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STATE OF THE GRID

QUARTER 2, 2026

Connecting the dots for a smarter energy future.
Expert consulting services tailored to utilities and their vendors, focusing on Smart Grid and System Operations.

IN THIS ISSUE

Welcome to our newsletter!

Q2 2026 wrapped with clear momentum across the industry, driven by accelerating load growth, faster regulatory action, and new models for utility–developer collaboration. This issue highlights the key developments and conversations that shaped the quarter, as well as the signals pointing to where grid modernization is headed next.

15 YEARS OF MODERN GRID SOLUTIONS:
A Journey of Reinvention, Resilience, and Relationships

By Dr. Mani Vadari, President, Modern Grid Solutions

In April 2011, I flew to Atlanta for what I assumed was the next step in a long corporate career. After a strong VP interview at GE, I called my wife, Anu, to share the news — and the likely relocation. She listened, then said the words that changed everything: "Why do you want to work for someone else? Start your own company. Come home."

On May 2, 2011, Modern Grid Solutions was born. Early clients — Mitsubishi, Alstom Grid, and Brookhaven National Lab — took a chance on a brand-new firm and gave us the confidence to grow. Those first projects shaped our identity: deep expertise, strategic clarity, and the ability to connect dots across the grid.

The early years were scrappy and expansive. We said yes to everything — EMS/ADMS/OMS requirements, global smart cities work, PMU placement, control center metrics, and more. Our partnership with JD Hammerly and The Glarus Group strengthened our capabilities and delivered a unified team across dozens of engagements.

By 2016–2017, the industry needed a different kind of advisor. We pivoted toward strategic work that helped utilities and vendors prepare for transformation, not just implementation. That shift expanded our reach across operations, planning, markets, and now the rapidly accelerating intersection of utilities and data centers.

Fifteen years later, the scoreboard reflects a company built on trust and expertise: 22 utilities, 4 wholesale markets, 32 suppliers, 5 national labs; 3 nonprofits founded; advisor roles with 4 companies; 3 books (and a fourth coming), 6,000+ newsletter subscribers, 100+ publications; New ventures including Modern Grid Academy, Modern Grid Simulations, and Modern Grid Press

The grid is transforming faster than ever, shaped by energy, computing, data, and intelligence. MGS isn't just adapting — we're helping define what comes next.

To everyone who has been part of this journey: thank you. Here's to the next chapter!

INDUSTRY EVENTS AND INFORMATION

IEEE General Meeting 2026

July 19-23 in Montreal, PQ

The IEEE PES General Meeting will bring together academics, utilities, manufacturers, and policymakers to discuss current research, power system planning, operations, and reliability. The program includes technical papers, panel sessions, and working group meetings covering a broad range of power and energy topics. More info here.

T&D World Live

September 1-3 in Orlando, FL

T&D World Live emphasizes utility-led case studies and applied learning across transmission and distribution operations. The conference is designed for professionals seeking takeaways they can apply directly to system performance and operational planning. More info here.

Data Center POWER eXchange

September 30 – October 1 in Washington, D.C.

Data Center POWER eXchange provides utilities with an opportunity to engage directly with the stakeholders shaping future demand. This executive-level forum brings utilities and data center leaders together to address interconnection strategies, regulatory considerations, and infrastructure planning. The event emphasizes collaboration and early alignment—helping utilities better anticipate large-load requirements, reduce project friction, and support long-term, scalable power delivery. More info here.

GridFWD 2026

September 29-30 in Snowbird, UT

GridFWD 2026 conference will emphasize affordability, innovation, and new research on rising electricity prices. The event spotlights regional modernization strategies and utility innovation case studies. Dr. Vadari and John Hammerly plan to attend. More info here.

Q2 Engagement Highlights

In Q2, Dr. Mani Vadari served as the **energy and grid-security expert** for the USTDA's East and Central Africa Power Sector Reverse Trade Mission, advising senior African utility and ministry leaders on modern grid operations, resilience, and large-load integration.

He also joined J.D. Hammerly in delivering a technical session to **Duke Energy's Power Engineers** titled **"Understanding Modern Data Centers: Impacts and Opportunities,"** providing a deep dive into interconnection challenges, operational impacts, and emerging collaboration models drawn directly from Modern Grid Solutions' field experience.

Together, these engagements reflect MGS's growing role in shaping both global energy-security strategy and U.S. utility readiness for rapidly accelerating AI and hyperscale load growth.

M&A

NextEra Energy to acquire Dominion Energy
NextEra Energy and Dominion Energy announced an all-stock merger valued at approximately $67 billion, creating the largest regulated electric utility business in the United States. The combined company will serve major load centers across Florida, Virginia, and the Carolinas, positioning it to meet accelerating demand from data centers and electrification. Read more.

Pattern Energy completes acquisition of Cordelio Power
Pattern Energy has completed its acquisition of Cordelio Power, adding more than 1.5 GW of operating and in-construction wind, solar, and storage assets across the U.S. and Canada. The deal also brings Cordelio's development pipeline and team into Pattern, significantly expanding its North American renewables platform. Read more.

Idaho Power seeks to sell Oregon distribution system to OTEC
Idaho Power has filed to sell its Oregon distribution system to Oregon Trail Electric Cooperative for $154 million. The proposed divestiture would transfer roughly 20,000 customers across four counties, while Idaho Power retains its generation and transmission assets, including the Boardman-to-Hemingway line. Read more.

Veregy acquires JDC Energy Services
Veregy announced it has acquired JDC Energy Services, expanding its national energy services and EPC capabilities across utility efficiency programs, distributed energy, and grid-edge modernization. The acquisition strengthens Veregy's position in large-scale energy-efficiency project delivery for public-sector and utility clients. Read more.

