AI's greater energy requirements – ranging from 300 to 500+ megawatts – will also require more energy efficient designs and locations. The need for more power will require data center operators to increase efficiency and work with local governments to find sustainable energy sources to support data center needs."[29]

Increasing Demand for Power

Growth in data center power demand in Virginia is increasing at a rate far exceeding Dominion Energy's capacity to provide it. A January 2024 Data Center Dynamics article projected data center power consumption will double by 2030.[30] This trend is magnified in Loudoun County because of our unique data center load. In a May 2, 2024 article, Bloomberg reports that Northern Virginia data center developers are now asking Dominion Energy for the energy equivalent of several nuclear reactors' output. In a recent quarterly earnings call, Dominion Energy's CEO Bob Blue stated that Dominion Energy is now receiving requests from data center campus developers for "several gigawatts" of power.[31] This is a staggering increase in data center power demand in just a few years. Below is a summarized timeline of actual power usage in Loudoun County since 2018, the year we first reached approximately 1 Gw (1,000 Mw; a megawatt is one million watts) of power consumption in "Data Center Alley."[32]

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[28] Steele, Kimberly. "Growth of AI creates unprecedented demand for global data centers." Jones Lang LaSalle IP, Inc. January 31, 2024. https://www.us.jll.com/en/newsroom/growth-of-ai-creates-unprecedented-demand-for-global-data-centers

[29] Ibid.

[30] Gooding, Mathew. "Newmark: US Power Consumption to Double by 2030." Data Center Dynamics. January 15, 2024. https://www.datacenterdynamics.com/en/news/us-data-center-power-consumption/#:~:text=While%20the%20hyperscalers%20typically%20need,up%20from%2017GW%20in%202022.

[31] Saul, Josh. "Data Centers Now Need a Reactor's Worth of Power, Dominion Says." Bloomberg. May 2, 2024. https://www.bloomberg.com/news/articles/2024-05-02/data-centers-now-need-a-reactor-s-worth-of-power-dominion-says?utm_source=website&utm_medium=share&utm_campaign=email

[32] Abdulsalam, Sami. "Dominion Northern Virginia Area Immediate Need." Slide #2, "Data Center Alley Area Load Growth and Transmission System." Slide #3, "Dominion 2022 Load Forecast." Data interpolated from data center load forecast line (orange). PJM. July 12, 2022. https://www.pjm.com/-/media/committees-groups/committees/teac/2022/20220712/item-08---dominion-northern-virginia---immediate-need.ashx

- 2018: 1 Gw (chart interpolation)
- 2019: 1.5 Gw (chart interpolation)
- 2020: 1.6 Gw (chart interpolation)
- 2021: 2.0 Gw (chart interpolation)
- 2022: 2.8 Gw (actual)
- 2023: 3.4 Gw (chart interpolation)[33]
- 2024: 4.14 Gw (actual)[2]
- 2025: 5.33 Gw (actual)[34]

If we assume a linear growth rate over the next five years similar to the previous five years, Loudoun County will demand 14.20 Gw of power by 2030. As mentioned earlier, an independently commissioned Kimley-Horn report has confirmed a similar estimate almost exactly, estimating 11.59 Gw of power will be needed by 2028.[3] But Artificial Intelligence (AI) is raising power demand much faster than a simple linear rate. As the use of AI grows, the need for more computing power within existing data centers means the demand for power within those walls is going to increase commensurately. According to an article in Data Center Knowledge, the average data rack power usage in a typical hyperscale data center today is 6-12 Kw. Because of their much higher reliance on Graphics Processing Units (GPUs) within the data rack, AI applications are going to increase that data rack power consumption to 40-60 Kw.[35] An October, 2024 McKinsey & Company report states the new Nvidia GB200 GPU AI chip could increase data rack density to 120 Kw per rack, a tenfold increase in the power required per rack.[10] This increase will affect both new data centers and existing data centers as well as both hyperscale/enterprise data centers and colocation data centers. This means that, using a base year of 2025 and 5.33 Gw of power consumption, by 2030, Loudoun County could easily require as much as 20-30 Gw of power due to AI demands. Put more bluntly, it is unlikely PJM and Dominion are going to be able to build enough grid infrastructure to meet Loudoun County's future energy needs. Moreover, we could stop building data centers today, and that would not stop a significant increase in existing data center demand for more power in the near to mid-term. As noted previously, the JLARC data center study arrived at the same conclusion.[2]

Increasing, Negative Impacts on Climate Change Initiatives

A disturbing, unintended consequence of this growth has also emerged. A recent New York Times article addressed an industry trend to slow or shelve plans to decommission legacy fossil fuel power plants in an effort to meet demand. According to this article, by 2030, power

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[33] Ibid.

[34] U.S. Dept. of Energy/National Renewable Energy Laboratory. "Accelerating Speed to Power." https://maps.nrel.gov/speed-to-power/data-viewer?vL=6834e82591241decedd4ef8c%2C682746c9d58843cf7876093e%2C6838ae2891241decedd4ef8f%2C685c736d77a7c73f0a473a5d&b=%5B%5B-80.01874%2C38.464018%5D%2C%5B-75.119437%2C39.6613%5D%5D

[35] Kleyman, Bill. "Data Center Rack Density Has Doubled. And It's Still Not Enough." Data Center Knowledge, April 15, 2024. https://www.datacenterknowledge.com/cooling/data-center-rack-density-has-doubled-and-it-s-still-not-enough

demands by the nation's data centers could triple.[36] A February 2023 report by PJM shows the RTO planning to retire about 40 Gw of old power plants by 2030 while expecting about 11 Gw of new orders by that same date.[37] Obviously much higher demands for power could significantly alter this plan.

These trends have very serious implications for our efforts to meet our climate change goals established by the Paris Agreement in 2016.[38] These global efforts are plainly failing based on the most recent climate change data. In 2024, the World Meteorological Organization reported that global temperatures increased 1.55 degrees centigrade. "The year 2024 was the warmest year in the 175-year observational record, clearly surpassing the previous warmest year, 2023 at 1.45 °C ± 0.12 °C above the 1850–1900 average. For global mean temperature, each of the past ten years, 2015–2024, were individually the ten warmest years on record."[39] Six global tipping points will be reached at a ten-year, 1.5-degree rise.[40]

It is fair here to note the data center community is pursuing very aggressive sustainability goals, goals that are far more aggressive than many other business enterprises. Unfortunately, by relying on power provided exclusively by the utility companies, their lofty sustainability goals are going to be negatively impacted if the utility companies continue this trend of postponing or even reversing the decommissioning of fossil-fuel power plants.

Increasing Demand for Power (cont.)

Recognizing this rapid growth in demand for power, and mindful of the legal requirement to provide power to all consumers in a regulated state, PJM, in the summer of 2022, advised Dominion Energy it would need to significantly increase its transmission infrastructure to handle the projected load in Loudoun County and to specifically address the urgent power constraints in "Data Center Alley." First, they needed to get power from the existing Loudoun north/south main transmission line to "Data Center Alley" to relieve the constraint. Then, they needed to bring additional power into Loudoun County from the north and south and connect it to the main north/south line to address the rapid growth in aggregate Loudoun County power demand.

To tackle the first and more urgent challenge, Dominion announced it would build a closed loop connecting the north/south main transmission lines to "Data Center Alley" in eastern Loudoun.

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[36] Plumer, Brad and Popovich, Nadja. "A New Surge in Power Use is Threatening U.S. Climate Goals." The New York Times. March 14, 2024. https://www.nytimes.com/interactive/2024/03/13/climate/electric-power-climate-change.html

[37] PJM. "Energy Transition in PJM: Resource Retirements, Replacements & Risks." PJM. February 24, 2023. https://www.pjm.com/-/media/library/reports-notices/special-reports/2023/energy-transition-in-pjm-resource-retirements-replacements-and-risks.ashx

[38] UNFCC. "The Paris Agreement. What is the Paris Agreement?" UNFCC. https://unfccc.int/process-and-meetings/the-paris-agreement

[39] World Meteorological Organization, WMO-No. 1368. "State of the Global Climate, 2024." https://library.wmo.int/viewer/69455/download?file=WMO-1368-2024_en.pdf&type=pdf&navigator=1

[40] Singh, Inayat. "At current rates, 5 key climate tipping points are already possible, new study warns." CBC. Sept. 11, 2022. "Climate Tipping Elements" graphic. https://www.cbc.ca/news/science/tipping-point-climate-change-paris-agreement-1.6577630

Dominion is now planning a new 500/230 Kv line from the Wishing Star to Mars substations in the southern part of the county and a 500/230 Kv line between the Aspen and Golden substations in the northern part of the county. The loop will be completed with the addition of a third 500/230 Kv line connecting the Golden substation in the northern portion of the loop to the Mars substation in the southern part of the loop. Again, these three lines don't add new power from outside the county, and they won't be built until 2028 at the earliest. They do not, by themselves, address the enormous future increase in demand projections expected for all of Loudoun County as a result of our high concentration of data centers.

To address this future demand and bring more power into the county, in December 2023 PJM accepted a proposal from NextEra, a Florida-based power company, to run a new 500 Kv line from an existing east/west line in West Virginia south through the heartland of western Loudoun County agriculture to connect to the north/south main transmission line. This proposal encountered fierce resistance from Loudoun citizenry, the BOS and environmental groups. As a result, in August 2024, PJM announced it would route the new line through the existing north/south right-of-way.[41] Dominion later announced it would build a second 500 Kv line in the existing right-of-way and is also planning to run a new 500 Kv line from the south to connect to the main Loudoun County line. These three new lines will increase the aggregate size of the Loudoun power grid.

The table below provides an inventory of the main transmission lines of the current Loudoun grid and then adds the three new lines to the mix. To understand the table, one must understand how much power each type of line can deliver. According to several sources, as a rough planning factor, depending on distance, a 500 Kv line can normally deliver between 1.0-1.5 Gw of power and a 230 Kv line can deliver about 500 Mw of power.[42] However, I've revised these power estimates based on recent conversations with Dominion Energy. According to their team, they've increased the amperage to 5,000 amps on 500 Kv lines and 4,000 amps on 230 Kv lines. Watts=Volts x Amps, so, by increasing the amps on these lines, more power can be delivered. With the increased amps, a 500 Kv line can now deliver an average load of about 2.1 Gw, and a 230 Kv line can deliver about 750 Mw. The table below shows the estimated power now being delivered into Loudoun County and projected with the new lines:

Current Lines Bringing Power Into Loudoun County:[43]

- From the north: (1) 500 Kv line = 2.1 Gw; (2) 230 Kv lines = 1.5 Gw
- From the south: (2) 500 Kv lines = 4.2 Gw; (2) 230 Kv lines = 1.5 Gw
- Total currently coming into Loudoun = **9.3 Gw**, but not to "Data Center Alley"

Planned new lines by 2028 at the earliest:[44]

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[41] Ferguson, Sheila. "Western Loudoun Power Line." Loudoun Wildlife Conservancy. Aug. 28, 2024. https://loudounwildlife.org/2024/08/western-loudoun-power-line/

[42] Power Engineers. "500 kV AC/DC Extra-High Voltage Transmission Project." Power Engineers. 2024. https://www.powereng.com/library/500-kv-acdc-extra-high-voltage-transmission-project

[43] Open Infrastructure Map. https://openinframap.org/#13.17/39.07107/-77.5192

[44] Tesfa, Nebiat. "PJM Regional Transmission Expansion Planning (RTEP) Process." PJM. December 8, 2023. Slide presentation, slide 17. https://www.pjm.com/-/media/committees-groups/stakeholder-meetings/ipsac/2023/20231208/20231208-item-02-1-pjm-regional-transmission-expansion-planning-process.ashx

- Aspen/Golden (north E/W line; planned completion date June 1, 2028), Wishing Star/Mars (south E/W line), Golden/Mars line (eastern N/S connector for Aspen/Golden and Wishing Star/Mars). These constitute the closed loop to "Data Center Alley" but add no new power to the Loudoun grid
- New power from the north, Mid Atlantic Resiliency Link (MARL): (1) 500 Kv line = 2.1 Gw; Doubs/Aspen (1) 500 Kv line = 2.1 Gw
- New power from the south, Morrisville-Wishing Star line: (1) 500 Kv line = 2.1 Gw
- Total new Loudoun grid power planned: **15.6 Gw** (existing 9.3 Gw + 6.3 Gw new lines)

Yet as we saw earlier, with the advent of AI, Loudoun could easily see its power demand rise to as much as 20-30 Gw by 2030, far more than will be available through the above buildout schedule. While Dominion and PJM will likely assert this demand can be met by more infrastructure construction, I believe the data indicates these new transmission lines will not keep pace with the rapid increase in future demand in Loudoun County.

Nor have we addressed the 30 million sq. ft. of data centers recently approved in Prince William County immediately adjacent to Loudoun County's southern border. If we assume a 1 million sq. ft. data center will request from Dominion about 150 Mw of power, the Prince William County campus will require about 4.5 Gw of power. And the lines delivering this added power will almost certainly come through Loudoun County.

Increasing Community Resistance

Prior to 2022, the proliferation of data centers in Loudoun County was largely confined to land parcels intended for data center construction, and they were largely accepted by our citizens. The BOS received occasional complaints about the loss of green space, the visual impact of massive data center buildings, the noise these facilities made both with cooling fans and backup diesel generators, and the environmental impact associated with extremely large power consumption, but this pushback was largely generalized. Our citizens also understood and accepted that Loudoun County data centers kept our real property tax rates about 25% lower than our Northern Virginia neighboring jurisdictions.

But in 2022, the Board of Supervisors began sensing real community resistance to more data centers in Loudoun County. At about that time, data center companies had started running out of industrial land to build on and had begun to exercise their "by right" options to build on parcels they had bought years earlier zoned for office parks, research and development parks and industrial parks, many of which are located near residential neighborhoods. This began to create real tensions between communities, Supervisors and the data center sector. For example, in 2019, there were no data centers in Ashburn District (the community of Ashburn actually encompasses two districts: Ashburn and Broad Run). As of this date, four hyperscale data centers are being planned or constructed in the Ashburn district, all "by right" and all across the street from residential communities.

Community resistance increased dramatically when in 2023, Dominion Energy announced it would need to construct four new overhead transmission lines to relieve the power constraints in the county and specifically in "Data Center Alley." The previously mentioned Aspen/Golden line would run along Rte. 7, a heretofore unthinkable routing Loudoun County Boards for the

previous 25 years had sworn would never happen. Earlier in 2023, Dominion Energy had already announced development of the Wishing Star/Mars line in southern Loudoun, but that line would run through a flood plain away from houses and drew little community response. Then a new line would connect the new Golden substation in the north to the new Mars substation in the south to close the loop to "Data Center Alley." Finally, a fourth line, a so-called "green field" transmission line—the previously mentioned MARL line—would run through western Loudoun County between the Potomac and Leesburg cutting across active farmlands, wetlands, tree conservation areas and through the historic village of Waterford. The public outcry was both immediate and predictable. As a result of that outcry, communities along Route 7 launched a year-long resistance movement to force Dominion to bury the 500/230 Kv line along Route 7, and a western coalition of citizens successfully pressured PJM to relocate the route of the new MARL line into the existing right-of-way coming into the county from Maryland. In October 2024, the State Corporation Commission announced it would not require Dominion to bury the Aspen/Golden 500/230 Kv line along Route 7.

Thus, between 2022-2024, community resistance to more data centers, more overhead transmission lines, more substations and more consumption of fossil fuel energy reached unprecedented levels and began to have a major impact on BOS decision-making. As discussed earlier, in March of 2024, for the first time, the BOS voted 5-4 to deny a major data center application to build a 2.9 million sq. ft. data center. The applicant resubmitted the application scaled down to 1.3 million sq. ft., the "by right" permitted size, and, to their credit, retained a substantial environmental package in the application. That scaled down application passed by a vote of 6-3. But that application marked the first time a major, new data center application was denied by the BOS.

The "by right" growth of data center construction since 2022 in Loudoun County has proven to be particularly problematic for the BOS. As a result, in late 2023, the BOS took steps to require BOS review of some of these types of parcels. Yet since 2022, "by right" construction has proliferated as land specifically intended for data centers became scarce.

This trend came to an abrupt end on March 18, 2025 when the Board of Supervisors, in a 7-2 bipartisan vote, ended all "by right" data center development in Loudoun County. With the exception of 22 data centers "grandfathered" with the vote, all new data center development in Loudoun County must now receive Board of Supervisors approval.[21]

To be clear, no one is to blame for this confluence of these three conflicting trends. The speed with which the entire data center environment has evolved is staggering, and each of the stakeholders has, heretofore and understandably, responded to that change largely within their respective silos and process paradigms.