Generac to acquire Enercon Engineering
Generac announced an agreement to acquire Enercon Engineering, adding specialized manufacturing expertise in generator enclosures and switchgear to support growing utility and data-center demand for resilient backup and microgrid-ready infrastructure. Read more.

EDF agrees to sell North American renewables business to KKR
EDF Renewables has agreed to sell its North American wind and solar development platform to global investment firm KKR. The transaction includes EDF's U.S. and Canadian onshore renewables portfolio, covering operating assets, projects under construction, and a multi-gigawatt development pipeline. The sale positions KKR to expand its presence in utility-scale clean energy while EDF refocuses on other strategic priorities. Read more.

ABB to acquire Netcontrol
ABB announced an agreement to acquire Netcontrol, a provider of grid automation and SCADA solutions for electric utilities and critical-infrastructure operators, expanding ABB's distribution-automation and control-room capabilities. Read more.

Leidos to acquire ENTRUST Solutions Group
Leidos signed a definitive agreement to acquire ENTRUST Solutions Group for $2.4 billion, adding engineering and design capabilities across electric transmission and distribution, as well as gas infrastructure modernization. Read more.

Nextpower acquires Zimmermann PV-Steel Group
Nextpower announced an agreement to acquire Zimmermann PV-Steel Group, expanding its solar-hardware and BESS structural-component portfolio for utility-scale developers. Read more.

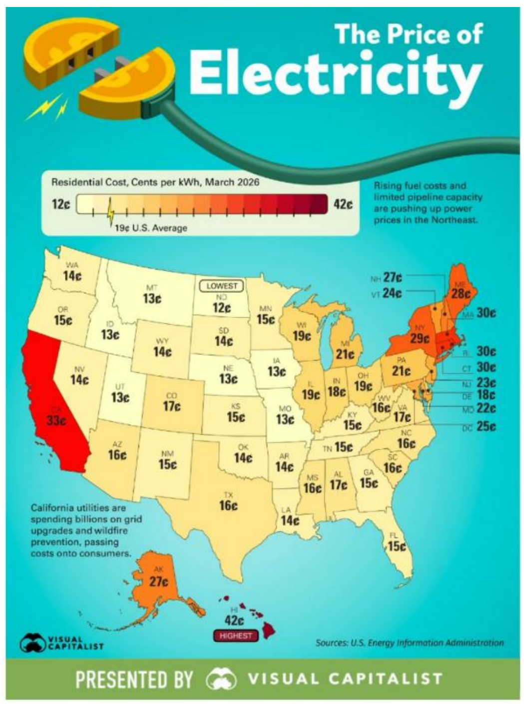
KEY HIGHLIGHTS

Largest U.S. renewable project begins generating electricity

The SunZia Wind and Transmission project — now the largest renewable energy project in U.S. history — began delivering electricity in Q2. The 3.5-GW wind complex and 550-mile HVDC transmission line link New Mexico generation to Arizona load centers, marking a milestone for large-scale clean energy integration and long-distance transmission development. Read more.

Mapped: Where electricity prices are highest in America

New analysis shows wide regional variation in U.S. electricity prices, with New England, California, and Hawaii topping the charts due to fuel constraints, congestion, and infrastructure costs. The map highlights growing pressure on affordability as utilities invest in grid modernization, resilience, and new generation. Read more.



Helion secures world's first regulatory licenses for fusion power plant

Helion Energy received the world's first regulatory approvals to build and operate a fusion power plant, located in Washington state. The licenses mark a historic step for commercial fusion and position the Pacific Northwest as an early hub for next-generation clean energy technologies. Read more.

Erin Brockovich joins fight against data centers

Environmental advocate Erin Brockovich joined community groups raising concerns about water use, land impacts, and grid strain from large data-center developments. Her involvement reflects growing public scrutiny of hyperscale load growth and its implications for local utilities and infrastructure planning. Read more.

U.S. clean energy sets new records in early 2026

New federal data shows the U.S. set multiple clean-energy records in Q2, including all-time highs for utility-scale solar additions and battery storage deployments. Solar accounted for more than half of new generation capacity, while storage installations surged as utilities respond to peak-load growth and data-center demand. Read more.

DOE appoints Travis Kavulla as Bonneville Power Administration Administrator

The U.S. Department of Energy named Travis Kavulla as the new Administrator of the Bonneville Power Administration. Kavulla will oversee BPA's transmission system, hydropower assets, and regional power marketing at a time of rising Northwest load growth, increasing interconnection pressure, and major grid-modernization needs across the region. Read more.

Nvidia unveils new data-center design to address AI's water-cooling challenge

Nvidia introduced a new data-center architecture aimed at reducing water use for AI cooling, replacing traditional evaporative systems with high-efficiency, closed-loop designs. The approach is intended to ease pressure on utilities and communities facing rapid hyperscale expansion, while supporting the next generation of high-density compute loads. Read more.

Plug-In Solar Bypasses Utility Interconnection

A growing market for plug-in, permit-free solar kits is emerging in the U.S., allowing customers to install small PV systems that feed directly into household circuits. While marketed as simple, low-cost alternatives to traditional rooftop solar, these systems bypass utility interconnection processes entirely, creating blind spots in distributed-generation tracking and complicating voltage management and safety protocols. The trend represents a new phase of "guerrilla solar" behavior driven by consumer frustration with permitting and interconnection delays. Read more.

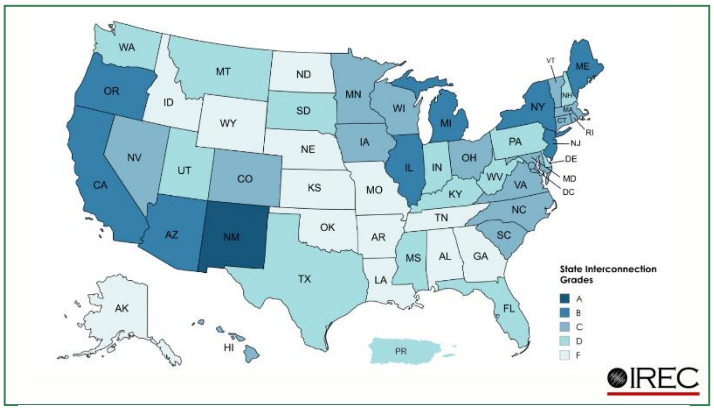
KEY HIGHLIGHTS

Global grid capex to surpass $650B

Global grid investment is set to exceed $650 billion in 2026, according to new analysis from Rystad Energy. The surge reflects rising demand for transformers, high-voltage equipment, and transmission expansion as utilities race to meet accelerating electrification and AI-driven load growth. Despite new manufacturing capacity, long lead times and elevated prices persist, underscoring the need for sustained, strategic grid modernization worldwide. Read more.

New Mexico earns nation's best interconnection policy

New Mexico earned the nation's only "A" grade for distributed energy interconnection in the latest Freeing the Grid report. Regulators were recognized for strong storage rules, transparent queue processes, and adoption of IEEE 1547 standards. With most states still scoring poorly, New Mexico offers a model for faster, more flexible DER integration as load growth accelerates. Read more.



Map source: Feeling the Grid, a joint initiative of the Interstate Renewable Energy Council (IREC) and Vote Solar

Elementl planning nuclear plant powered by SMRs

Elementl Power is planning a 1.2-GW clean energy campus in Meigs County, Ohio, anchored by small modular reactors alongside solar, battery storage, and green hydrogen production. The project is designed to provide firm, zero-carbon power for new industrial and data-center load, signaling how hybrid nuclear-renewable hubs are emerging as a next-generation grid strategy. It may be in service by 2034 if the interconnection request and other requirements are met. Read more.

Tesla Powerwall leases to include VPP savings

Tesla has updated its Powerwall lease program to include built-in VPP (Virtual Power Plant) savings, automatically crediting customers for grid services like peak-shaving and demand response. The move effectively turns every leased Powerwall into a turnkey grid resource, with the expectation of lowering customer bills while expanding behind-the-meter flexibility for utilities. The pilot is rolling out in Massachusetts and Connecticut. Read more.

FERC orders all six grid operators to speed large-load integration

FERC has ordered all six RTOs/ISOs to either justify or reform their tariffs for large loads, pushing operators to streamline studies, improve cost transparency, and better support flexible and co-located resources. Each operator must respond within 60 days, marking one of FERC's most significant moves to accelerate "speed-to-power" as demand from data centers and industry continues to surge. Read more.

Google and Voltus launch "bring-your-own-capacity" program in PJM

Google and Voltus have partnered to open a new "bring-your-own-capacity" pathway in PJM, enabling commercial customers to enroll flexible load and behind-the-meter resources directly into PJM's capacity market. The 'first-of-its-kind' agreement allows Google to aggregate customer-sited flexibility as accredited capacity, expanding demand-side participation and helping PJM manage rising peak demand from AI, data centers, and electrification. Read more.

Nuclear poised for historic scale-up as demand surges, says head of Nuclear Energy Institute

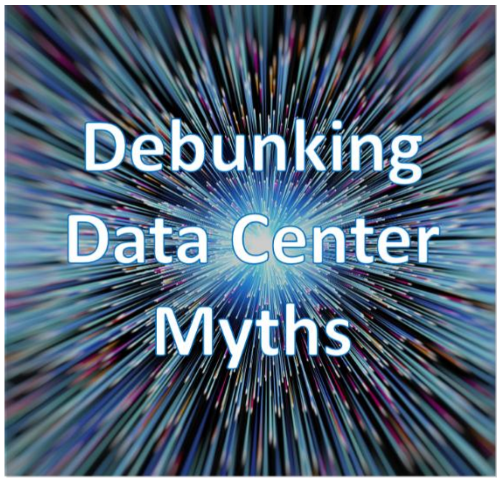
In her 2026 State of the Nuclear Industry address, NEI CEO Maria Korsnick said the U.S. now has 90 nuclear projects in development and 8 already breaking ground, with a national goal to quadruple capacity by 2050. She emphasized nuclear's role in meeting soaring electricity demand — including a projected tripling of data-center load by 2030 — as federal support and private investment accelerate deployment. Read more.

FEATURED ARTICLE

DEMYSTIFYING DATA CENTER MYTHS: UNDERSTANDING THE REAL IMPACTS ON GRIDS, COMMUNITIES, AND GROWTH

By Dr. Mani Vadari, President, Modern Grid Solutions

There is a lot of misinformation about data centers today, and as a result, they have become a flashpoint in local debates, often portrayed as energy hogs or industrial intruders. Cities, counties, and states are moving quickly to impose moratoriums on new data center development. The reality is more complicated. Modern hyperscale and AI-driven facilities are reshaping electricity demand at a pace the grid wasn't built for, while also raising real questions about land use, water, and community impacts. At the same time, many assumptions about how data centers use power, affect bills, and fit into communities are outdated, oversimplified, or simply incorrect.



Understanding the real impacts is essential as digital infrastructure becomes a defining feature of the modern economy. If the U.S. fails to engage with these issues thoughtfully, other countries will, and the center of innovation will shift to the places that welcome and plan for this growth.

Below are ten of the most common myths shaping public debate, and what the evidence actually shows.