BOS Focus. From the BOS point of view, prior Loudoun County Boards and the Department of Economic Development saw an opportunity to get in on the ground floor of revolutionary technology likely to bring enormous economic growth to our community. It enabled us for almost 20 years to lower taxes even though our population growth was the highest in Virginia for that entire period.

Data Center Focus. Similarly, the data center community was and is simply responding to revolutionary changes in the market and historic demand for data.

Utility Focus. And that demand for data has now translated into an insatiable demand for power. The energy utilities are required by law to provide sufficient power to their customers

even if demand for that power is increasing at an unprecedented rate. Asked at public meetings, including Board of Supervisors meetings, if they will be able to meet growing demand, they always assure their audiences they will—because the law requires them to.

Facing the New Realities

However we got here, we're here now. Going forward, it is incumbent upon all stakeholders—the data center community, Dominion Energy/PJM and the Board of Supervisors—to develop a strategy based on the new realities we face, a strategy that protects the quality of life of every Loudoun County citizen and reflects the tough choices we are clearly going to have to make. Based on the facts thus far presented, I believe the following are some obvious new realities we, as a Board, must address:

1. **Artificial Intelligence will change, but not substantially diminish, the unique and critical role "Data Center Alley" plays within the world data center market.**

   As mentioned previously, AI's demand for power will continue to grow exponentially, a reality we are experiencing every day. But going forward, we must also understand the changing functionality of Loudoun County's "Data Center Alley" with the advent of AI. Recently, I've heard conjecture that AI will obviate the need for our data center density because latency is not as important for AI. My research suggests this is an oversimplification. Here's why.

   The key, historic advantage of Loudoun County's data center market is its latency: the speed with which data is transmitted from point A to point B. Because of Loudoun's extensive buried fiber optic network, we have the lowest (fastest) latency rates in the world. While it is true that latency is less important for AI in one regard, it still plays a vital role.

   In layman's terms, AI processing occurs in two phases: training and inference. The training phase occurs when an AI process is "trained" to perform certain functions. The inference phase occurs when that trained AI model is then subjected to external inputs and applies its "training" to provide a learned and ever-evolving response.

   The AI training phase is heavily dependent on computations within the cloud, computational processes for which Loudoun County's data centers have been historically well suited. Latency—"Data Center Alley's" key advantage—takes on a lesser role during the AI training phase, but, depending on market demands, can still play an important role.

   The inference phase, a phase in which the AI model relies on its training to provide learned and evolved responses to the customer, is highly dependent on latency. A lower latency rate means the AI processes are far more responsive to a changing AI market environment.

   The key takeaway here is that AI training and AI inference each rely on both cloud computations and latency to perform optimally. For this reason, I don't believe the development of AI will significantly reduce Loudoun County's vital positioning within the global data center marketplace.[45]

[45] Farmer, Donald. "AI inference vs. training: Key differences and tradeoffs." Tech Target. November 13, 2024. https://www.techtarget.com/searchEnterpriseAI/tip/AI-inference-vs-training-Key-differences-and-tradeoffs

2. **In the author's opinion, as evidenced by PJM documents citing load violations existing since 2022 and Dominion's establishment of a "constrained area," the Loudoun County electric grid is now significantly oversubscribed, and planned new powerline construction will likely lag behind rapidly increasing power demand for years to come. This conclusion was also reached by the JLARC study released in December 2024.**

   To be clear, "oversubscribed" does not mean the power grid is insecure; it means large customers with existing Electric Service Agreements (ESAs) will be power constrained—likely for years—by Dominion Energy until sufficient grid infrastructure is built to handle the contracted load. In its 2024 Integrated Resource Plan,[46] Dominion Energy illustrates how it constrains customer load below the contracted ESA amount for as much as seven years. In a letter to at least one large customer on August 22, 2024, a senior Dominion official confirmed this by stating, "However, the size and quantity of large scale requests requiring supporting backbone expansion results in an extension of planning analysis and project execution lead times. Therefore, we expect the typical duration of the planning and execution process for large (greater than 100 MW) DP [Delivery Point] requests within the Dominion Energy transmission zone (DOM Zone) to increase by 12 to 36 months [from the current 3-4 years to 4-7 years]."[47]

3. **Halting new data center construction will not solve the problem.**

   Even if all new data center construction is halted immediately, the oversubscription of the power grid in Loudoun County will continue as our dependence on AI—requiring up to a tenfold increase in processing power within existing data centers—proliferates throughout the world.

4. **"Data Center Alley" rapidly rising power demand will slow the retirement of fossil fuel power plants throughout the PJM/Dominion service area.**

   This is the only way PJM/Dominion can meet the increasing demand, because the majority of power being delivered to Loudoun County data centers is derived from fossil fuels. This could be slowed somewhat if PJM/Dominion accelerate their conversion to carbon-net-zero fuels in response to aggressive data center programs demanding the utilities do just that, but the net result of these competing trends is difficult to predict.

5. **Community resistance is going to rapidly increase.**

   Thus far proposed are the new 500 Kv MARL line entering Loudoun from the north along the existing north/south corridor, a second 500 Kv line from Doubs to Aspen in the north, a new Morrisville/Wishing Star 500 Kv line coming into Loudoun from the south, and the closed loop to "data center alley" comprising the new Aspen/Golden line proposed along Rte. 7 in the north, the new line from Golden-Mars through "Data Center Alley," and the Wishing Star/Mars line closing the loop in the south. But as previously stated, this loop adds no new power, and these won't be enough. A second line down Rte. 7 is probably next up. After that, Dominion will have likely used the last available routing to "Data Center Alley" that won't require using eminent domain. The next available routes along the W+OD Trail or the Dulles

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[46] "Virginia Electric and Power Company's Report of Its 2024 Integrated Resource Plan." Case No. PUR-2024-00184; Docket No. E-100, Sub 204. Pg. 14

[47] August 22, 2024 email from Dominion Energy official to a large Delivery Point customer. Available upon request.

Greenway will require the use of eminent domain to obtain the necessary right of way. Community resistance will build accordingly. If incumbent elected officials are then voted out of office, they will be replaced by other elected officials with a mandate to vehemently oppose the data center and utility sectors.

6. **Burying 500 Kv transmission lines delivering AC power is possible but challenging and expensive; burying 500 Kv High Voltage DC (HVDC) lines is much easier and more efficient, however historically, HVDC lines have only been used to transmit power over long distances. Loudoun County may offer an excellent opportunity to develop the nation's first underground HVDC regional grid for exclusive use by data centers.**

   As stated earlier, in October 2024, the Virginia State Corporation Commission denied the citizens' petition to underground the new 500/230Kv line from Aspen to Golden substations. Undergrounding a 500 Kv AC line has only been done once in the U.S. In 2013, an underground 500 Kv line was constructed traversing 3.7 miles through Chino Hills, CA. The project took three years and cost $224 million (not including the seven years of court battles).[48] Underground lines transmitting AC power must be insulated, usually with oil, and buried in a concrete tunnel, require much higher power transmission to deliver the same energy due to energy losses underground, are much harder and take longer to repair, and are not practical over long distances.[49]

   Undergrounding HVDC is now a viable alternative, loses very little power when buried, is used in many locations around the world and accepts renewable energy additions to the grid more easily.[50] While HVDC generally only makes sense for transmission over very long distances, the unique circumstances in Loudoun County, with its very high concentration of data centers within a relatively small geographic area, may offer an opportunity to develop a separate HVDC regional grid for the exclusive use of Loudoun County data centers. This would offer two, major advantages: 1) it would create an entirely separate grid for data centers enabling a separate Dominion billing structure for data center users exclusive of residential and other commercial users, and 2) because HVDC is a more efficient means of transmitting carbon net-zero power, it would facilitate the transmission of carbon net-zero power (solar, wind, etc.) from numerous sources directly to "data center alley." Attachment 1 to this white paper outlines a concept for developing an underground HVDC power grid in Loudoun County, within the existing HVAC rights of way, dedicated exclusively to our data centers.

7. **Solar and wind, by themselves, are not viable alternatives for Loudoun County data centers.**

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[48] Nisperos, Neil. "Edison about to flip the switch on controversial power line project through Chino Hills." Daily Bulletin. October 30, 2016. https://www.dailybulletin.com/2016/10/30/edison-about-to-flip-the-switch-on-controversial-power-line-project-through-chino-hills/

[49] XcelEnergy. "Overhead vs. undergrounding. Information about burying high-voltage transmission lines." XcelEnergy Information Sheet. 2021. https://www.transmission.xcelenergy.com/staticfiles/microsites/Transmission/Files/PDF/Projects/CO/Avery/Transmission-CO-Avery-Substation-Overhead-Vs-Underground-Info-Sheet.pdf

[50] NextGen Highways Fact Sheet. "Buried High-Voltage Direct Current (HVDC) Transmission is Cost Competitive." November, 2022. https://nextgenhighways.org/wp-content/uploads/2023/01/NGH_Buried-HVDC-Cost-Competitive.pdf

a. **Solar.** The average solar panel has a capacity factor (explained below) of about 24%. This means, due to clouds, darkness and other external factors, solar panels only deliver an average of about 24 percent of their "nameplate" (maximum rated power) per hour during a year. While estimates vary between 5-10 acres required per 1 Mw of nameplate power based on the topography and support structure layout, a reasonable planning factor for a commercial solar field using state-of-the art technology is about 5 acres of land per Mw.[51] Loudoun County had about 200 data centers with 4.14 Gw of power capacity in 2024. Assuming a 100 Mw data center average, and a capacity factor of about 24%, that usage level would require 400,000 acres of solar panels. Loudoun County's entire land mass is 333,000 acres. If power demand in Loudoun County for the next five years grows at the same rate as the previous five years (this does not account for AI growth), the county will be using 11.43 Gw of power in 2029. Solar power alone is simply not a viable answer for Loudoun County.

b. **Wind.** As an illustrative, Vineyard Wind, a 62-turbine wind farm being built off the coast of Martha's Vineyard, will generate 806 Mw (nameplate) of electricity when complete, but only 193 Mw per hour on average after applying a 34.3% capacity factor.[52] At completion, this offshore wind farm theoretically will generate enough power to power 400,000 homes in the local area at nameplate power. But in practice, at an average of only 193 MW/hour, it would meet the power needs of about two of Loudoun County's 200 data centers.

8. **The 135-yr. old paradigm of power generated by large, remote power plants and transmitted across hundreds of miles of transmission lines will no longer work for Loudoun County's globally unique needs.**

   Given the above power demand projections and the time required to build new power infrastructure, it seems highly unlikely our traditional approach of delivering power to a consumer market as large and growing as Loudoun County can safely and effectively serve our needs.

Only Three Possible Scenarios Exist to Reduce or Stabilize Future Data Center Power Demand

If, as this paper and the JLARC study predict, the power grid infrastructure in Loudoun County—even with its planned expansion—will be insufficient to meet the future energy demand of the county's data center market, there are only three possible future scenarios by which that demand can be stabilized to manageable levels:

Scenario #1: Government-Imposed Energy Use Constraints. In this scenario, the Commonwealth of Virginia, the power utilities or both artificially constrain the energy consumption of high-energy consumers to ensure grid stabilization for all Virginia energy consumers. Such constraints are already in place in Loudoun County and are likely to remain in place for the foreseeable future. As stated earlier, Dominion Energy has already

[51] Community Solar Authority. "How Much Land for 1 Mw Solar Farm: A Quick Guide." Community Solar Authority. May 31, 2024. https://communitysolarauthority.com/how-much-land-for-1-mw-solar-farm-a-quick-guide/

[52] Vineyard Wind. "Avangrid, CIP Announce First Power from Nation-Leading Vineyard Wind 1 Project." Vineyard Wind. January 3, 2024. https://www.vineyardwind.com/press-releases/2024/1/3/cip-avangrid-announce-first-power-from-nation-leading-vineyard-wind-1-project

extended the planning and execution time for delivering requested power to large consumers from 3-4 years to 4-7 years. In the author's opinion, this extended delay for full-power access will likely only increase. The JLARC study tacitly acknowledges this trend in its recommendation #2:

> "The General Assembly my wish to consider amending the Code of Virginia to clarify that electric utilities have the authority to delay, but not deny, service to customers when the addition of customer load cannot be supported by the transmission system or available generation capacity. (Chapter 3)"[53]

Like many aspects of the Loudoun County data center environment, I believe this de facto power constraint is a harbinger of what's to come globally for the data center market. We are the "canary in the mine." Data center power constraints were hardly mentioned in large data center conferences I attended in 2023. Now, they are a key topic in virtually every major data center conversation. Artificial caps on available power for data centers will likely become the norm as utilities struggle to achieve their core mission mandate, grid resiliency for all customers. A recent article in AP highlights this growing trend throughout the country.[54] This reality establishes the foundational argument for two subsequent market evolutions: 1) continuing technological advancements requiring less power within data centers, and 2) the development of microgrids to reduce data center dependency on the grid.

Scenario #2: Technological Breakthrough. Technological breakthroughs are now on the near horizon that are likely to significantly reduce the power needed by AI and cloud-based computing. Such developments will initially reduce strains on the power grid and give the power utilities time to adjust to meet the growing infrastructure needs of the industry. For example, a July, 2024 article in Windows Central discusses the newly emerging chip technology called computational random-access memory (CRAM) that would reduce generative AI's power consumption by 1000-fold potentially achieving a 2,500 percent energy savings.[55] Note: this scenario could lead to significant stranded costs (discussed below). As discussed below, such technological breakthroughs would likely be iterative and provide only temporary relief.

Scenario #3: Industry Conversion to Onsite Power. Faced with exponential market demand and possessed with almost unlimited resources to meet that demand, the data center industry will likely develop the capacity to generate onsite power through microgrids for its operations and, in so doing, significantly reduce its reliance on the regional power grid. Such developments could eventually stabilize the grid by allowing an industry-wide, demand response system to develop. The JLARC study specifically recommends a change

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[53] Joint Legislative and Audit Review Commission. "Data Centers in Virginia, Commission Draft." Report to the Governor and the General Assembly of Virginia. December 9, 2024, pg. xi. https://jlarc.virginia.gov/pdfs/reports/Rpt598-2.pdf

[54] AP. "US electric grids under pressure from energy—hungry data centers are changing strategy." AP. September 13, 2025. https://apnews.com/article/big-tech-data-centers-electricity-energy-power-texas-pennsylvania-46b42f141d0301d4c59314cc90e3eab5

[55] Okemwa, Kevin. "This breakthrough tech could solve Microsoft's AI power consumption woes and is 1,000x more energy-efficient." Windows Central. July 29, 2024. https://www.windowscentral.com/software-apps/this-breakthrough-tech-could-solve-microsofts-ai-power-consumption-woes-and-is-1000x-more-energy-efficient

to state code requiring data centers to participate in demand response systems that would enable data centers to shift their loads on the grid to stabilize grid resiliency.[56] This would better enable the power utilities to meet the more predictable infrastructure needs of the industry. This evolution has already begun in Loudoun County (see below). Note: this scenario could lead to significant stranded costs (see below).

Likely Future: All Three Scenarios Occur Simultaneously and Energy Demand Still Grows

The three scenarios will likely occur simultaneously but to differing degrees based upon market conditions. The utilities have already begun delaying additions of large loads to the grid, and the JLARC study recommends codifying this in state code to allow delays for limited generation or transmission capacity (scenario #1). Meanwhile, new GPU (AI) chips are emerging that use significantly less power (scenario #2), and we already have examples of data centers in Loudoun County building advanced microgrids to reduce their dependence on grid power (scenario #3). All three scenarios will continue to develop for the foreseeable future.

But even as these three scenarios evolve in varying degrees and temporarily reduce demand on the power grid, data centers will adjust, increase data processing density to fill the space created by the efficiencies, and once again operate at maximum capacity using all the power available to them. The JLARC study acknowledges this critical point. They quote one data center representative who succinctly captures the phenomenon known as Jevon's Paradox[57]:

> "Consequently, any energy saved from efficiency gains is likely to be used to perform more computing activity. One company representative noted 'at the end of the day, a 200 MW data center is going to be a 200 MW data center.'"[58]

And so, in its continuing quest for more power, the data center industry will evolve in order to meet market demand. The utilities will begin to artificially cap that demand, as they eventually must do to preserve grid resiliency (scenario #1), the data industry will produce ever more energy-efficient chips (scenario #2), and data centers will strive to become less reliant on grid power by developing microgrid, onsite/communal/distributed energy baseload, backup and stored power (scenario #3).