MYTH 1: "Data centers will make everyone's power bill go up."

Assessment: Mostly False

FACT: In most U.S. jurisdictions, data centers are required to pay the costs they create, including interconnection, grid upgrades, and large-load tariffs.

Regulators use cost-causation principles to prevent residential customers from subsidizing industrial load. In many regions, data centers also expand the tax base, which can ease pressure on local budgets.

Still, the scale and timing of new loads can create planning challenges for utilities, especially when multiple projects cluster in the same area.

MYTH 2: "Data centers are giant energy hogs with no grid value."

Assessment: Mostly False

FACT: Nationally, data centers used 176 TWh in 2023, or 4.4% of all U.S. electricity. For comparison, air conditioning in U.S. homes uses about 12% of household electricity, making data centers a major, but not singular, driver of demand. Data centers are also one of the most flexible large loads on the grid. They can:

- Participate in demand response, curtailing load during peaks
- Shift computing tasks to off-peak hours
- Provide fast, automated load variation that helps integrate wind and solar.
- Provide backup power to the grid operator, reducing the need for peaker plants

Of course, this flexibility is not automatic. It depends on tariff design, interconnection agreements, and operator participation. When those pieces are in place, data centers can augment grid reliability rather than strain it.

MYTH 3: "Data centers only strain the grid when they're using power."

Assessment: Mostly True

FACT: Large data centers can create real operational challenges if they trip offline suddenly or change load faster than the grid can respond.

NERC recently issued a Level 3 alert after several large facilities dropped offline unexpectedly, causing rapid swings in demand that stressed local systems.3F AI-driven workloads can also ramp up and down quickly, creating variability that grid operators can mitigate through joint forecasting of consumption.

These risks are manageable, but they require updated interconnection standards, ride-through requirements, and coordinated controls so data centers behave more like predictable grid assets and less like unbounded loads. As the digital economy grows, integrating these fast, flexible loads is becoming a core part of modern grid operations.

MYTH 4: "Utilities can move at the speed data center developers need."

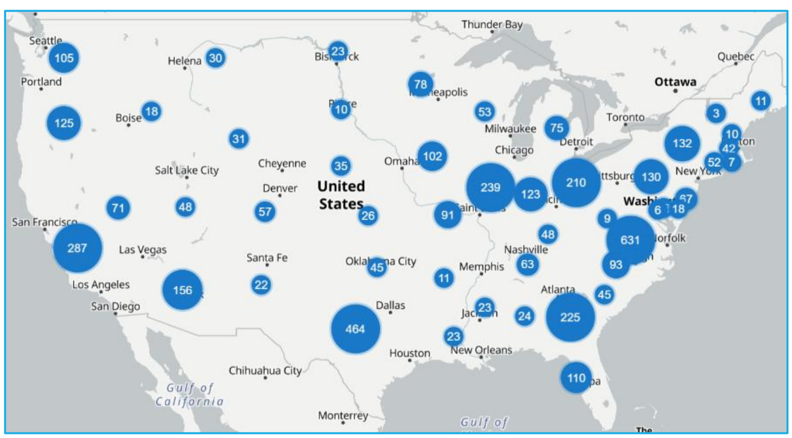
Assessment: Mostly True

FACT: Data center developers operate on fast capital cycles — often 18–36 months and are mostly limited by their own supply chain constraints. However, utility infrastructure follows a much slower timeline shaped by engineering, permitting, procurement, and regulatory review.

Even when utilities want to move quickly, interconnection studies, environmental review, community engagement, equipment lead times, and construction sequencing create unavoidable delays.

Developers sometimes assume utilities can "flex" to match their pace, but utilities must follow statutory processes and reliability standards that don't bend to market urgency.

Transmission and substation upgrades can take 5–10 years, even when fully supported by all parties.



As of June 2026, there are 4,378 data centers in the U.S.

The mismatch isn't about unwillingness; it's about the physics, permitting, and public interest obligations that govern utility work. The result is a structural tension: capital moves fast; infrastructure moves slow. Successful projects recognize this gap early and plan around it rather than assuming utilities can accelerate on demand.

MYTH 5: "Data centers fit easily into any community."

Assessment: Mostly True

FACT: Data centers often trigger significant land use debates, especially when proposed near homes, farmland, or environmentally sensitive areas. They require large parcels, access to transmission, and proximity to substations, which can put them in competition with agriculture, open space, or planned development. Local residents frequently raise concerns about visual impact, loss of rural character, construction traffic, and long-term land conversion. Permitting can become contentious when zoning codes weren't written with data centers in mind.

Communities that proactively plan for where data centers should go, and where they shouldn't, tend to experience fewer disputes and more predictable outcomes.

MYTH 6: "Data centers consume/waste enormous amounts of water."

Assessment: Partially False

FACT: Water use varies dramatically by region and cooling technology. Many modern data centers use air-cooled or hybrid-cooled systems that require far less water than older designs or facilities in hot, arid climates. And a growing number of data centers are shifting to using recycled water (treated wastewater) instead of potable water. For example, Google uses reclaimed or non-potable water at over 25% of its data center campuses (one notable example is its Douglas County, Georgia data center, which runs on recycled municipal wastewater). Lastly, many of the newer data centers are running water in a closed loop, reusing the water again.

Still, in water-stressed regions, even modest use can be contentious — and communities increasingly expect transparency about cooling choices and long-term water planning.

MYTH 7: "Data centers don't benefit the local community."

Assessment: Mostly False

FACT: Data centers can provide stable tax revenue and high-value construction and technical jobs, often with relatively low demand on schools, roads, or social services. Loudoun County is a leading example: data center revenue has helped fund more than $1 billion in road improvements and 36 new schools while allowing the county to maintain the lowest property-tax rate in Northern Virginia, supported by nearly $900 million in annual data-center taxes.

These benefits are not universal. Communities with unclear zoning, limited infrastructure, or rapid clustering may experience friction if growth outpaces planning, and tax revenue may not offset concerns about land use, water, or long-term development priorities. The real question is whether data center benefits align with local goals and whether siting decisions are transparent and well-planned.

MYTH 8: "Data centers undermine climate goals."

Assessment: Mostly False

FACT: With the right policies in place, data centers can help accelerate clean-energy deployment, but this outcome is not guaranteed.

Tools such as renewable additionality requirements, green tariffs, and 24/7 carbon-free energy commitments ensure that new data center demand is met by new wind, solar, and storage projects rather than by increased fossil-fuel generation.

Many operators already procure renewables at a scale that enables them to bring new projects online faster than utilities typically can.

Still, without strong policy frameworks, large new loads can increase fossil generation in the near term. And when data center development outpaces grid capacity, communities may face increased pollution — a dynamic now prompting legal action in Mississippi, where residents have sued xAI, claiming that its on-site gas turbines constitute an unpermitted power plant.6F

MYTH 9: "Data centers create noise and air pollution that harm nearby communities."

Assessment: False

FACT: Modern data centers are quiet, low-emission facilities that operate within local environmental standards. Cooling systems are engineered to meet strict noise limits, and the loudest components, such as backup generators, run only during short testing periods or rare outages. Data centers do not emit air pollution during normal operations because their electricity comes from the grid rather than on-site combustion. Backup generators must meet stringent EPA emissions standards, and many operators are transitioning to batteries and other clean backup technologies.

Still, generator testing schedules, visual impact, and cumulative effects can be legitimate community concerns that require thoughtful mitigation.

MYTH 10: "Data centers are a mature, settled technology."

Assessment: False

FACT: Rapid growth, siting constraints, and grid bottlenecks are pushing the industry toward new and sometimes unconventional models. Investors are exploring ideas like floating, wave-powered AI data centers that shift the challenge from energy transmission to data transmission. Other approaches include conceptual orbital data centers, modular micro-data centers, on-site clean-energy systems, advanced immersion cooling, and AI-optimized load shaping.

These efforts reflect a simple reality: the traditional "build a large facility near a substation" model is becoming harder to execute as land, community support, and interconnection capacity tighten. Not all innovations will succeed, but they show an industry under pressure to adapt as compute demand accelerates.

Bottom Line: The modern world runs on energy, computing, data, and intelligence. The infrastructure behind it is growing faster than many parts of the grid can accommodate. Data centers pose real challenges, from energy demand to siting friction, but they also offer opportunities for investment, jobs, flexibility, and innovation. By separating myths from facts, communities, utilities, and developers can focus on practical steps that ensure new facilities strengthen the entire ecosystem rather than strain parts of it. When done properly, the growth will align with local priorities, long-term planning, and deliver benefits to all.

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Early Praise for Dr. Vadari's Latest Book

As *OMS Unlocked: Pathways to Successful Implementations* neared completion, Dr. Vadari enlisted experienced OMS practitioners to pressure-test the material and validate its real-world relevance. Their perspectives follow.

"Vadari's focus on team structure, implementation methodology, and real-world practices makes this an essential resource for anyone seeking to execute a successful OMS project."
— James A. Walters, Utility Industry Veteran/ Senior Advisor, Exelon Corporation (Retired)

"Dr. Mani Vadari continues to be a driving force in the ongoing transformation of the electric industry. Calling out the need for an "Owner's Engineer" is an immediate, actionable step that utilities can take for a more effective rollout."
— Melanie Miller, PD Data & Technology General Manager, Southern Company

"Dr. Vadari distills complex concepts and technologies into practical insights, while not missing the point that none of this is easy but navigating this modernization and resilience challenge will pay strategic benefits."
— John A Ryan, Director, ADMS Program, Exelon Corporation

"Dr. Mani Vadari thoughtfully captures the complexity of modern OMS implementations — where technology, process, and human coordination must operate seamlessly under pressure. It is an invaluable resource for navigating the evolving demands of grid operations."
— Andrew Dicker, Managing Director, Accenture

"If you want fewer surprises, stronger storm readiness, and a smoother path to go-live, I highly recommend starting here."
— Jens Nedrud, Director Transmission Planning, Pacific Gas & Electric

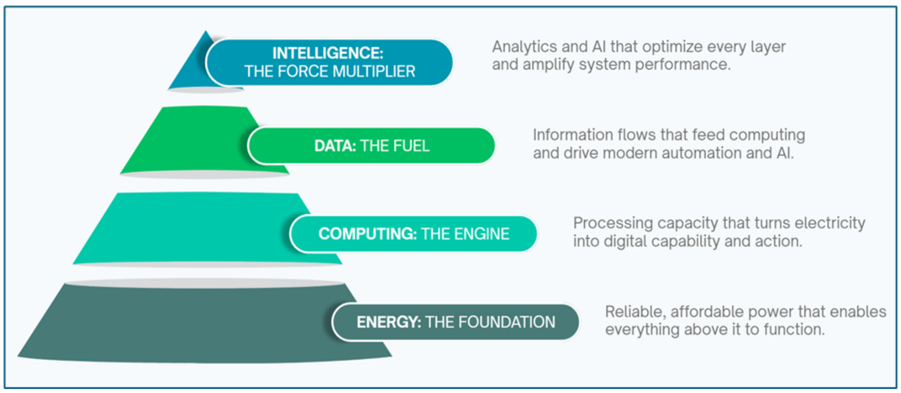
The softcover/hardcover book and eBook are coming soon. Stay tuned for more news on their release.