I believe the development of onsite microgrid power will reshape the national power grid going forward, though due to geographic constraints and our very dense data center market, its applicability in Loudoun County will be limited. As access to grid power becomes more and more constrained and chip efficiencies constantly evolve, a comprehensive demand response system will become the core of a regional and even nationwide distributed energy system. This is the heart of the new energy paradigm. Local, regional and national demand response systems will enable onsite power sources to stabilize hourly grid operations.

Assessment of the 2024 JLARC Data Center Study[59]

The 2024 JLARC study concurs with the basic premise of this white paper, namely that it will be either "very difficult" or "difficult" to build sufficient infrastructure to meet the projected energy demands of the data center industry. Unfortunately, the study's underlying premise and all its

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[56] Joint Legislative Audit Review Commission. "Data Centers in Virginia, 2024: Report to the Governor and General Assembly of Virginia." Pg. 38-40. https://jlarc.virginia.gov/pdfs/reports/Rpt598-2.pdf

[57] Wikepedia. "Jevon's Paradox." https://en.wikipedia.org/wiki/Jevons_paradox

[58] Ibid, pg. 41.

[59] Joint Legislative Audit Review Commission. "Data Centers in Virginia, 2024: Report to the Governor and General Assembly of Virginia." https://jlarc.virginia.gov/pdfs/reports/Rpt598-2.pdf

recommendations and policy options represent a tacit acceptance of scenario #1 above as the only possible way to reduce the energy demands of the data center sector.

Of the study's eight recommendations, six deal with data center siting or locally imposed performance standards to improve energy efficiencies. Yet the study plainly states improved performance measures would have a limited impact on decreasing data center sector energy demand:

> "Improving data center efficiency makes better use of energy but is likely to have only a marginal impact on demand."[60]

One recommendation suggests allowing utilities to delay but not deny data center construction to protect the grid. This is already occurring; the change would simply legally codify the practice. It also doesn't reduce increasing energy demand.

Finally, the one remaining recommendation addresses stranded costs (see below).

Of the study's ten policy options, eight suggest the General Assembly should use the state sales tax exemption as an incentive to encourage data centers to use less energy. The study acknowledges such actions could have significant, unintended consequences on the data center sector. In fact, this option would have a devastating impact on Loudoun County's economy:

> "If the General Assembly wishes to slow down the data center industry's growth in Virginia…it could allow the sales tax exemption to expire…. While it is difficult to gauge the exact effect this would have, it is likely industry growth would slow and could eventually stop or even contract.[61]

In short, the entire study essentially recommends two broad approaches: 1) local governments should use performance standards to improve energy efficiency, measures it acknowledges will have only a limited impact on reducing sector energy consumption, or 2) state government should use the state sales tax exemption to incentivize greater energy efficiency, precisely the type of artificial government intervention described in scenario #1, to reduce sector energy demand. Very brief mention is made of either technological breakthroughs (scenario #2) or onsite/communal power generation through microgrids (scenario #3) as ways to significantly reduce demands on the regional power grid.

Stranded Costs

As mentioned above, scenarios #2 and #3 could easily result in what the utility industry refers to as "stranded costs." Stranded costs occur when a regulated utility, required by law to meet the energy demand of its customers, is forced to build new infrastructure to meet predicted, future demand for energy, and, at some time during the infrastructure buildout process, that predicted demand is not realized. The regulated utility has incurred the costs of the buildout, but the consumer demand no longer justifies those costs. The utility must then absorb the costs or pass them on to residential and small commercial customers.

Normally, this is not a major challenge as historically, energy demand has been both relatively stable and predictable over time. For example, PJM charts illustrate that energy consumption between 2007-2017 in the Dominion service area decreased slightly, presumably due to realized

[60] Ibid, pg. 40
[61] Ibid, pg. 88-89.

efficiencies.[6] In such a stable market, predicting future energy demand, while a complex process, is relatively straightforward.

Since 2022, however, energy demand in Northern Virginia and particularly in Loudoun County, has increased rapidly and exponentially making it extremely difficult to accurately predict future power demand. Despite the turbulence in the marketplace, because Virginia is a regulated state, the investor-owned utilities must plan to build that infrastructure even though the predicted demand may never be realized.

Such is the case with scenarios #2 and #3. If PJM and Dominion Energy build billions of dollars of new generation and transmission infrastructure to meet what at present appears to be enormous future demand, and data centers subsequently find a way to process data using far less energy or move heavily towards microgrids and onsite power generation, the costs to the utility companies of that new infrastructure become "stranded" because demand for grid energy has dropped. The Virginia State Corporation Commission specifically addressed the issue of stranded costs at its December 16, 2024 technical conference.[62]

One way to insulate utility companies from stranded costs is to allow the utilities to charge major energy consumers an upfront tariff to absorb the cost of the infrastructure development should demand suddenly drop. This tool was used in May, 2024, when AEP Ohio filed a plan with the Public Utilities Commission of Ohio (PUCO) to require data centers to commit to a 10-year plan to make monthly payments equal to 90% of the cost of the energy they said they needed even if they ultimately didn't use that much energy.[63] In July, 2025, over strong objection from the data centers, PUCO approved a modified version of AEP's request and imposed a data center tariff requiring data centers to pay for 85% of the power they contracted for whether or not they use that much power. The tariff would be in effect for twelve years.[64] The Virginia State Corporation Commission is considering just such a tariff structure.

Strategies for the Future

Clearly there is no "silver bullet" to meet these complex challenges, especially in Loudoun County. Any approach will require the thoughtful integration of a range of options to meet the growing demand for more power from the data center sector in ways that do not drastically and negatively impact the quality of life of our residents or the stability of our economy. Obviously whatever strategies are developed will be policy decisions for the Board of Supervisors to make by a majority vote.

Offered below are some suggested options by the author and as such are entirely subjective and debatable. They will likely generate considerable discussion, hopefully based upon the factual foundation thus far provided. It seems clear however that, over the next ten years, unless the data

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[62] Pamploni, Hanna. "State Leaders Grapple with Infrastructure, Generation Costs." Loudoun Times Mirror. December 31, 2024. https://www.loudounnow.com/news/state-leaders-grapple-with-infrastructure-generation-costs/article_ebb47fac-c7b1-11ef-808d-df584e150bf9.html?utm_source=loudounnow.com&utm_campaign=%2Fnewsletter%2Foptimize%2Fdaily-headlines%2F%3F-dc%3D1735676910&utm_medium=email&utm_content=read%20more

[63] AEP Ohio. "AEP Ohio Files Plan to Secure Grid Resources for Data Centers, Protect Residential Customers." AEP Ohio news release, May 13, 2024. https://www.aepohio.com/company/news/view?releaseID=9539

[64] Wolfe, Sean. "Ohio utility regulators approve AEP's contested data center tariff proposal." Power Engineering. Factor This. July 10, 2025. [link proprietary]

center industry undergoes a major technological transformation enabling it to significantly reduce its power consumption permanently, the Board of Supervisors will likely be faced with a repeating binary choice:

1) Accept the traditional paradigm of AC power generated at massive, remote power plants, transmitted over hundreds of miles of overhead transmission lines, then delivered to customers, including Loudoun's data centers with their historic demand for power. The likely result will be a significant threat to Loudoun County's power grid resiliency and a lattice of overhead transmission lines throughout Loudoun County, or;

2) Reject that 135-yr. old power infrastructure paradigm and facilitate the data center sector's market-driven move to a radically new power delivery model and market environment. Large power consumers will find ways to reduce their power needs while simultaneously generating low or carbon-net-zero power onsite or locally to enable them to participate in a demand response system and deliver surplus power onto the regional power grid as part of a nationwide distributed energy network. This is precisely the model the Department of Defense (DoD) has adopted. In a recent update to Title 10, DoD has directed all Services to make select military bases and critical installations energy independent and resilient through the use of onsite, sustainable energy generation, including long-term energy storage and nuclear and hydrogen power generation. This program is now being implemented worldwide.[65]

Here, then, are some possible strategies for consideration:

1. **PJM/Dominion Energy: Increase Transmission Capacity.**

   a. Reconductoring.

   The 2025 session of the Virginia General Assembly passed a law requiring all new transmission lines in Virginia to use advanced conductors (transmission lines). Dominion has advised they now plan to replace their existing lines with advanced conductors and use advanced conductors for all new lines in Loudoun County. They will use Aluminum Conductor Steel Supported (ACSS) line. Depending on other upgrades, this will cost about 35% more than the cost of the current type of conductor in use for the past 100 years. ACSS conductors can increase line capacity by 50-100%, are the cheapest of the new alternatives and are proven technology. This type of conductor has been in use since the 1970's but is still considered an "advanced conductor" option because of the capacity increase.

   While there are several other advanced reconductor options, the most common new alternative to ACSS is Aluminum Conductor Carbon Core (ACCC) conductors. Developed around 2003, this would also increase capacity by about 100%. It's a lighter line and delivers increased capacity, but is prone to breakage during installation, has

[65] TITLE 10 / Subtitle A / PART IV / CHAPTER 173 / SUBCHAPTER I / § 2911. May 31, 2024. https://uscode.house.gov/view.xhtml?req=(title:10%20section:2911(b)%20edition:prelim)

had some recent, unforeseen challenges, has challenges in icing conditions and costs about three times more than ACSS conductors.[66]

The newly reconductored lines would eventually be overtaken once again by rising demand, but, if combined with other measures, could be a valuable tool in building a new energy transmission paradigm.[67]

b. **Create an Underground, High Voltage Direct Current (HVDC) Parallel Power Grid in the Existing Dominion HVAC Transmission Line Rights of Way in Loudoun County. (See atch.1 for a Loudoun County concept plan.)**

The National Renewable Energy Laboratory (NREL), a Department of Energy laboratory, is exploring the expanded use of HVDC transmission lines in more multiple connection environments.[68] Recent technological advances now make the use of HVDC transmission lines a real alternative to the present AC-power dependent U.S. power grid. HVDC transmission lines are currently used in many countries. An HVDC transmission line is far more efficient in transmitting high-voltage power across long distances, experiences much less power loss through transmission, can be buried underground much more easily and with little loss of power, and is much better suited to allowing a grid to accept power from renewable and onsite sources.[69] There are currently three underground HVDC projects in the U.S.: Soo Green, IA, Champlain Hudson Power Express, NY, and Clean Path, NY.[70]

What if PJM, Dominion Energy, the data center community in Loudoun County, the Commonwealth of Virginia and Loudoun County government collaboratively proposed to DoE and NREL the creation of a national pilot project to create a separate, underground, HVDC power grid in Loudoun County specifically to deliver HVDC power directly to Loudoun County data centers, the highest concentration of data centers in the world? This entire HVDC grid, capable of delivering 2 Gw of of HVDC power, could be placed underground in a five-foot underground trench within the existing Dominion HVAC overhead transmission line rights of way. TenneT Netherlands is a company specializing in underground HVDC transmission projects and is engaged in several of these types of projects in Europe.[71] Data centers could begin planning to fully convert to internal DC power by 2028, the projected completion date for some of the new lines. At

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[66] Idaho National Laboratory. "Advanced Conductor Scan Report." Idaho National Laboratory. Dec. 2023; revision April, 2024. https://inl.gov/content/uploads/2024/02/23-50856_R8_-AdvConductorszScan-Report.pdf

[67] Plumer, Brad. "The U.S. Urgently Needs a Bigger Grid. Here's a Fast Solution." The New York Times. April 9, 2024. https://www.nytimes.com/2024/04/09/climate/electric-grid-more-power.html

[68] NREL. "On the Road to Increased Transmission: High-Voltage Direct Current." NREL.gov. June 12, 2024. https://www.nrel.gov/news/program/2024/on-the-road-to-increased-transmission-high-voltage-direct-current.html

[69] Berthou, Andreas. "The Benefits of High-Voltage Direct Current (HVDC) Power." EE Power. October 19, 2020. https://eepower.com/technical-articles/the-difference-that-dc-makes/#

[70] NextGen Highways. "Buried High-Voltage Direct Current (HVDC) Transmission is Cost Competitive." NextGen Highways. November, 2022. https://nextgenhighways.org/wp-content/uploads/2023/01/NGH_Buried-HVDC-Cost-Competitive.pdf

[71] TenneT. https://www.bing.com/videos/riverview/relatedvideo?q=underground+hvdc&mid=CBFAD8D2D54C82255EC5CBFAD8D2D54C82255EC5&FORM=VAMTRV

completion of the pilot project, Loudoun County would have two separate power grids, an HVAC grid for residences and normal-sized commercial customers, and an HVDC grid exclusively for data centers.

If PJM and Dominion must build the new HVAC lines anyway, why not make the project a national pilot project and incorporate state-of-the-art technology throughout the pilot project? This would include using all advanced conductors to double overhead HVAC line capacity supplemented by a buried HVDC transmission grid to distribute DC electricity directly to data centers.

The advantages of this admittedly bold concept would be significant:

1) The existing HVAC power grid in Loudoun County would immediately stabilize as data centers were moved off that grid;

2) A large infusion of DoE funding would relieve PJM and Dominion Energy of the burden of financing the currently planned infrastructure upgrades, a burden existing residential and commercial customers will undoubtedly have to bear;

3) Two separate grids would facilitate two separate billing systems for Dominion Energy, thereby relieving residential/small commercial customers from having to help pay the added infrastructure costs associated with the growing power consumption by the data centers;

4) The new HVDC power grid could be buried within existing rights of way;

5) The new HVDC grid would be much more adaptable to the incorporation of onsite data center microgrids with multiple DC power sources such as natural gas, battery backup, hydrogen fuel cells and distant solar/wind inputs.

In September, 2025, to prove both this concept and the corollary concepts of regional microgrids and long-duration energy storage, the author, in cooperation with Emtel Energy—USA, proposed the creation of just such a pilot project in Loudoun County comprising a regional HVDC underground power grid, a long-duration energy storage field, natural gas turbines and a utility-scale solar field, all contained in a 300-acre installation called NOVA SES-1 (See atch. 1: "NOVA Strategic Energy Storage-1"). NOVA SES-1 would be capable of storing 10 GWh of electricity, could recharge every 2-3 days and would deliver its power directly to participating data centers via a regional underground HVDC grid laid within the existing HVAC rights of way.

2. **Loudoun County:**

   a. **Create Performance Standards Requiring New Data Centers to Conserve Energy and Develop Microgrids.** We must insist new data centers adhere to rigorous energy-conserving performance standards while incorporating essential microgrid elements into their campus designs enabling them to significantly lower their projected power load on the regional grid.

   b. **Create an Incentive/Disincentive Program to Encourage/Require Existing Data Centers to Operate More Sustainably and Reduce Community Impact.** While retrofitting existing data centers to incorporate microgrids may, at present, be impractical, steps can be taken to reduce emissions, reduce noise levels and

improve viewsheds. It may also be possible in the near future to incorporate several microgrid elements on existing data center campuses.

The planning objective for both new and existing data centers should be to demonstrate a commitment to the Loudoun County Board of Supervisors to reduce their load on the grid and their impact on the surrounding community over time.

Loudoun County's highly dense data center environment is unique in the data center world today. This means we are literally on the frontier of a new digital age. The county's key stakeholders are now faced with a simple binary choice: lead, through innovation and imagination, or wait and react too little, too late to a rapidly expanding traditional power grid infrastructure inappropriate for Loudoun County's needs and unable to solve our unique demand challenges.

What is a Microgrid?

A microgrid generally consists of five elements: 1) a major power "load" or consumer such as a data center, 2) an onsite or nearby communal baseload power source (power delivered continuously to sustain normal, daily operations), 3) an optional backup power source to supplement the baseload power source during times of grid instability or to store excess power, 4) connections to the utility power grid enabling upload of excess power or operation of the microgrid independently in "island" mode, and 5) a system to manage all elements of the microgrid and determine if, when and how the microgrid should interface with the regional power grid.[72]

If we accept the premise the traditional power grid infrastructure serving the nation, by itself, will ultimately not be able to meet the unprecedented aggregate nationwide increase in demand for power—and some may not accept that premise—then the only viable national-scale alternative is a distributed energy network. Such a distributed energy network would offer nationwide power grid resiliency and redundancy in much the same way information stored in "the cloud" is continuously available through any smart device and not susceptible to any single device failure.