WATT'S on MANI'S MIND?

HOW ENERGY, INTELLIGENCE, COMPUTING, AND DATA MUST COME TOGETHER TO SHAPE THE NEXT CENTURY

Part 1: The Destination

By Dr. Mani Vadari, President, Modern Grid Solutions



How We Got Here: The Forces That Shaped Three Centuries

For three centuries, each era has been defined by its dominant force — from steam and steel to computing and the internet. Today, a new shift is emerging from the convergence of four layers: **energy, computing, data, and intelligence**. Together, they will form the new engine for the century ahead.

Over my 40+ years in power systems, I've watched these layers develop in parallel, but rarely in sync. Even as they've begun to converge, the value has remained fragmented. We haven't reached the point where the whole is greater than the sum of the parts.

We know how to build energy systems, embed computing, and generate data. And the intelligence tools are far beyond the Expert Systems and Artificial Neural Networks I worked with during my Ph.D. What's new is the speed and scale, and the need to integrate these forces to develop something greater.

This century will test our ability to do that. If we can't, progress will stall. If we can, the opportunity is almost boundless. And based on what I've seen across industries and across my own career, I believe we are moving in the right direction — unevenly at times, but unmistakably forward.

Energy: The Foundation

Without enough energy, the world stops — cars don't move, factories don't run, homes don't function, and computers don't compute. Every modern breakthrough — AI, automation, electrification, digital services — depends on reliable, abundant, affordable electricity. Energy is the foundation layer, and everything else sits on top of it.

But demand is rising faster than the systems can adapt. Data centers that once requested 50 MW are now routinely requesting 500 MW or more, and gigawatt-scale campuses are becoming common. According to the U.S. Department of Energy, data centers consumed about 4.4% of U.S. electricity in 2023 and are projected to reach 6.7-12% by 2028.[i]

The challenge isn't just demand, it's timing. Developers move at the speed of capital, while utilities move at the speed of regulation and construction. Some utilities are now quoting four- to ten-year interconnection timelines. One told Google it would take 12 years just to study a request.[ii]

Energy is the foundation layer, but it's also the constraint. Unless we rethink how we plan, build, and operate the grid, that constraint will set the ceiling on innovation.

Computing: The Engine

If energy is the foundation, computing is the engine that turns that power into digital capability. Every digital service — every email, every web query, every AI model, every automated workflow, even the control systems that run the grid — depends on computing. Hyperscale computing and AI clusters have turned data centers into digital factories. Just like factories of the past, they need land, power, cooling, communications, and interconnection — real physical assets. Computing is the new physical industry.

And the engine has become so power-hungry that it can no longer choose its own geography. Developers used to build where the fiber was. Now they build where the megawatts are. The availability of power — not land, not fiber, not capital — is increasingly the determining factor in where computing can grow.

But the engine is running hotter than the grid can support. These new factories are scaling faster than the infrastructure around them — expanding footprints, accelerating timelines, and driving demand in ways the existing system wasn't built to absorb. The result is a widening mismatch between how quickly computing can grow and how long it takes to deliver the physical capacity it depends on.

Data: The Fuel

If computing is the engine, data is the fuel. It's the raw material for automation, AI, and modern decision-making. But data isn't weightless. It has a physical footprint, which is also measured in megawatts.

It's estimated that the world generated 173.4 zettabytes of data in 2025, and that is set to triple by 2029 to over 525 zettabytes.[iii]

Every byte created or consumed requires computing and energy. Every byte stored, processed, or moved consumes energy and requires more computing. AI and machine learning have intensified this dynamic: training modern models requires massive datasets and massive amounts of energy.

Data is the fuel layer, but it's also a growing load on the foundation, with data processing outpacing almost every other aspect of energy consumption.

Intelligence: The Force Multiplier

At the top sits intelligence — the force multiplier that unlocks the value of the other three layers. Intelligence turns raw data into actionable insight, computing into capability, and relegates energy into a critical tool that drives productivity.

Utilities already operate with intelligence systems in their control rooms: Energy Management Systems (EMSs) for transmission, Outage Management Systems (OMSs) for outage response, and Advanced Distribution Management Systems (ADMSs) for distribution, to name a few. These platforms take in real-time data from SCADA, AMI, and field sensors and translate it into operational decisions. They show that intelligence in the grid isn't new, but the scale and speed of today's computing and data demands require intelligence that spans the four layers across all industries, not just the utility footprint.

The electric grid is only one example. We're seeing the same convergence across other sectors where energy, computing, and data are becoming inseparable. In manufacturing, smart factories now run on sensor-rich equipment, edge computing, and AI systems that optimize quality and throughput in real time — all of which depend on reliable power. In buildings, advanced management systems combine energy data, occupancy patterns, and on-site computing to automate comfort, cost, and carbon. These industries show the same pattern: intelligence sits at the top, but intelligence depends on everything beneath it. Intelligence without energy is inert. Intelligence without computing is theoretical. Intelligence without data is blind. The force multiplier only works when the layers beneath it are aligned.

As intelligence becomes more capable and more deeply embedded across industries, it also requires thoughtful governance and built-in safeguards. These measures ensure the technology enhances productivity and decision-making without crossing clearly defined societal red lines, and that it is always applied with the right intent and approach.

Why Integration Is So Hard

These four layers evolve at different speeds. Technology sprints. Infrastructure crawls. Policy lags. Developers want speed. Utilities want certainty. Regulators want prudence. Communities want benefits without disruption — and everyone wants those benefits to remain affordable.

Building physical infrastructure takes time. New generation and transmission face regulatory reviews, community resistance, and long-lead equipment. And because customers must be protected from higher bills, utilities can't overbuild or take on the risk of stranded assets. The system is built for reliability and affordability, not speed — and that creates friction with fast-moving demand. It's not that anyone is wrong; it's that the four layers aren't aligned.

Coordinated planning that treats energy, computing, data, and intelligence as one interconnected ecosystem is missing.

What Success Looks Like

Success in the next century will come from integration:

Energy (The Foundation): Reliable, affordable energy systems — from electricity to thermal and industrial power — built for flexibility, speed, and scale so everything above them can function and thrive.

Computing (The Engine): Processing infrastructure placed where it can deliver the most value — aligning with energy availability, operational need, and the ability to support local or global digital demand.

Data (The Fuel): Governance and digital infrastructure that manage the volume, movement, and storage of data so the fuel stream strengthens, rather than overwhelms, the systems that depend on it.

Intelligence (The Force Multiplier): Analytics and AI that anticipate needs, optimize operations, and coordinate across systems, making every layer more adaptive, efficient, and effective.

Each layer strengthens the others. Success comes when energy, computing, data, and intelligence operate as one system rather than four silos — not just in the energy sector, but across industries. Whether it's buildings that optimize comfort and carbon in real time, manufacturers running sensor-rich production lines, or cities coordinating transportation, energy use, and digital services, the pattern is the same: progress accelerates when these layers are aligned and slows when they aren't.

The Century of Integration

The Industrial Age gave us machines. The Computing Age gave us processing power. The Internet Age gave us global connectivity. This century will be defined by our ability to integrate energy, computing, data, and intelligence — intentionally, intelligently, and at scale.

Bottom Line: Integration is the destination. But knowing the destination is only half the challenge. The next step is understanding how we get there — the practical steps, decisions, and tradeoffs that turn this vision into reality. That journey is the focus of the next article. Stay tuned!

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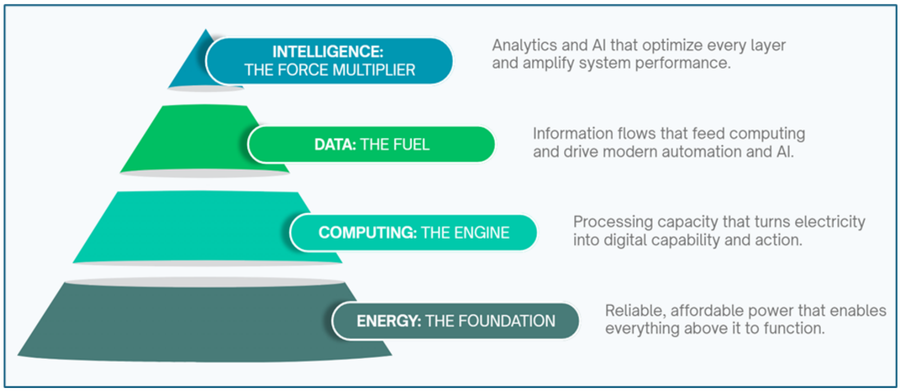
[i] https://escholarship.org/uc/item/32d6m0d1
[ii] https://www.networkworld.com/article/4117329/google-warns-transmission-delays-are-now-the-biggest-threat-to-data-center-expansion.html
[iii] https://www.statista.com/statistics/871513/worldwide-data-created/

HOW ENERGY, INTELLIGENCE, COMPUTING, AND DATA MUST COME TOGETHER TO SHAPE THE NEXT CENTURY

Part 2: The Journey

By Dr. Mani Vadari, President, Modern Grid Solutions



In Part 1, we established that the next century will be shaped by four interdependent layers: energy, computing, data, and intelligence. Each is advancing rapidly on its own. The problem is that they are not advancing together. The system is not failing; it is misaligned. And misalignment, not technology, is threatening our ability to build the future we all want and need.

Part 2 is about the journey forward. This article represents a practical roadmap for building an integrated system that delivers value to everyone — utilities, large-load developers, regulators, communities, and the industries that depend on them.

And to be clear: none of the four layers can dominate the conversation. Energy, computing, data, and intelligence are equal pillars of the system we are trying to build, and we need them all to succeed. If we focus too much on one — or not enough on another — we create new bottlenecks even as we solve old ones. Over-index on energy, and we miss the architectural shifts happening in computing. Over-index on computing, and we ignore the data flows and physical realities that make it possible. Over-index on data, and we overwhelm the infrastructure beneath it. Underinvest in intelligence, and the entire system becomes slower, more expensive, and less adaptive.

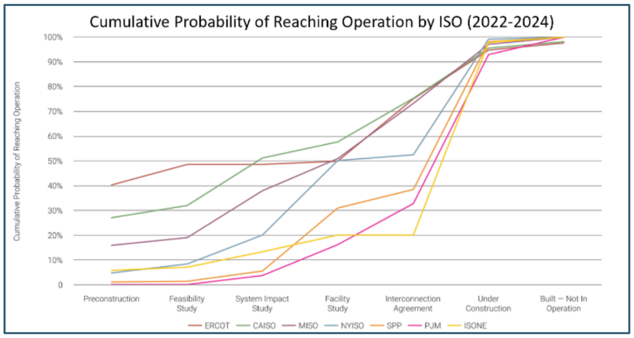
The opportunity — and the responsibility — is to design a future in which all four layers advance together, reinforcing one another rather than competing for priority.

This matters now because the pace of innovation has outstripped that of infrastructure, and without alignment, the future will arrive faster than we can deliver it or use it to its full potential.

The Reality Check: A Foundation Out of Sync with Demand

Before we talk about the journey, we need to acknowledge the gap between what the future requires and what today's system can deliver.