A distributed energy network would comprise thousands of microgrids around the country continuously generating baseload power for their onsite customers, storing energy for periods of grid instability, and uploading excess energy to the national grid when available to increase grid resiliency. These microgrids could be as large as data-center scale microgrids generating hundreds of megawatts of power, smaller scale microgrids to provide backup power to large consumers or even tiny, point source microgrids such as individual electric vehicle charging stations whereby your personal vehicle, once fully charged, begins to discharge onto the local power grid.

The Challenges of Developing Microgrids in Loudoun County

Though the solution for the national power grid may be the development of a nationwide distributed energy network through microgrids, such a solution has limitations for widespread deployment in Loudoun County. While I believe the development of a nationwide distributed energy grid infrastructure is highly likely, such a model presents significant challenges in Loudoun County for one reason: land. Our 200+ data centers are packed into about 30 square miles of real estate in eastern Loudoun County, and "data center alley" is literally a zero-lot-line checkerboard of data centers built on just about every square meter of space. My research suggests microgrids capable

[72] NREL. "Microgrids." https://www.nrel.gov/grid/microgrids.html

of generating the baseload power many of our data centers would require would likely need land that simply isn't available.

However, even with that limitation, an organic evolution within the industry is now gaining momentum in Loudoun County. The Board recently learned of a "by right" natural gas microgrid operating in Loudoun County in "island" mode (not connected to the power grid but operating autonomously) that has been under development for the past two years. Because it was "by right," the application did not come before the Board. In August 2022, the company was forced to develop this microgrid when, after signing a billion-dollar land lease for its property, Dominion Energy informed the landowner it would not be able to provide power for several years. The site is now operating eight natural gas turbines with Selective Catalytic Reduction (SCR; see below) units attached and is in compliance with federal EPA, Virginia DEQ and Loudoun County emission and noise regulations. They plan to expand the concept to a second campus soon. Similarly, another company recently submitted an application to build a 750 Mw data center campus in Loudoun County powered, at least in part, by blue hydrogen fuel cells (see below).

Thus, while fully autonomous, carbon-net-zero, baseload microgrids may not be immediately feasible for many Loudoun County data centers, several microgrid elements could be adapted and applied to our existing data centers as transitional steps moving us to a distributed energy, fully carbon-net-zero data center environment in the future. For example, the natural gas generators in the example above have SCR units attached. According to site operators, these installations reduce Nitrogen Oxides (NOX), Carbon Monoxide (CO), and unburned Hydro-Carbons (HC) to Tier IV Final EPA emission standards, the strictest standards in the industry. They remove about 95% of NOX and over 85% of CO. However—and this is an important point—if not properly tuned, natural gas turbines with SCR can actually increase PM2.5 emissions, and turbines burning natural gas always emit CO_2.[73, 74] If Loudoun County were to create incentives or require, through new performance standards, existing data centers to replace their 4,000 diesel generators with either Tier IV diesel generators or natural gas generators, the county would experience a significant reduction in NOX, CO and HC emissions and noise levels. With this in mind, let's examine the various onsite power generation options either available now or being developed in the near future.

In researching this paper, I encountered a common theme among many I talked to when I raised the issue of carbon-net-zero onsite power production. Many believe such onsite power production is still purely theoretical and that practical demonstrations of this technology are years away. I was one of those people. What I have learned, however, is that there are several working installations delivering onsite power with the potential to provide the Loudoun County data center sector with various options for a viable way forward.

Potential Onsite Power Sources for Loudoun County

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[73] Power. "Could SCR Catalyst Technology Adoption Be a Roadmap for Power Plants Seeking Economical and Efficient CO2 Point-Source Solutions?" Power. August 8, 2023. https://www.powermag.com/could-scr-catalyst-technology-adoption-be-a-roadmap-for-power-plants-seeking-economical-and-efficient-co2-point-source-solutions/

[74] Jiang, Binfan and Dehong, Xia. "Potential PM2.5 generation mechanism induced by ammonia-based SCR: Nucleation of SO3, H2O and NH3." Science Direct. May 15, 2024. https://www.sciencedirect.com/science/article/abs/pii/S0016236124002606#:~:text=As%20a%20main%20precursor%20for%20the%20PM2.5%2C,gas%2C%20which%20may%20induce%20heavier%20particle%20pollutions.

Given the current state of our technology, here are the six sources of onsite power that could be tailored to meet Loudoun County's unique microgrid challenges: (I include Small Modular Reactors (SMR) and Advanced Nuclear Reactors (ANR) because, while largely unproven and likely not practical in Loudoun County, they offer the most efficient carbon net-zero solution, and there is global interest in their rapid development) :

Power Source Type	Baseload Capacity	Carbon-Net-Zero	NOX, PM2.5 Free
Diesel Backup Gen. w/SCR		**Tier IV**	**Tier IV**
Batt./Long-Duration Storage		✓	✓
Natural Gas Turbine w/SCR	✓	**Tier IV**	**Tier IV**
Green Hydrogen Fuel Cells		✓	✓
Blue Hydrogen Fuel Cells			
SMR/ANR	✓	✓	✓

Below are the pros and cons of each power source:

Battery Energy Storage Systems (BESS).[75] A lithium battery energy storage system captures energy from various sources and stores it for later use. These are most often used to capture renewable energy produced, for example, from solar or wind installations, but they can be used to store energy from any source. They are typically used as backup power to augment a continuous power supply.

Advantages: Carbon-net-zero; no pollution; no noise.

Disadvantages: Not a source of sustainable, baseload power; lithium for batteries is becoming scarcer, and the fire hazard requires new suppression methods. These batteries must retain 20% of their charge to preserve the life of the battery, only have about a 10-yr. operational life, and have only one discharge rate.

Long-Duration Energy Storage.[76] While definitions vary, LDES typically refers to energy storage systems capable of delivering power for at least 8–12 hours or longer—well beyond the limits of conventional lithium-ion Battery Energy Storage Systems (BESS). LDES solutions step in where lithium leaves off, offering safer, more sustainable, and more scalable options.

[75] ABB. "What Are Battery Energy Storage Systems?" https://electrification.us.abb.com/battery-energy-storage-systems-bess-basics

[76] Mullendore, Seth. "Long-Duration Energy Storage: What Is It, Why Do We Need It, and When Will It Get Here?" Clean Energy Group. May 5, 2025. https://www.cleanegroup.org/what-is-long-duration-energy-storage/

In my research, I have found only one company currently mass-producing LDES at scale: Emtel Energy USA. Their ENVAULT Electrostatic Long-Duration Energy Storage (ELDES) unit offers flexible discharge durations ranging from instantaneous to more than 24 hours. Unlike lithium-based systems, ENVAULT carries no thermal runaway or propagation risk, relies on graphene rather than lithium, and is fully recyclable. It contains no hazardous materials or emissions, has a significantly longer service life, and is designed to complete multiple charge-discharge cycles daily with negligible capacity degradation.

The ENVAULT system units can be mounted on skids for rapid transport, stacked vertically, and configured into high-density arrays. For example, a 24-unit stacked installation can store 10.4 MWh of energy on a pad measuring just 40 feet by 30 feet (including skids, platforms, and a 12-foot forklift lane). At scale, this configuration achieves approximately 322 MWh of storage per acre. That density is critical for land-constrained applications such as those found in Loudoun County.

> **Advantages:** No fire hazard; versatile charge/discharge options; 20-yr. service life; 98% efficient discharge; no precious metals; bio-degradable materials; high storage density.
>
> **Disadvantages:** Not a source of baseload power; requires an energy generation source which, in turn, determines its climate change impact.

Natural or Renewable Gas.[77, 78] Natural gas (local pipeline) onsite power generation is not carbon-net-zero and is a fossil-fuel derived energy source. If used to generate baseload power without active emission controls, it has significant CO_2, NOX, PM2.5, HC and CO emissions. These can be significantly mitigated through the use of Selective Catalytic Reduction (SCR) mentioned earlier, a modification that should be mandatory in Loudoun County. Renewable natural gas (RNG or "biomass" gas) is waste gas produced by organic waste, captured, and delivered to the microgrid. Since the waste gas would otherwise be released into the air, using waste gas to run generators can reduce the net CO_2 emissions even considering the CO_2 released in burning the gas. It too may use SCR to reduce emissions.

> **Advantages:** Biomass or renewable natural gas may reduce total CO_2 emissions by capturing and using waste gas that would otherwise be released into the atmosphere; natural gas has lower carbon emissions than diesel and these are significantly reduced by the use of SCR; it can provide sustained, baseload power; it can rely on existing gas lines; it could replace Loudoun's 4,000 diesel backup generators; a gas microgrid design could easily accommodate a different energy source (hydrogen fuel cells, nuclear) in the future.
>
> **Disadvantages:** Even with SCR, gas turbines run on fossil fuel, create some emissions, and create sustained noise levels requiring mitigation; they could easily oversubscribe the gas grid with widespread use; natural gas power plants are notorious for leaking methane—up to 80-100 times more harmful to global climate than CO2—when extracting the natural gas and preparing it for pipeline delivery.[79]

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[77] https://enchantedrock.com/the-advantages-over-diesel/
[78] https://www.sapphiregassolutions.com/renewable-natural-gas/
[79] Climate Portal. "How much does natural gas contribute to climate change through CO2 emissions when the fuel is burned, and how much through methane leaks?" Ask MIT Climate. July 17, 2023.

Important Note for Loudoun County: Natural gas turbines can deliver onsite, baseload energy today by tapping into local Loudoun County natural gas lines. It may be the quickest, cheapest option for onsite baseload power for our data centers and could quickly become their local option of choice if not regulated. However, it is essential the county mandate the use of SCR for all natural gas turbines in the county to significantly mitigate emissions. Also, baseload turbines would run 24/7/365, and the one existing natural gas microgrid in the county has a noise level of 65db at the property boundary directly across the street from a residential neighborhood. Our zoning ordinance would have to be changed reducing that noise level to a maximum of 55db at the sending property line.

Hydrogen Fuel Cells.[80] Hydrogen is present in abundance throughout nature, but it is rarely available in a free form. Instead, it is usually part of the chemical makeup of other energy sources such as oil, gas, biomass or even water. Through a process called reforming, hydrogen molecules are stripped off these compounds, passed through an electrolytic membrane and combined with oxygen. This process produces an electrical charge with a byproduct of water. The source of the hydrogen and the method used to strip off the hydrogen molecules determine the classification of the type of hydrogen. About 95% of hydrogen production in the U.S. is accomplished through natural gas reforming[81].

Note: Only green hydrogen is carbon-net-zero and fully pollutant free. Blue hydrogen and gray hydrogen "reform" natural gas (primarily methane, a highly potent greenhouse gas) to obtain the hydrogen molecules, but the reforming process leaks methane and produces CO_2 emissions which must be captured and stored. Carbon Capture and Storage (CCS) is a nascent technology with significant infrastructure obstacles and environmental impacts.

Renewable Hydrogen ("Green Hydrogen"): The hydrogen source is water (H_2O), and the reforming process is done using electricity from sustainable sources such as solar or wind.

Decarbonized Hydrogen ("Blue Hydrogen"): Natural gas is reformed to separate hydrogen from the methane leaving carbon dioxide. There are two methods of reforming: Steam Methane Reforming (SMR) or Autothermal Reforming (ATR). The SMR process leaks methane (see natural gas disadvantages above) and releases carbon dioxide during hydrogen production. The carbon dioxide can theoretically be captured through Carbon Capture and Storage (CCS), but this is only being done in three of the existing U.S. hydrogen SMR plants. "Blue hydrogen" is up to 99% carbon-net-zero in the fuel cell itself, but methane leakage in the reforming process and CCS present significant global warming and technological issues.[82]

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https://climate.mit.edu/ask-mit/how-much-does-natural-gas-contribute-climate-change-through-co2-emissions-when-fuel-burned

[80] https://www.energy.gov/eere/fuelcells/hydrogen-and-fuel-cell-technology-basics

[81] U.S. Department of Energy. "Hydrogen Production Natural Gas Reforming." https://www.energy.gov/eere/fuelcells/hydrogen-production-natural-gas-reforming

[82] Schlissel, David and Juhn, Anika. "Blue Hydrogen: Not Clean, Not Low Carbon, Not a Solution." Institute for Energy Economics and Financial Analysis. September, 2023. https://www.energy.gov/sites/default/files/2024-02/090.%20David%20Schlissel%20and%20Anika%20Juhn%2C%20IEEFA%2C%20Blue%20Hydrogen%20Not%20Clean%20Not%20Low%20Carbon.pdf

Traditional Hydrogen ("Gray Hydrogen"): Uses the same natural gas reforming process except the carbon dioxide is not captured.[83] This has major environmental impacts and should not be used in Loudoun County.

Hydrogen Fuel Cell Advantages: Green hydrogen is carbon-net-zero; hydrogen fuel cells make no noise and emit no pollutants; could replace diesel backup generators as a cleaner source of backup power

Hydrogen Fuel Cell Disadvantages: Hydrogen fuel cells are not practical as a baseload power source because they generate too little power for use at utility scale; unless the system uses green hydrogen, the gas reforming process has all the disadvantages of unfiltered natural gas as a power source.

Small Modular Reactors (SMR) and Advanced Nuclear Reactors (ANR). A micro nuclear reactor is a small nuclear reactor capable of producing up to 20 Mw of electricity independently. An SMR/ANR is similar but is capable of producing 20-300 Mw of electricity.[84] There are more than 50 designs for SMR/ANRs. These reactors can be cooled by light water, the existing technology, or by gas, liquid metal or molten salt.[85]

Advantages: Carbon-net-zero; 93 percent capacity factor (see below); essentially noiseless; no pollutants; relatively small footprint

Disadvantages: Other than the few, traditional, light-water SMRs being developed, the majority of new ANRs produce much higher quantities of nuclear waste and entirely new types of nuclear waste not yet fully evaluated for their storage risk.[86] Moreover, there is no national repository for nuclear waste, meaning the waste produced by these new SMR/ANRs would be stored locally. Finally, while all current nuclear reactors in the country use 5 percent enriched uranium, the new ANRs propose using High Assay Low-Enriched Uranium (HALEU) which enriches the uranium 5-20 percent, a largely untested and unproven level of enrichment[87]; community resistance would be extreme; there is an extended licensing process; SMR/ANRs are at least two years from construction; they are extremely expensive.

Nuclear Fusion. On December 17, 2024, Commonwealth Fusion System, associated with the Massachusetts Institute of Technology, announced plans to build the world's first nuclear fusion power plant in Chesterfield County, VA. The plant is planned to produce 400 Mw of power by the early 2030's.

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[83] Shell Oil Company. "Blue Hydrogen Production." https://www.shell.com/business-customers/catalysts-technologies/licensed-technologies/refinery-technology/shell-blue-hydrogen-process.html#:~:text=Blue%20hydrogen%20is%20a%20common,and%20autothermal%20reforming%20(ATR).

[84] Idaho National Laboratory. https://inl.gov/trending-topics/microreactors/

[85] DoE, Dept. of Nuclear Energy. https://www.energy.gov/ne/advanced-small-modular-reactors-smrs

[86] Krall, Lindsay, McFarlane, Allison, Ewing, Rodney. "Nuclear Waste from Small Modular Reactors." PNAS. May 31, 2022. https://www.pnas.org/doi/full/10.1073/pnas.2111833119?trk=public_post_comment-text

[87] Dept. of Energy. "What is High-Assay Low-Enriched Uranium (HALEU)." Office of Nuclear Energy. December 3, 2024. https://www.energy.gov/ne/articles/what-high-assay-low-enriched-uranium-haleu

Nuclear fusion has been largely theoretical for decades. It combines atomic nuclei from isotopes of hydrogen derived from sea water or lithium to release enormous amounts of energy. This is the process our sun uses. The energy released is completely clean, and the process produces no nuclear waste. The singular disadvantage of fusion is that it requires enormous heat to combine the isotope atomic nuclei. In 2022, after 70 years of experimentation, scientists were able to create a fusion reaction for the first time that produced more energy than it needed to create the reaction.

Given the developmental timeframe, I believe the data center sector will be well along the way to meeting its energy needs long before nuclear fusion becomes a practical reality.

Capacity Factor: Choosing A Microgrid Energy Source

A key metric used to determine what type of microgrid is appropriate for any given application is the capacity factor of the power source used in the microgrid. The U.S. Energy Information Administration (EIA) defines the capacity factor of an energy source as:

Capacity factor: The ratio of the actual electrical energy produced by a generating unit for the period of time considered to the electrical energy that could have been produced at continuous full power operation during the same period. [88]

An example illustrates this ratio. Suppose we have an energy source that can generate a maximum of 1 Mw of electricity at its peak operating power. If that energy source operates at peak power for one hour, it is generating 1 megawatt hour (1 MWh) of electricity. There are 8,760 hours in a year. We determine that energy source's historic capacity factor by dividing how many hours in a year that energy source actually operated at full capacity by the total hours in the year. If that 1 Mw energy source actually only delivered an average of .5 Mw per hour for 8,670 hours in a year, it has a capacity factor of 50%: (.5 Mw x 8,760 hours) / 8760 total possible hours = .50 or a 50% capacity factor. Similarly, if that same energy source delivered its maximum power for only 4,380 hours in a year, that too would be a capacity factor of 50%.

U.S. EIA keeps track of the average capacity factors associated with each of the various types of energy sources now available for use in microgrids. The higher the capacity factor, the greater the amount of time that energy source can deliver its maximum possible power. Below is a chart depicting the annual capacity factors for various energy sources in 2024:[89]

2024	Geothermal	Hydroelectric	Nuclear	Biomass	Gas	Solar	Wind
Capacity Factor	65%	34.5%	92.3%	59.0%	59.7%*	23.4%	34.3%

[88] U.S. Energy Information Agency. "Glossary." U.S. EIA. https://www.eia.gov/tools/glossary/index.php?id=Capacity_factor#:~:text=Capacity%20factor%3A%20The%20ratio%20of,operation%20during%20the%20same%20period.

[89] U.S. Energy Information Administration. "Table 6.07.B. Capacity Factors for Utility Scale Generators Primarily Using Non-Fossil Fuels" Electric Power Monthly. https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_b *An email exchange with EIA suggested the appropriate gas capacity factor is in Table 6.07.A. Also, the gas capacity factor applies to natural gas plants, not onsite natural gas turbines.

As shown, nuclear power is, by far, the most efficient power source presently available for use in microgrids. It's capable of delivering its maximum power 92.3 percent of the time throughout any given year. It is not weather dependent and not subject to significant external constraints. Solar, on the other hand, only delivers its maximum rated power about 23.4% of the time due to night, weather, length of day, and many other external factors. Thus, a utility-scale solar farm rated at 100 MW will only be able to deliver 100 Mw about 24 percent of the time throughout the year. Here's another way to look at capacity factor in this example: A 100 Mw solar field (nameplate) will actually deliver only about 24 Mw every hour over one year.

Natural gas microgrids using SCR offer a relatively low emission option with a fairly high capacity factor of 59.7%. This capacity factor applies to natural gas plants. The functional capacity factor for onsite natural gas turbines is likely much higher than this. This makes them good candidates for charging energy storage fields or replacing diesel backup systems and may prove to be a viable transitional source of microgrid power in situations where the power grid is constrained such as in Loudoun County.

Geothermal microgrid applications are geographically dependent and largely theoretical for baseload power at present.

Strategy Implementation: Creating a New Paradigm for Loudoun County

Based on the foregoing analysis, what then might a new paradigm for Loudoun County look like? At present, diesel generators, BESS, and possibly hydrogen fuel cells are only best suited for backup power. Given the large number of diesel generators being used in the county, we should, in the near term, incentivize or require a sector-wide transition to Tier IV diesel generators or Tier II generators with SCR units attached. This is one of the recommendations of the JLARC study.[90] Natural gas turbines incorporating SCR and significant noise mitigation could operate as either backup or baseload power and represent a very viable microgrid option for data centers facing power grid constraints. Loudoun County should immediately develop performance standards and zoning requirements for all of the above microgrid component systems.

Nationally, SMR/ANRs, while likely 3-7 years away, are the only viable long-term option for carbon-net-zero, baseload, onsite power generation, but they are simply not viable until the significant nuclear waste issue is addressed and resolved. They will also face significant community resistance. Given that the only alternatives to SMR/ANRs will be more power lines, gas turbines or a continuously constrained power grid, the greater Loudoun County community—and indeed, the Commonwealth of Virginia—have some very challenging discussions ahead.

Yet even within these practical constraints, we can still identify and provide the data center community with a set of desired data center characteristics based on Loudoun County's unique power grid environment. As technological advances occur, data centers can be encouraged, through a series of tax incentives, or required, through changes to our Comprehensive Plan or Zoning Ordinance, to organically shift away from grid over-reliance towards greater power independence. Such a model would guide future data center development and incentivize existing data centers to strive to incorporate as many desired characteristics as possible. The result could be transformational sector change. If successful, we could become a world pioneer ushering in a new age of data center design supported by a transformed national power grid. At the same time, we could create a thriving new green business market here in Loudoun County.

[90] Op. Cit., pg. 60

The following is a proposed list of desired attributes for Loudoun County data centers:

Practical, Immediate Improvements Possible Through Incentives (Existing Data Centers)/Performance Standards (New Data Centers):

1. **Tier IV or Tier II/SCR Backup Generators**
2. **Maximum of 55 Db Noise Levels at the Sending Property Line with Pre-/Post-Construction Noise Studies**
3. **Minimum of 500' Setback from Property Line Facing Residential**
4. **Significant Visual Screening**

Desired Attributes (All Data Centers):

5. **Microgrid Elements in Site Plan**
6. **Low Carbon or Carbon Net-zero Power (baseload and/or backup)**
7. **Leadership in Energy and Environmental Design (LEED) Gold Certified or above buildings**
8. **Green Building Initiative "Green Globe" Rating of Three or Higher**
9. **Total Usage Efficiency of 1.15 or Less (TUE=IT Usage Efficiency x PUE)**
10. **Liquid-submerged Data Racks**
11. **Waste Heat Reuse Systems (District Energy)**

Summary

While the challenges are great, implementation of a strategy incorporating some or all the elements above would accomplish several urgently needed objectives. It would:

- **Establish Loudoun County as a Pioneer in a Long-Term Transition to a "Green" Data Center Environment.** Loudoun County could become a role model for communities around the world seeking to host "greener" data centers in their community or to transform the data center markets they already have.
- **Increase Loudoun County's Power Grid Resiliency.** Incentivizing data centers to develop autonomous microgrid elements will increase grid resiliency and reduce the threat to residential and other commercial users posed by rapidly increasing demands on our power grid. Elements such as Long Duration Energy Storage and a separate HVDC underground grid would also help keep rates low for non-data center customers. "Peak shaving" by having numerous microgrids operate in "island mode" or switch to stored energy during peak power demands would help stabilize the grid. Nationally, microgrids could also constitute a major source of distributed energy.
- **Create a New Loudoun County Market for a Burgeoning Green Microgrid Industry.** Just as the sector's rapid growth over the past twenty years led to an economic boom in Loudoun County, transforming Loudoun County's data center industry to a wider use of microgrid elements, especially "green" microgrid elements, could have similarly beneficial business revenue effects. Such a change could attract green industry companies to the county and have a significant, positive multiplier effect on Loudoun County's entire business environment by diversifying our tax revenue with a host of complementary businesses supporting the transformation.

Challenges

Without question, there are major challenges implementing this strategy. Here are a few:

- Will Dominion Energy eventually cap available power to data centers? Such a physical constraint will drive greater innovation within the data center community.
- Though widespread adoption of microgrid designs is probably impractical in Loudoun County, can the Board of Supervisors create a legislative environment encouraging data centers to adopt various microgrid design elements into their planned and existing campuses?
- Can the Loudoun County Board of Supervisors react quickly enough to shape the outcomes of the rapid change taking place in the energy environment?
- Will Dominion Energy allow point source power generation in its market?
- Will Dominion Energy commit to the development of a separate HVDC power grid in Loudoun County?
- It will take 12-18 months to implement a formal CPAM/ZOAM change. Will BOS votes prior to this codified change reflect a willingness to implement the new strategy?
- What form will incentives/requirements/disincentives take to effect the needed changes in the Loudoun County data center environment?

Likely Future Scenarios

Based on my experience as a County Supervisor and my understanding of the issues addressed herein, let me suggest some likely near- to midterm developments:

- **More Grid Infrastructure.** Of necessity, PJM and Dominion Energy must continue to aggressively pursue their regulated legal requirement to expand and enhance their infrastructure to accommodate increased power demand. This means Loudoun County will likely see more overhead transmission line proposals in the near term. Given that the SCC recently denied a community advocacy effort to bury the Aspen/Golden 500/230 Kv transmission lines, it is unlikely any similar effort in the future will be successful. Pressure to build new lines will only be alleviated by stabilizing large consumer demand on the grid. This will only be possible through three simultaneous occurring conditions: 1) artificially imposed power constraints, 2) technological advancements significantly reducing AI power requirements, and 2) rapid development of data center microgrids or microgrid elements making data centers less grid dependent.
- **Continued Power Constraints for Major Power Consumers.** With a five-year infrastructure buildout likely, Loudoun County data centers will be power constrained until at least 2029, and that assumes a predictable increase in demand. The growth of AI and its attendant power demands could vastly complicate that problem. As we have already experienced here in Loudoun County, this is going to create an organic industry push to develop onsite microgrids to reduce data center dependence on the grid. This transition is likely to happen relatively quickly, and therefore the Loudoun County Board of Supervisors must act now to assert and maintain managerial oversight, through land-use planning and new zoning requirements, of this sector-wide evolution.

- **Development of Natural Gas Turbine Microgrids.** Natural gas turbines with Selective Catalytic Reduction are currently the only near-term microgrid solutions capable of providing baseload power in a constrained power grid environment. This makes them a key component of a transition strategy leading ultimately to nuclear power. In addition to baseload power, they can provide backup power and can act as a power generation source for recharging energy storage fields. Given that one islanded gas turbine site in Loudoun County has already been built and another is likely within a year, more widespread use of this transitional solution to grid constraints seems likely. The Loudoun County Board of Supervisors must ensure it has continuous visibility over this rapidly evolving sector in the years ahead.

  A key question is how much capacity Loudoun County's natural gas infrastructure has to support this transitional evolution. Widespread use of gas turbines for things like data center baseload power, energy storage field recharging power and data center backup power will place enormous demand on the natural gas infrastructure in the county and elsewhere in Virginia.

- **Increasing Community Resistance.** This expansion of the natural gas infrastructure required by an industry-wide move to gas turbines will significantly increase pressure on the utilities to delay or cancel the retirement of fossil fuel power plants, primarily gas plants. These plants are major sources of methane and CO_2 pollution through leakage. In 2024, global temperatures increased to 1.55 degrees above the Paris Agreement levels for the first time. Increased gas plant pollution from highly potent greenhouse gases in the face of this disturbing climate change trend will likely lead, as it should, to major environmental community pushback about the increased use of natural gas in Loudoun County.

  At the same time, we can expect the continued proliferation of more power lines in Loudoun County as Dominion Energy strives to meet its legal obligation to provide power to all its customers. More overhead power lines combined with a greater reliance on natural gas will almost certainly increase community opposition to unprecedented levels.

The list of challenges is no doubt long and complex. But the stakes of the game have never been higher for our county. Our task is not to fight the changing environment. Our task as Loudoun County's elected governing body is to learn how our environment is changing and adapt to the changes in a way that preserves our quality of life and protects the people we work for. I believe we're up to the task.

Download Vice Chair Mike Turner, Loudoun County, VA Board of Supervisors White Paper, **"Loudoun County, Virginia: Data Center Capital of the World, 'A Strategy for a Changing Paradigm,'** at www.Loudoun.gov/Ashburn.

Data Center Pros:

1. Very high tax revenue (depending upon your tax structure).
2. Strong support for community initiatives.
3. Very low impact on infrastructure (no kids in schools; no cars on roads).
4. Good construction jobs when building.

Data Center Cons:

1. Visually unappealing (60-100' high; concrete walls). This can be somewhat mitigated by setback, berms, greenery, fenestration (faux windows).
2. Noise, both class A and low frequency vibration.
3. Power consumption enormous and growing (rule of thumb: 150 Mw per every 1 mill. Sq. ft.).
4. Water consumption (if not a closed loop, recapture system).
5. Light pollution.

Recommended Best Practices for Communities:

1. Make sure your Comprehensive Plan addresses data center performance standards such as the ones listed below, and make sure your Zoning Ordinance aligns with the Comprehensive Plan. Make sure both are current.
2. NEVER allow data centers to build "by right" without governing body specific approval.
3. Require Tier IV diesel backup generators.
4. Limit noise to a maximum of 55 Db perceived noise at the sending property line.
5. Conduct a pre-construction and a post-construction operational noise study.
6. Check for and measure low frequency noise (not db(A) noise; consult noise expert). This can be caused by certain cooling fan installations.
7. If natural gas turbines are used, ensure Selective Catalytic Reduction (SCR) units are attached and use ammonia, not urea, as the catalyst. The SCR eliminates about 95% of NOX and over 85% of CO. Be aware, however, the SCR can increase PM2.5 emissions, and it also doesn't capture CO_2. Unburned hydrocarbons can be otherwise filtered. Ensure the gas turbines meet state and federal emission standards.
8. For energy storage, use Electrostatic Long-Duration Energy Storage (ELDES) systems. These are like batteries but much better and more efficient using graphene, not lithium. Emtel Energy USA is a major producer of these units.
9. If near residential now or in the future, require a 500' setback; 1,000' is ideal.
10. Explore waste heat recapture if near other buildings or homes (called District Heat).
11. Encourage microgrid design within the data center campus for future use (Microgrid: baseload power source, backup power source, long-duration storage, grid connection, automated site load management to allow load balancing and grid demand response).
12. Have utilities use advanced conductors for transmission lines (Aluminum Conductor, Steel Supported (ACSS), at least).
13. If possible, have your utility run underground HVDC lines to power your data centers on a separate power grid from traditional HVAC residential customers (this is brand new and has never been done in the U.S. but raise the issue; your utility may push back).
14. Incorporate Green Building Initiative (www.TheGBI.org) "Three Green Globes" ratings into new data center performance standards in addition to LEEDS standards.
15. Require the utilities to specify, in writing, how much power is requested by the data center and how the utility plans to deliver power (routing, overhead, substations, etc.)



TESTIMONY OF CAMILLA TAYLOR
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Before the House Small Business Committee's Subcommittee on Rural Development, Energy, and Supply Chains

January 21, 2026

Thank you for the opportunity to submit this written testimony for the record.

The American Sustainable Business Network (ASBN) is a national network of businesses and business associations working across multiple sectors of the economy. ASBN brings together practical expertise from companies and nonprofit partners to share insights and elevate business perspectives.

We see both the opportunities and the challenges of new tools and infrastructure in rural communities. AI can help streamline operations, connect supply chains, and provide timely insights that support economic resilience. At the same time, the benefits are not guaranteed. Without careful design and inclusive decision-making, these tools can create barriers or amplify inequities at the expense of the communities and economies they are operating in.

IMPACT ON BUSINESS/COMMUNITY

Through our work with a wide range of stakeholders, we have seen significant variation in how data center development impacts communities across the country, further underscoring the importance of meaningful community input in siting and development decisions. Too often, these decisions are moving faster than communities' ability to access critical information, evaluate underlying assumptions, negotiate fair terms, and protect long-term rural livelihoods. The following impacts have been shared by our community:

- **Energy use impacting rates**

Data centers place substantial, continuous demand on local electric grids. In regions with limited generation or transmission capacity, this can increase strain on the grid, raise energy prices for existing customers, and undermine reliability. Recent reporting has shown that in areas with concentrated data center development, wholesale electricity costs have risen significantly, with these increases passed on to households and businesses. In some

communities, ratepayers are absorbing the cost of new infrastructure upgrades required to serve data centers, while the benefits accrue primarily to outside developers.

- **Water rates and quality**

Data centers are extremely water-intensive, some using 5 million gallons of water a day, equivalent to the water use of a town populated by 10,000 to 50,000 people. For businesses that rely on clean, affordable water, this can mean higher water rates, reduced availability, and increased competition for a finite resource.

Increased withdrawals and discharges can also raise concerns about water quality and long-term watershed health. As demand grows, municipalities may be forced to accelerate water, wastewater, and stormwater infrastructure upgrades, shifting costs onto existing users and increasing long-term rate pressure for water-dependent businesses.

- **Impact on the value of land and taxes**

Members from the agricultural sector have seen land values skyrocket, bringing with them sharp increases in property taxes. For farmers operating on thin margins, and for beginning farmers trying to buy or lease land, these rising costs can make continued operation financially untenable.Once land is converted for industrial use, it is effectively removed from long-term agricultural production, reducing future options for farming and weakening regional food systems.

In other contexts, particularly suburban or peri-urban areas, data centers sited near housing developments have lowered nearby property values due to noise, visual impacts, and air pollution from backup generators, creating uneven and often unexpected economic consequences for local residents and small businesses.

- **Impact on tourism**

Rural and scenic communities often depend on tourism, outdoor recreation, and a strong sense of place. Large-scale industrial facilities can alter landscapes, increase traffic and noise, and degrade air and water quality. These changes can deter visitors and reduce revenue for locally owned businesses, including lodging, restaurants, outfitters, and cultural destinations.

- **Job creation and workforce impacts**

Community leaders and academic research have raised concerns about the short-term nature of job creation associated with data centers. While construction phases can temporarily increase employment, operational data centers typically require relatively few permanent

workers. Many of the highest-wage positions require specialized technical skills or security clearances and are often filled by workers brought in from outside the community. At the same time, agricultural and land-based jobs may be displaced prior to development, leaving communities with fewer long-term employment opportunities than they had before.

CONCERNS ABOUT EXPANSION

ASBN members and partners have expressed growing concern about the pace of data center expansion in the absence of clear standards, transparency, and enforceable protections. The following concerns have been shared by our community:

- **Energy affordability and grid reliability**

Continued growth without clear regulation can lock communities into higher long-term energy costs and increased grid instability. Utilities may rely more heavily on fossil fuel generation, including gas peaker plants and on-site diesel generators, to meet new demand, undermining both affordability and climate goals.

- **Urban Heat Island effect**

Built land with asphalt and buildings holds more heat than undeveloped land. In addition to just contributing to the build environment, data centers emit a large amount of heat that isn't able to dissipate. This Urban Heat Island effect leads to worse air quality, increased energy demand for cooling, and poses health risks, especially to vulnerable populations during heatwaves. Across the economy, this means missed work or less productive days for employees. For industries like outdoor recreation, tourism, or agriculture, this means fewer operating days.

- **Flooding risks**

Similar to how developed land creates hotter temperatures, it also is not able to absorb water as quickly. Without proper mitigation, this will increase the strain on existing stormwater infrastructure, leading to more overflows and flooding.

U.S. water infrastructure is past its prime. An estimated $3.4 trillion over the next 20 years is needed to repair and modernize water, wastewater, and stormwater systems. In states whose economies rely on water-dependent industries, infrastructure failures put up to 40% of economic activity at risk. The increased strain on these systems would lead to accelerated damage to this already fragile system. This means more broken pipes, costly water treatment, higher insurance premiums, and more contaminants like PFAS entering our water system.

- **PFAS contamination and health impacts**

The use of industrial materials and cooling systems raises concerns about PFAS contamination, which persists in the environment and poses serious health risks. Communities bear the long-term cost and liability of remediation, while local businesses may face additional operational or compliance burdens.

- **Electronic waste**

Data centers generate hazardous waste, including batteries, diesel fuel stored in underground tanks, and toxic liquids associated with engines and cooling systems. Improper handling, leaks, or decommissioning failures create risks for soil, groundwater, and surrounding communities.

- **Lack of transparency & community input in siting decisions**

Many communities report limited access to information about energy use, water withdrawals, tax agreements, or long-term liabilities associated with data centers. Without meaningful local engagement, residents and businesses lose the ability to negotiate fair terms and protect their economic futures. Rapid technological change raises fundamental questions about what happens when facilities become obsolete. Communities may be left with stranded assets, environmental cleanup costs, and diminished economic resilience once facilities are no longer needed or economically viable.

CALL TO ACTION

Policy makers must take a more deliberate, transparent, and community-centered approach to data center development that recognizes both the potential of new technologies and the real impacts they can have on local economies, infrastructure, and livelihoods. Business leaders, policymakers, utilities, and developers must work together to ensure that growth does not outpace communities' ability to understand, negotiate, and protect their long-term interests.

Responsible development means clear standards for energy and water use, meaningful community input in siting decisions, fair allocation of infrastructure costs, and enforceable protections for ratepayers, farmers, and locally owned businesses. It means ensuring that economic benefits are real, durable, and shared—rather than externalized costs borne by rural and working communities. ASBN is ready and willing to be a partner in that process.

Thank you for the opportunity to submit this testimony.



TESTIMONY OF KAITLIN ARCHAMBAULT
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Before the House Small Business Committee's Subcommittee on Rural Development, Energy, and Supply Chains
January 21, 2026

INTRODUCTION

Members of the Subcommittee: thank you for the opportunity to submit this written testimony for the record.

My name is Kaitlin Archambault. I am Founder & CEO of Open Future Coalition (OFC), an initiative that supports rural and community-led ecosystems advancing regenerative agriculture, ecological restoration, and resilience. Much of our work sits in rural food systems—supporting the farmers, producers, and rural small businesses that feed our country. These food systems are strategic infrastructure underpinning public health, supply chain resilience, and national security. Our work also sits at the intersection of rural resilience and digital infrastructure: we design and deploy shared data and coordination tools in direct partnership with local communities and networks, in real-world conditions.

Through this work, we have seen the promise of data and AI-enabled tools to strengthen rural prosperity: improving technical assistance delivery, supporting supply chain coordination, reducing administrative burden, and expanding access to timely insights from weather forecasting to market access. We have also seen the harms that arise when communities are excluded from decisions about the tools and infrastructures that shape livelihoods, long-term public health and environmental wellbeing.

The question before us is not whether AI can support rural communities—it can—but whether we are willing to take a context-driven approach to how and where infrastructure is built: aligning scale, pace, and long-term stewardship with the realities of rural land, water, and economic systems, so the harms of rapid buildout do not outweigh the benefits.

IMPACTS ON RURAL LIVELIHOODS AND FOOD SYSTEMS

Across OFC's work with rural food systems and resilience networks, including farmers, producers, and rural small business ecosystems, we are hearing consistent patterns about both near-term disruption and long-term risk as data center development accelerates. Across

these impacts, a recurring theme emerges: rural livelihoods are being shaped by decisions made far from the communities who bear the long-term consequences.

1) Land conversion and agricultural continuity

In rural regions, land is often framed as a low-cost input for rapid industrial-scale development. When agricultural land is converted, or when land becomes speculative, local land prices rise, making it harder for farmers and communities to steward essential production lands over time. Partners emphasize that these pressures are not experienced as one-off impacts, but as structural shifts in land markets that erode long-term viability.

2) Water security for agricultural and rural communities

Many rural communities are already confronting drought, aquifer decline, and increasing water stress. Industrial-scale data centers rely heavily on water for cooling. A typical facility can use about 300,000 gallons of water per day, while large "hyperscale" centers may use up to 5 million gallons per day (Brookings Institution; Cornell Chronicle). In 2023, U.S. data centers directly consumed an estimated 17 billion gallons of water for cooling, with usage projected to grow as AI workloads expand (industry and academic estimates). Even in agricultural regions where farming remains the dominant water use overall, large industrial facilities can create new competition for limited water supplies in already stressed rural areas. Recent investigative reporting also shows that communities may face limited transparency and delayed disclosure about facility-level water demand, making it harder for rural leaders to assess impacts and plan responsibly (Business Insider, 2025).

3) Grid impacts, affordability, and public health

Data centers' large and concentrated energy demand can strain local systems and contribute to affordability pressures that ripple across rural households, farms, and food-system small businesses. One municipal leader described electricity rates in their community as having doubled since the first large data center buildout began in 2007. Rural leaders also raised concerns about air quality impacts associated with backup diesel generation; in one community, local involvement in air permitting processes was essential to requiring any pollution controls at all, and the same leader noted there are now "over 400 diesel engines" concentrated in a single corridor of facilities.

4) Economic development claims vs. durable local benefit

Rural communities are often approached with data centers framed as economic development through job creation. Yet research suggests that while construction employment can be significant in the short term, operational staffing needs are comparatively limited—raising questions about the durability of promised economic benefits without enforceable commitments. (University of Michigan STPP report, 2025; Wall Street Journal, 2025) These

examples illustrate the practical reality rural communities are navigating: the burdens of industrial-scale infrastructure are material and cumulative, and once facilities are sited and scaled, impacts can be difficult to reverse.

CONCERNS ABOUT EXPANSION

The central concern is not innovation—it is accountability. Rural communities deserve to share in the upside of digital innovation. But outcomes depend on governance: whether communities have transparent information, meaningful decision-making power, and enforceable protections over the full lifecycle.

Across our work in food systems and rural resilience, we repeatedly see that harms arise not only from impacts themselves, but from how decisions are made: communities are asked to absorb long-term burdens while decisions move faster than their ability to access information, assess proposals, negotiate fair terms, or enforce commitments over time—often in negotiations where the firms proposing development have far greater technical, legal, and financial leverage In effect, rural communities become involuntary stakeholders, bearing long-term risks while having limited influence over how projects are structured or how benefits are distributed.

In many cases, these outcomes are not simply the result of local siting decisions, but of how projects are financed and de-risked upstream. Rural communities are often asked to weigh proposals whose financial structures, long-term risk assumptions, and exit costs are partially or structurally invisible. When decommissioning, remediation, or stranded-asset risks are not fully priced into project finance, those risks do not disappear: they are shifted downstream onto host communities and public systems.

These facilities are industrial-scale infrastructure. Decisions being made now will shape rural land, water, and grid systems for decades. They will also shape the physical backbone of the knowledge infrastructure the next economy depends on.

Our concern is what happens as the impacts described above compound through a rapid national buildout—especially in communities with limited capacity to assess proposals, negotiate terms, and enforce protections.

Two compounding risks deserve particular attention as this buildout accelerates:

1) Facility scale and concentration of risk
A core governance challenge is scale. Industrial-scale “hyperscale” facilities concentrate land conversion, water demand, and grid impacts into single locations, creating risks that are

difficult to mitigate, enforce, or reverse once siting decisions are made. These projects are often designed around the operational logic of hyperscale efficiency and global network optimization, which does not naturally align with the governance capacity, infrastructure limits, or long-term stewardship priorities of rural communities.

Concentration also increases resilience and national security risk: when essential compute and data infrastructure are centralized in a small number of large facilities, failures — whether from disaster, grid instability, or malicious attack — can have outsized downstream impacts. At the same time, compute infrastructure does not inherently need to be centralized at massive scale. Distributed and localized models (including smaller facilities and edge compute) can meet many needs while reducing concentrated burdens and making oversight more manageable at the community level.

A more accountable approach is to align infrastructure scale with public benefit: where communities bear resource impacts, they should also have visibility, decision-making power, and enforceable terms commensurate with the scale of development and the risks they are asked to carry.

2) Socialized costs and weak lifecycle accountability

Across communities, leaders have emphasized that accountability must extend across the full lifecycle. Data center energy load and backup generation can create downstream burdens that rural residents and small businesses absorb through affordability pressures, strained infrastructure, and air quality impacts. Community leaders have underscored the need for enforceable protections that include responsibility for long-term impacts, remediation, and decommissioning obligations. When environmental or public health harms occur, or when public lands and water resources are degraded, financial and legal responsibility should not shift onto state or local governments or the rural residents themselves. Accountability should remain with facility owners and operators across the full lifecycle, and public agreements should not allow those entities to be indemnified by state or local governments for environmental damage, public health costs, or long-term remediation.

These lifecycle gaps are often embedded upstream in how projects are financed. Public incentives and infrastructure investments can reduce private risk at the outset, while long-term environmental, infrastructure, and closure liabilities are not equally secured. Without clear bonding, decommissioning funds, and durable responsibility requirements, the financial model itself can externalize risk onto rural communities.

Precedents to build on

Importantly, rural communities are not starting from scratch in governing infrastructure for public benefit, or in weighing centralized buildouts against more distributed, community-scaled alternatives. In sectors like rural broadband and renewable energy, communities have increasingly used enforceable frameworks, such as Host Community Benefit Agreements and standardized host-community payments, and have also advanced models like municipal solar and cooperative microgrids to ensure that when essential infrastructure is sited locally, the benefits are durable, measurable, and accountable over time. These practical precedents can inform how AI infrastructure is sited, scaled, and governed. At the same time, experience in these sectors shows that fiscal payments alone are not sufficient without meaningful participation in governance and enforceable long-term protections where communities bear enduring risk.

Questions Congress should ask

Ultimately, the siting of AI infrastructure raises recurring questions that Congress should treat as core to responsible innovation:

- Who benefits economically over time, and what share of that value stays local?
- Who bears the economic, health, and environmental costs, and how will these risks be quantified so communities can make informed decisions?
- If incentives or permits are granted based on promised jobs or benefits, how will those commitments be enforced (including through clawbacks where appropriate)?
- Do host communities have clear visibility into the true counterparties, current and future, behind agreements—including when special-purpose LLCs are used—and an understanding of how they are sharing financial, operational, compliance, and other responsibilities over the full facility lifecycle?
- Do communities have the tools and capacity to vet underlying business models and long-term assumptions so they are not left with unmet promises or stranded infrastructure?

Put simply, rural communities should not be asked to trade long-term land and water security and public health for benefits that are uncertain, unenforceable, or based on opaque assumptions.

CALL TO ACTION

Congress has an opportunity to ensure that rural communities and small businesses benefit from digital innovation without being asked to absorb disproportionate infrastructure burdens.

We urge the Subcommittee to advance accountability mechanisms that ensure AI data center siting is transparent, locally accountable, and structured for durable public benefit. Specifically:

1) Set thresholds on facility scale and incentivize distributed alternatives
Congress should examine whether current incentive structures are unintentionally accelerating oversized facilities that concentrate risk. Consider tiered review requirements tied to facility scale; cumulative impact accounting across multiple facilities; and incentive alignment for distributed, community-scaled alternatives (including smaller facilities and edge compute) that reduce concentrated land, water, and grid burdens while improving accountability, governability, and resilience.

2) Require standardized, public disclosure of resource use and impacts
Require plain-language reporting on projected and actual:

- water sourcing and annual water use
- energy demand (including peak demand) and grid interconnection impacts
- backup generation and air emissions
- facility expansion plans
- decommissioning and remediation plans

This information should be publicly accessible, consistent across jurisdictions, and updated annually. Recent investigative work has demonstrated that key facility-level data, including water use, may not be readily transparent to communities under current conditions. (Business Insider, 2025)

3) Ensure early-stage community consultation and fund community capacity
Require meaningful community consultation before approvals, incentives, and permitting decisions are finalized, including accessible disclosure of impacts and timelines. Establish mechanisms that fund local legal, technical, and environmental review capacity so that rural counties and communities can assess proposals and negotiate fair terms—particularly given the complexity of data center-associated energy infrastructure permitting. (Congressional Research Service, 2025)

4) Make public benefit enforceable where communities host public-resource burdens
Where developments draw significantly on shared public resources (land, water, grid capacity), require enforceable commitments tied to:

- community benefit agreements
- water and energy accountability
- local procurement and workforce pathways tied to real roles



- investment in local resilience infrastructure (including emergency services)
- decommissioning and remediation bonding requirements

5) Create guardrails for accountability when public incentives accelerate private buildout
Where tax incentives or infrastructure upgrades are granted in the name of economic development, communities should be protected through enforceable performance requirements and accountability mechanisms—so that commitments related to jobs, benefits, and long-term impacts cannot quietly degrade over time. Public incentives should not function solely to de-risk private capital; they should also require that long-term community exposure to environmental, infrastructure, and closure risk is matched by enforceable obligations, financial security mechanisms, or forms of shared governance and benefit.

CONCLUSION

Rural America is essential national infrastructure: it feeds the country, stewards land and water resources, and sustains local economies that underpin national resilience. AI-enabled tools can strengthen this rural foundation when designed in partnership with communities and deployed in service of real rural needs. But AI infrastructure is physical, resource-intensive development, and must be governed accordingly.

If data centers are to be sited in rural communities, rural residents and small businesses must have real voice, transparent information, enforceable protections, and a fair share of long-term benefit. Congress can help ensure the AI economy is built with accountability, resilience, and shared prosperity.

Respectfully submitted,
Kaitlin Archambault
Founder & CEO, Open Future Coalition

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Testimony of Andrea Crooms
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Before the House Small Business Committee's Subcommittee on Rural Development, Energy, and Supply Chains
January 21, 2026

My name is Andrea Crooms, and I operate a small, diversified farm in Prince George's County, MD. Our operation is located within the broader Washington D.C. foodshed, a region with a recognized deficit of local food production capacity. I am here today to detail the direct, operational threats the proposed data center poses to agricultural businesses like mine, leading us to halt planned investments and expansion. Today, I'm here to speak not just as a farmer, but as someone whose future has been put on hold. This past spring, we had plans. Plans to build a second greenhouse to extend our season. To invest in more pasture for our livestock. But those plans are now frozen. We cannot risk that investment, or our legacy, on the profound uncertainties of the proposed data centers in our area. Our primary concern is the shared aquifer. Our entire irrigation system, livestock water supply, and domestic water rely on our well. The projected millions of gallons of daily water consumption for data center cooling presents a clear and quantifiable risk of aquifer drawdown and increased water stress. This uncertainty makes capital investments in water-dependent infrastructure, like expanded irrigation or additional livestock, an unacceptable financial risk. Secondly, the data center projects directly convert productive, prime farmland into impervious surface. This is a permanent loss of a finite agricultural resource critical for regional food security. Furthermore, peer-reviewed studies in agricultural science indicate that chronic noise and light pollution from industrial facilities can negatively impact livestock welfare metricssuch as stress levels and milk

productionand disrupt essential pollinators and crop cycles. Thirdly, the infrastructure pressures are substantial. The massive, instantaneous energy demand will exacerbate existing grid constraints, potentially leading to higher utility costs and reliability issues for surrounding rural customers. The projected increase in heavy construction and service vehicle traffic will accelerate the deterioration of our rural roadways, which are not engineered for such loads, imposing future public costs. Finally, the scale of data center development will intensify competition for already scarce local housing and skilled labor, further squeezing the agricultural sector, which operates on thin margins.

In summary, data center projects in rural communities introduce multiple, cascading risks that undermine the economic viability of local agriculture. It consumes the very resources, water, land, and community infrastructurethat farms need to operate and grow. At a time of increased focus on supply chain resilience and local food systems, prioritizing this use of resources directly contradicts those goals.

Hearing on the Impacts of AI Data Centers in Rural Communities
U.S. House Small Business Committee
Subcommittee on Rural Development, Energy, and Supply Chains
January 21, 2026

Submitted by:

Dr. Crystal A. Cavalier-Keck, Ed.D., M.P.A., MLS
Indigenous Policy Advocate, Community Organizer, And Environmental Justice Scholar
Upper Dan River Region / Upper Sauratown (North Carolina)

Introduction: Who I Am and Why I Am Here

Chair, Ranking Member, and Members of the Subcommittee—

My name is Dr. Crystal A. Cavalier-Keck. I hold a Doctorate in Organizational Leadership, a Master of Public Administration in Emergency Management, and I am currently completing a Master of Legal Studies in Indigenous Peoples Law. My academic and professional work

focuses on Indigenous sovereignty, environmental justice, infrastructure governance, and the long-term impacts of extractive industries on frontline communities.

I am also an Indigenous community advocate working in the Upper Dan River and Upper Sauratown region of North Carolina, where ancestral homelands, cultural landscapes, and burial grounds remain embedded in the land despite centuries of displacement and erasure. I submit this testimony not only as a scholar and policy professional, but as a person accountable to land, water, and future generations.

I have worked within federal emergency management and national security systems, and I understand how large-scale infrastructure decisions are made—often far from the communities most affected by them. I also understand how "economic development" narratives are routinely used to justify long-term harm, particularly in rural and Indigenous territories.

What brings me before you today is not opposition to technology. It is opposition to unchecked, extractive AI data center expansion that prioritizes virtual reality and speculative digital growth over real-world life, water security, community stability, and Indigenous sovereignty. This industry is not being built to improve the lived conditions of rural or Indigenous peoples. It is being built to enhance virtual experiences—while degrading the real world we depend on to survive. That is a trade we refuse to make.

We Are Not Sacrifice Zones

Across the country, resistance to large-scale data center development is growing—and for good reason. Communities are learning that these facilities deliver minimal local benefit while imposing enormous environmental, economic, and social costs.

Indian Country and rural America are now being treated as the next sacrifice zones.

Tech corporations are deliberately targeting rural and Indigenous lands because they have faced resistance in cities and suburban municipalities. They believe rural communities lack political power, legal resources, and visibility. They believe Indigenous nations can be pressured into compliance through economic fear and incomplete information.

They are wrong.

What we are witnessing is a new form of digital colonialism—where land, water, and energy are extracted to fuel speculative technologies that do not serve local people and leave permanent harm behind.

Predatory Promotion and the Failure of Due Diligence

I am deeply concerned by the way the National Congress of American Indians and other national bodies are promoting AI data center development across Indian Country without adequately addressing:

- Long-term water depletion
- Grid instability and rising utility costs
- Cultural site destruction
- Violations of sovereignty and consent
- The mounting financial risk of the AI industry itself

At this point, there is no shortage of factual information—domestic or international—documenting the dangers this industry poses to economies, communities, lands, water, and sovereignty. Yet many tribal leaders, operating without full information or independent analysis, are being encouraged to replicate these models.
That is not self-determination.
That is predatory development.

The AI Bubble Is Not a Stable Economic Foundation

In 2025, Deutsche Bank released a report warning that the AI data center boom is financially unstable, projecting that the eventual collapse could exceed the damage of the 2008 housing crisis.

Despite these warnings, rural counties and tribal nations are being asked to lock themselves into:

- Permanent land conversion
- Long-term infrastructure dependency
- Rising energy and water costs
- Environmental liabilities that will remain long after developers exit

Once land is rezoned, once aquifers are depleted, once burial grounds are destroyed—there is no undoing the harm.

Project Delta: A Case Study in Rural and Indigenous Exploitation

In Stokes County, North Carolina, a developer operating as Engineered Land Solutions ("Project Delta") has submitted a conditional rezoning application for approximately 1,800 acres of land along the Dan River, seeking approval for a hyperscale AI data center complex.

This project:

- Sits directly atop Upper Sauratown, an Indigenous cultural landscape with known burial grounds
- Is positioned to extract massive quantities of water from the Dan River • Far exceeds existing electrical capacity in the region

A public hearing on this rezoning is scheduled for January 12, 2026, before the Stokes County Board of Commissioners. The majority of informed local residents oppose the project.

However, most residents are unaware of what is happening quietly behind the scenes.

Nuclear Power to Feed AI: Infrastructure Sequencing Without Consent

On December 31, 2025, Duke Energy submitted an Early Site Permit application to the U.S. Nuclear Regulatory Commission for potential new nuclear generation near the Belews Creek Steam Station, also in Stokes County.

While this application does not authorize construction, it preserves the site for future nuclear development—clearly aligned with anticipated hyperscale data center demand.

This is not coincidence.
This is infrastructure sequencing.

Duke Energy's history along the Dan River should concern every policymaker:

- In 2014, approximately 27 million gallons of coal-ash wastewater were released into the river
- In 2015, Duke subsidiaries pleaded guilty to nine criminal violations of the Clean Water Act
- The river remains burdened with toxic heavy metals

To now position nuclear development on the same watershed—to power AI data centers—is reckless and unacceptable.

The Real Costs to Rural Economies and Small Businesses

AI data centers are routinely marketed as economic development. In practice, they deliver the opposite.

Documented impacts include:



- Electricity prices rising up to 250% in regions with concentrated data centers • Billions of gallons of clean water diverted for cooling—enough to serve over 18 million households by 2028
- Permanent loss of productive farmland
- Housing and infrastructure strain with minimal job creation
- Destruction of Indigenous sacred sites and burial grounds

These facilities enhance virtual reality experiences, not real-world community well-being. They ask rural and Indigenous peoples to sacrifice the real world so others can upgrade their digital one.

Sovereignty, Consent, and Responsibility

Indigenous lands are not empty.
Rural communities are not expendable.
Water is not infinite.
Free, prior, and informed consent is a minimum standard—not a courtesy. Yet it is routinely ignored in AI data center siting decisions.

When communities are pressured to rezone land without full disclosure, when nuclear infrastructure is quietly advanced to support speculative industries, and when burial grounds are treated as obstacles rather than responsibilities—sovereignty is being violated.

What Congress Must Do

I urge this Subcommittee to:

1. Pause federal incentives for AI data centers until cumulative water, energy, and economic impacts are fully assessed
2. Require disclosure of linked infrastructure plans, including nuclear generation and transmission build-out
3. Strengthen federal protections for Indigenous cultural sites
4. Center rural residents and small businesses—not corporate projections—in AI policy
5. Reject the false narrative that this industry is inevitable or necessary

Closing: We Choose a Different Future

Rural America and Indian Country do not have to repeat the mistakes of fossil fuel extraction—only now in digital form.

We are not anti-technology.

We are anti-extraction.

We refuse to trade our rivers for servers, our burial grounds for bandwidth, or our future generations for virtual convenience.

Thank you for the opportunity to submit this testimony.

TESTIMONY OF MICHAEL JARRETT
Clean Energy Advocate & Strategist
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Before the House Small Business Committee's Subcommittee on Rural Development, Energy, and Supply Chains

January 21, 2026

My name is Michael Jarrett and I serve as a Clean Energy Advocate and Strategist for the Pennsylvania Sustainable Business Network (PASBN). PASBN is a state affiliate of the American Sustainable Business Network (ASBN) dedicated to engaging diverse business communities, promoting sustainable practices, and advocating for policies that drive meaningful change for Pennsylvania businesses of all industries and sizes - many of whom operate in rural communities.

Pennsylvania businesses depend on affordable, reliable energy and clean air and water to operate successfully. There is a growing concern about the ongoing rise in electricity costs in the commonwealth that are having a significant impact on the bottom lines of our business, with a disproportionate impact on small and mid-sized businesses, particularly in rural communities. Electricity demand due to the expansion of large, AI-driven data centers is a primary driver of these increased costs. Additionally, the environmental impacts of unregulated AI data center development could have an adverse effect on Pennsylvania's rural businesses.

While PASBN supports innovation, responsible economic development, and job creation, we believe the current pace and scale of data center expansion is placing disproportionate costs and risks on rural communities and their businesses.

Businesses across rural Pennsylvania are already experiencing or anticipating significant impacts from nearby AI data center development.

Energy Costs and Grid Reliability
PJM, the regional transmission organization that manages the wholesale electricity market and grid in Pennsylvania, increased electricity costs in most parts of the commonwealth by 10-20% on June 1, 2025. Another 5% increase is planned for June 1, 2026, and costs are expected to remain high for at least two years. These rate increases are driven in part by rising regional demand, much of which is coming from the rapid growth of AI data centers. Reporting from NPR and Axios highlights that AI data centers can consume as much electricity as tens of thousands of homes and are increasingly influencing regional power prices and capacity planning. In Pennsylvania's PJM territory, new large-load interconnection requests, many from data centers, are already straining grid infrastructure and delaying upgrades needed, impacting business utility costs.

For energy-intensive small manufacturers and agricultural operations, a 10 - 20% increase in electricity costs can determine whether they remain competitive or scale back operations. This can cause those businesses to postpone equipment upgrades or new hiring due to energy cost uncertainty.

Air Quality and Emissions Concerns
Researchers at the Massachusetts Institute of Technology's Technology Review note that AI data centers currently consume 4.4% of all U.S. energy and are projected to use as much electricity as 22% of U.S. households by 2028. Unfortunately, the analysis also shows that AI data centers tend to use electricity that's 48% more carbon-intensive than the U.S. average electricity usage. Pennsylvania businesses are familiar with the dangers associated with less clean energy sources, as the commonwealth is still dealing with the negative environmental impacts of the fracking industry growth that began in the early 2000s.

In Hazle Township (Luzerne County), residents and local officials unanimously rejected a proposed data center campus. Public opposition centered on quality-of-life and environmental impacts, including air pollution and community health implications, reflecting widespread unease about the industrial scale of these facilities near residential areas. Similarly, in Cumberland County's Hampden Township, residents voiced strong concerns at a public hearing that current zoning proposals did not do enough to protect from noise, air emissions and other issues associated with hyperscale data center operations.

For small businesses that rely on outdoor spaces, tourist engagement, or customer foot traffic, even temporary episodes of degraded air quality can translate into measurable revenue loss and harm to customer experience. This is to say nothing of the health of their own employees who may be absent from work due to the adverse effects of poor air quality.

Water Availability and Quality

Water demand from data centers, primarily for cooling, is another pressing concern raised by Pennsylvania businesses, particularly in the agriculture sector. A single large AI data center can evaporate up to five million gallons of water per day, a volume comparable to the daily usage of tens of thousands of residents, potentially stressing regional water supplies if sustainable cooling alternatives are not prioritized.

Hampden Township's residents and local officials reflected anxieties over water withdrawals from underground aquifers and surface water systems, with residents warning that existing low creek flows and declining water pressures could be exacerbated by large industrial water use if controls and comprehensive feasibility studies are not required. Across Pennsylvania, current planning processes do not always require transparent disclosure of projected water use, sources, or impacts before approvals are granted.

For rural businesses that depend on private wells or small municipal systems, including farms and food producers, increased industrial water withdrawals raise concerns about long-term availability, rising costs, and reliability, especially in watershed areas already facing stress from existing uses. These concerns underscore the need for stronger federal guidance on water resource assessments and sustainable cooling practices that safeguard community water supplies before further AI data center expansion occurs.

PASBN respectfully urges the House Small Business Committee's Subcommittee on Rural Development, Energy, and Supply Chains, and Congress as a whole, to take the following actions to protect rural communities and small businesses:

1. Limit the electricity rate increases caused by AI data center expansion, or require tech companies responsible for AI data center growth to cover the cost of the increases, so they do not create an added burden on the business community.

2. Require AI data centers to purchase their electricity for a specific percentage of clean energy sources, reducing reliance on fossil fuels and, therefore, reducing the air quality and public health concerns associated with dirty energy sources.

3. Require comprehensive environmental impact assessments for AI data centers, including air quality modeling and grid impacts.

4. Mandate water usage reporting and enforceable limits, particularly in water-stressed or rural regions.

5. Strengthen federal emissions standards and monitoring for backup generators and on-site power generation.

6. Ensure meaningful community consultation, including input from local businesses, before siting approvals or federal incentives are granted.

Innovation should not come at the expense of rural economies and their business communities. With thoughtful oversight and planning, AI data centers can coexist with rural communities, but without action or oversight, the current trajectory risks undermining the very businesses and regions this Committee is charged with supporting.

TESTIMONY OF JOHN IMES

Cofounder & Executive Director, Wisconsin Environmental Initiative

Before the House Small Business Committee's
Subcommittee on Rural Development, Energy, and Supply Chains

January 21, 2026

INTRODUCTION

Chairman, Ranking Member, and Members of the Subcommittee, thank you for the opportunity to submit testimony.

My name is John Imes. I am the Cofounder and Executive Director of the Wisconsin Environmental Initiative, a nonprofit that works with businesses, local governments, and developers to advance affordable clean energy and responsible economic development.

My perspective is shaped by decades of work at the intersection of environmental leadership and economic strategy. As Village President of Shorewood Hills, Wisconsin, I see firsthand how local governments balance infrastructure needs, fiscal constraints, and community expectations to support long-term resilience. I am also a member of the Clean Economy Coalition of Wisconsin, a statewide network of climate, energy, environmental justice, conservation organizations, businesses, and allies working to accelerate Wisconsin's transition to a clean energy economy. In addition, through the American Sustainable Business Network's Climate and Energy Working Group, I engage with business and policy leaders nationwide who are aligning clean energy and climate action with economic growth.

This combined local and national perspective informs how I view the impacts of rising energy costs, infrastructure strain, and land-use decisions tied to large-scale development. I am submitting this testimony on behalf of small businesses, local governments, and rural communities across Wisconsin that support innovation and economic growth, but are increasingly concerned about how AI data centers are being sited, powered, and financed,

often without sufficient protections for ratepayers, water resources, farmland, or meaningful community input.

IMPACT ON BUSINESS AND COMMUNITIES

Wisconsin is experiencing proposed data center development at a scale unlike anything we have seen before.

Just two announced projects—one in Port Washington and another in Mount Pleasant—have requested nearly **4 gigawatts of electricity combined**, more power than all Wisconsin households use today. Meeting this demand requires massive investments in generation, transmission lines, substations, gas pipelines, and water infrastructure.

Under current utility cost-recovery models, these investments are **not borne solely by the companies driving demand**. Instead, they are spread across all ratepayers, including small businesses, farms, and households that will never benefit from data center power. For small businesses operating on tight margins, even modest increases in electric and water rates materially affect hiring, pricing, and long-term viability.

Communities are also seeing increased pressure on:

- **Farmland conversion**, reducing productive agricultural land
- **Water systems**, as data centers require millions of gallons per day for cooling and indirect power generation
- **Local infrastructure**, including roads, housing, and emergency services, often without proportional tax or community benefits

These pressures are especially acute in rural areas, where infrastructure costs are shared among fewer customers and public budgets are already stretched.

CONCERNS ABOUT EXPANSION WITHOUT GUARDRAILS

Without a clear regulatory framework, data center expansion presents serious risks:

Energy Affordability and Grid Reliability
Utilities are already citing data center demand as justification for new methane gas plants and delayed coal retirements. New gas plants lock ratepayers into decades of volatile fuel costs just as clean energy alternatives become cheaper and faster to deploy.

Stranded Asset Risk
Building permanent fossil fuel infrastructure for speculative demand is a gamble. In Nevada, a major utility has acknowledged that only about **15 percent of proposed data centers are likely to be built**. When projects fail to materialize, ratepayers are left paying for infrastructure they did not need.

Water Stress and Environmental Impacts
A single hyperscale data center can consume millions of gallons of water per day directly, and many more indirectly through electricity generation. In rural communities with limited water systems, this can crowd out agricultural use and raise costs for residents.

Lack of Community Input
Too often, siting decisions are made behind closed doors, constrained by non-disclosure agreements that limit transparency. Local residents, small businesses, and farmers are left reacting after commitments have already been made.

This is not an ideological concern. It is basic risk management for rural economies.

CALL TO ACTION

Congress can play a critical role in ensuring AI data center growth strengthens, rather than strains, rural communities.

I respectfully urge Congress to:

1. **Require Full Cost Accountability**
   Ensure large-load customers pay the full cost of generation, transmission, distribution, and water infrastructure needed to serve them, so existing customers are not subsidizing massive corporate energy users.
2. **Link Data Centers to Clean Energy**
   Require new data centers to be powered by 100 percent clean energy, with meaningful on-site or contracted renewable generation, rather than relying on fossil fuel expansion.
3. **Protect Ratepayers from Stranded Assets**
   Require proof of project viability before utilities are allowed to build permanent infrastructure, and include clawback protections when public incentives are used.
4. **Mandate Water Impact Assessments and Reporting**
   Require data centers to demonstrate sustainable water use, protect local water supplies, and publicly report both direct and indirect water consumption.

5. **Strengthen Community Engagement Requirements**
   Ensure early, meaningful consultation with local communities, farmers, small businesses, and local governments before siting and infrastructure decisions are finalized.

6. **Support Modern Grid Solutions**
   Encourage demand response, energy efficiency, battery storage, and other distributed energy resources as first-line solutions to meet rising demand, rather than defaulting to new fossil fuel plants.

CONCLUSION

Wisconsin and other rural states do not have to choose between economic development and affordability, reliability, and environmental stewardship. With clear rules and smart planning, we can do both.

AI and data centers are coming. The real question before us is whether rural communities and small businesses will be partners in that growth—or whether they will be left paying higher bills, losing farmland, and absorbing long-term risk.

I urge Congress to ensure that innovation is powered responsibly, communities are protected, and those driving demand pay their fair share.

Thank you for the opportunity to submit this testimony.

TESTIMONY OF PATRICIA MARTIN
Former Mayor, Quincy, WA
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Quincy, WA 98848
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Before the House Small Business Committee's Subcommittee on Rural Development, Energy, and Supply Chains

January 21, 2026

Dear Chairman Hunt and Members of the Committee,

My name is Patricia ("Patty") Martin. I grew up in Quincy, WA, and I am a former mayor of the community - a community that has become a hub for resource draining, landscape altering,

data centers, and AI. Living less than ¼ mile from the original Microsoft data center built in 2007, I have firsthand knowledge of the impacts of these facilities.

Quincy is part of the United States Bureau of Reclamation's (USBR) irrigation project constructed in the mid-1950's to bring water to farmers throughout the Columbia Basin. Around the same time, Grant County Public Utility District (GCPUD) constructed two hydroelectric dams on the Columbia River – Wanapum and Priest Rapids - to provide hydroelectric power to irrigators and residents of Grant County. Both of these resources are being overutilized.

The combined capacity of the two dams is a little over 2000 megawatts, providing enough power for well over 500,000 homes. That capacity is now exhausted, but not because of Grant County's population (105,000). While hydroelectric power is renewable, it is finite on a day-to-day basis. To make up for the deficit, the GCPUD must supplement this renewable source with other potentially less desirable sources of electrical production.

A contributing factor to exhausting the electrical production, and indeed to the continuing increase in electrical costs, is the wholesale-rate availability of electricity to the data centers. A data center is billed at a little over $0.02/kWh (2 cents) for its first 7,300,000 kWh, and then charged $0.038/kWh (3.8 cents). With discounts such as these given to these large electrical consumers, there is little incentive to conserve. And some data centers that lease space actually sell their discounted electricity to their lessees at a profit.

For residents, the influx of data centers has led to a near doubling of electrical rates from a little over $0.03/kWh (3 cents) in 2007 to $0.062/kWh (6.2 cents) in 2025. Looking forward, the GCPUD expects a 3.4% increase in 2026 and a 30% increase by 2035.

Because of the projected growth of AI in Quincy, the GCPUD is using eminent domain to seize property from 84 landowners to bring a 230kV (230,000 V) powerline directly from Wanapum Dam into Quincy. This doesn't increase the amount of electricity available to residents, or increase reliability as promoted by the GCPUD, instead eminent domain is being employed because "*AI data centers require direct 230kV (230,000-volt) electrical lines primarily to handle immense power consumption, minimize energy loss during transmission, and ensure high reliability for 24/7 operations. These high-voltage lines are necessary to deliver the gigawatt-scale capacity demanded by modern AI training and inference, which often exceeds the capacity of local distribution grids*."

An equally disturbing impact is on our water supply. Quincy sources its drinking water from five 400-420 ft. wells from the same aquifer. A hydrogeologic study conducted by my administration in the mid-1990s found that as the city extracts water from these wells, the

aquifer is recharged by the upper 200 ft. aquifer contaminated with farm chemicals. The presence of the data centers and their extraordinary need for water has undoubtedly increased drinking water contaminants, but has also reduced the level of the aquifer. In order to satisfy the ever-growing need for water, the City of Quincy has requested 6000 acre-feet (1.9 billion gallons) of water from the USBR's main canal passing by Quincy. This, in addition to reclaiming wastewaters. Quincy's population of 8000 is not responsible for this water demand that could service a community of 65,000.

With the data center build-out seemingly moving forward without end, our community is now delineated to the immediate north with data centers stretching over 3.5 miles, and permitted for over 400 locomotive-sized diesel engines for backup power. Appeal as we did, during the air quality permitting for a number of these sites, we were not able to get these multi-billion dollar industries to use the latest Tier 4 diesel engines with built-in air pollution controls, or for some, to install after-market controls, because of their expense. Congress has long held that the cost of pollution should not be externalized onto the community in increased health costs, environmental damage, etc., but rather paid for by the polluting industry.

Additionally, Congress anticipated that with each required application of pollution controls, the technology would become more efficient and cost-effective over time. When the industry is allowed to forego this step, it slows the progress of pollution control technology development.

There is also the problem with the engines themselves. They cannot meet the EPA's emission standards required for these engines without averaging the engine loads, and other manipulations. What this means is that while permitted emissions are based on meeting an emission standard at each load, the engine is incapable of doing so. Instead, during engine certification, manufacturers do a weighted average of engine loads, and do not include start up, shut down or engine malfunction emissions. This is an EPA rule that effectively allows for an engine certification to claim to meet the standard, allowing industry to base modeling on invalid emission estimates to support compliance, underestimating risk to communities.

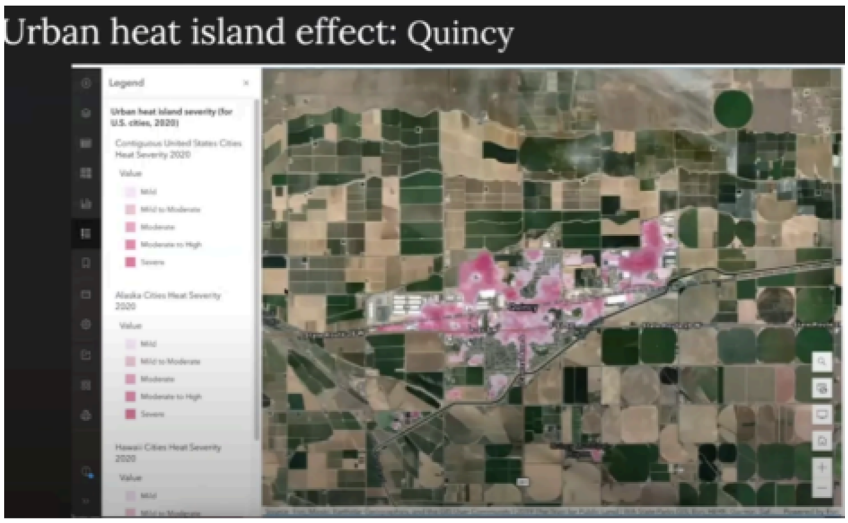
To avoid more stringent Title V compliance, all of the data centers in Quincy have taken voluntary emission limits, in part to avoid triggering emission quantities that would require the use of controls, and more stringent monitoring requirements. For their part, the industry will argue that they don't run the engines very often. However, with 400-plus engines requiring a monthly maintenance run, the sheer number means that at least 10 of these huge locomotive-sized engines will be run every day.

Diesel engines emit ultrafine particulate (<2.5 $\mu g/m^3$) that is immediately bioavailable when inhaled. Linked to cancer in the long term, diesel particulate matter is linked to

cardiovascular issues, asthma, and stroke. But diesel emissions are not the only pollutant emitted by data centers. Cooling towers, which must be descaled and disinfected, emit pollutants too. Bacteriocides and heavy metals are released into the surrounding air and released over neighborhoods and schools. Cooling tower emissions are included in the emissions inventory for particulate matter, but not for the toxics they contain. Additionally, improper disinfection of these cooling systems can result in the release of *Legionella bacteria*, leading to Legionnaire's disease.

Cooling tower water is heavily contaminated and requires treatment before being released to an NPDES permitted facility; it cannot be reused. For this reason, a continual supply of fresh water is needed and can range from 300,000 gallons/day upward per facility.

Cooling systems are an integral part of data centers, and are necessary to dissipate the heat generated by rows and rows, and stacks and stacks, of servers. The heat dissipated is not accounted for in any effect it may have on a warming climate, or the impact it has on local weather, with the creation of a heat island. Below is the impact of heat released by data centers on Quincy.



Credit: Lauren Bridges, 2023-2024 fellow at Harvard University's Berkman Klein Center for Internet & Society

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In addition to all of the environmental impacts mentioned, some of the richest farmland in the nation is found in the Columbia Basin, and as seen in the photograph above, is being converted to data centers.

Some questions have not been addressed in the permitting of data centers. What happens to the electronic waste that is generated? How are liquid batteries (lead-cadmium, lithium-ion, etc.) disposed of or recycled? Are these hazardous materials conscientiously managed, or do they become a waste management nightmare for less fortunate countries?

As for job creation, these data centers employ very few people. Initially, the tax incentive legislation passed in Washington State required 35 full-time positions, but that has been amended down multiple times. The savings to the industry are significant, but not the jobs created.

This industry tempts the state and local communities with promises of higher tax revenues, and plays one state against the other in an "economic-environmental blackmail". Sure there have been tax benefits in Quincy, but the impact on local resources is not sustainable, nor tenable. By continuing to allow the build-out of data centers, we are spending valuable resources that cannot be easily replaced. A thorough review of existing resources, especially water, including future predictions on use and availability are needed before allowing AI unfettered access to what rightfully belongs to humanity.

And Mother Nature brings its own risks, i.e., solar storms. With our increasingly technology-dependent economy, a "Carrington" event would be catastrophic. Substation transformers would be disabled, electrical delivery systems would fail, and in my community, that would result in over 400 locomotive-sized diesel engines simultaneously running to protect the sensitive electronically stored data in these facilities. There is no fail-proof electrical supply, and plans for such a national catastrophe need to be put in place, if this has not already been done.

Every time I see Quincy from a distance, I think of Dr. Seuss' *The Lorax.* The data centers, with their tall stacks – to dilute emissions – sticking up from the landscape like a wicked pincushion, and just like in the story, are "figuring on biggering and biggering", without end in sight. This industry is not sustainable. It is resource-intensive and essentially unregulated. We can't afford to wait and see what the outcome will be. There will undoubtedly be industrial pressure on Congress, and promises made, but without it codified in law, the endgame belongs to them.

My recommendation to Congress is to put a moratorium on AI growth; identify and listen to



harbingers within the industry; require that baseline air quality be established prior to the permitting of new facilities; require that data centers be located away from towns and cities; clearly elucidate that tall stacks are not a replacement for controls, and that engines comply with standards at each operational load without consideration of weighted averages.

Additionally, I would request that Congress require that citizens be allowed access to engine runtimes and emissions data. Currently, a citizen in Washington State can only access the records if the Department of Ecology has physical possession of them. To keep citizens from accessing the records, Ecology reviews them onsite and doesn't retain a copy. Citizen suit provisions under the Federal Clean Air Act are therefore not feasible.

Finally, I am very concerned about the ability of our local, state and federal governments to support displaced workers; control rising electrical costs; prevent degradation of our air quality, and protect our diminishing water supply. What I see in my hometown is Dr. Seuss' dire prophecy, that "Unless someone like you cares a whole awful lot, Nothing is going to get better. It's not."

Please listen to communities that are impacted by these facilities. Without Congressional oversight and proactive intervention, small community resources will continue to be exploited.

Thank you for considering my comments. Please do not hesitate to contact me if you would like additional information. I can be reached at (509) 679-8711 or at 2pattymartin@gmail.com.

Respectfully submitted,

Patrica Martin
Former Mayor, Quincy, WA
Project Director, Save Our Soil

TESTIMONY OF Denise Nelson
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Before the House Small Business Committee's Subcommittee on Rural Development, Energy, and Supply Chains

January 21, 2026

I own a small consulting business supporting local and regional government bodies in planning and operating sustainable and resilient infrastructure systems to support community quality of life. My business is impacted by the rising costs of energy and water, and my clients and I are concerned about the rapid development of data centers and associated infrastructure by private companies in rural areas.

Rural community leaders are ill-equipped to review and approve mega-developments that will have long-term impacts on local water resources, the energy grid, and surrounding development options. Rural community members are not prepared for the significant increases in utility rates and other social, environmental, and economic impacts. Data center developers are prospecting sites with disregard for opportunities to integrate into communities as partners. There are industry standards and guidance available to improve developer-community relationships and inform decision-making.

Thank you for the opportunity to submit this written testimony.

Joanne Mosher

TESTIMONY OF Joanne Mosher
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Before the House Small Business Committee's Subcommittee on Rural Development, Energy, and Supply Chains
January 21, 2026

Thank you for the opportunity to submit this written testimony for the record.

I am a farmer, soil scientist (MS. Purdue University in Soil and Land Use), and a member of our County Council. We live in White County, Indiana, a rural farming county that also has a flair of tourism for over 100 years in the warm months because of our lakes.

To the surprise of most residents, years ago wind farms snuck into our county, now covering substantial acreage. Then solar took thousands of acres of prime farmland, with battery storage in tow. Now, the largest monster is threatening at our door, hyper-scale data centers are having



private meetings with our county economic development director, as well as certain stakeholder that will gain.

Our county has been struggling to pull together stiffer ordinances to protect our land, water resources, energy costs, and the integrity of our rural character. However, some county officials are pushing the development for fear of losing economic opportunities. But the majority of citizens are not for a data center coming into the community. Another large-scale data center development is under construction in another area of our state, and our local concerns rise as we see their struggles with their loss of farmland, construction traffic and accidents, loss of rural character, water loss and quality issues, and utility costs, and this is only through the construction phase.

What can rural citizens and businesses do to protect our home? I can share specific information for our area. We do not want to become another statistic to the impacts of hyper-scale data centers on rural communities.

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