Compute evolves on 18-36 month cycles. AI companies, manufacturers, and data center developers plan on similar timelines because their markets demand it. Utilities, by contrast, build infrastructure on 5-10 year cycles — and that's when everything goes right. Transmission can take a decade or more to plan, permit, and construct. Some projects, like SunZia[1], take nearly two decades.



Source: Enverus 2025 Interconnection Queue Outlook[i]

Interconnection queues tell the same story. Only a fraction of the capacity in those queues will ever reach operation. As of the end of 2025, over 2,060 gigawatts (GW) of total generation and storage capacity were actively seeking grid connection. However, most projects that apply for interconnection are ultimately withdrawn, and those that are built are taking longer on average to complete the required studies and become operational[ii]. This dynamic is now driving counterproductive behavior among compute-focused developers, including submitting multiple requests to multiple utilities, pursuing their own local generation, and making investment decisions with incomplete information, all of which increase risk and cost and raise the likelihood of stranded assets.

And even when projects can move, physical and locational constraints — land, cooling, siting, transmission — limit where and how fast we can build.

The takeaway is simple: the bottleneck isn't technology. It's misalignment. Four layers, four speeds, and no shared operating model.

The Journey: What It Takes to Build the Integrated Future

Align Planning Horizons Across All Four Layers

Today, energy, computing, data, and intelligence operate on separate timelines, with separate planning processes and separate incentives. That must change.

We need shared forecasting, shared visibility, and shared accountability and commitment among utilities, large-load developers, policymakers, and regulators. Data center developers know their five-to ten-year load forecasts. Utilities know where capacity can be built and how long it will take. Policymakers know where growth is desired and where constraints exist. Intelligence — AI and advanced analytics — can help all three see further and act faster.

Alignment is the first step. Without it, nothing else works.

Redefine Interconnection for the World We're Actually Building

Incremental tweaks will not get us there. We need a structural redefinition of what it means to deliver power to a customer, large or small.

That means streamlined study processes, queue management reforms, and proactive planning. It also means recognizing that not every load needs a traditional grid connection. Some loads may be better served by microgrids, behind-the-meter generation, very-close-to-the-meter (VCFTM) solutions, or hybrid arrangements.

Utilities should be positioned — and allowed — to provide backup power, microgrid services, and ancillary services. If a data center needs backup power, the utility should be able to provide it. If a microgrid is the right solution, the utility should be able to build and operate it. If a customer needs ancillary services, the utility should provide them.

Right now, everyone is being forced to become an energy expert. That is inefficient. There is no reason for a company like Amazon to build and manage its own power and energy team. The utility should own the energy equation.

The Federal Energy Regulatory Commission (FERC) is also beginning to recognize that the current model cannot support the scale and speed of modern load growth. By the end of June 2026, FERC is expected to take formal action on its Advance Notice of Proposed

[1] For a concise explanation of the permitting, routing, and legal delays behind SunZia's timeline, see the Wall Street Journal video, *Why It Took 17 Years to Approve the Largest Wind Farm in the U.S.*: https://www.youtube.com/watch?v=hmeM0zxJqFI

Rulemaking for large-load interconnections — a process initiated at the direction of the U.S. Department of Energy. The goal is to establish standardized, nondiscriminatory rules for connecting loads greater than 20 MW[iii]. It's an important step, but it still operates within the boundaries of a system designed for a different era. True progress requires not just new rules, but a redefinition of what "interconnection" means in a world where computing, data, and intelligence evolve far faster than traditional infrastructure.

If new tariffs are required to meet the needs of these emerging customers, we should not hesitate to create them, and utilities should be empowered to work together across service territories whenever collaboration delivers a faster, more efficient interconnection.

Build Ahead of Demand — Not Behind It

If we continue building infrastructure reactively, we will always be behind.

We need strategic transmission corridors, pre-identified routes for high-capacity lines, coordinated permitting across jurisdictions, and standardized, repeatable engineering. We need to do the hardest parts — routing, permitting, environmental review — once, not for every project.

Energy corridors could be to the AI revolution what the interstate highway system was to American mobility and what fiber-optic backbones were to the expansion of the internet: the enabling infrastructure that unlocks scale, speed, and economic transformation. Without them, growth is fragmented and slow; with them, entire industries accelerate.

"Time to power" must become a critical metric. Regions that shorten it will win the economic competition for the next century.

Rethink the Paradigms of Energy, Computing, Data, and Intelligence

This is where the real transformation happens.

Energy: Rethink how we deliver power. The utility must own the full energy equation — grid, behind-the-meter (BTM), front-of-the-meter (FTM), VCFTM — and deploy the right model for the right customer, rather than forcing every load through a single interconnection pathway.

As Jensen Huang recently noted, energy abundance and compute abundance are deeply linked: regions with plentiful energy can scale compute less efficiently, while regions with constrained energy must optimize every watt. That reality makes U.S. energy scarcity not just an infrastructure issue, but a competitiveness issue.[iv]

Computing: Rethink how and where compute happens. The assumption that bigger data centers are always better no longer holds. As communications become faster and cheaper, distributed architectures may deliver more value, resilience, and efficiency than ever-larger campuses.

Data: Rethink how data moves. We need to understand where data is created, where it is consumed, and what it costs to move it. In some cases, compute may need to shift closer to the data to reduce latency, infrastructure strain, and total system cost.

Intelligence: Rethink how the system is orchestrated. Intelligence is the differentiator — the layer that optimizes the others in real time. As energy, computing, and data become increasingly commoditized, intelligence becomes the source of adaptability, speed, and competitive advantage. The more evenly spread it is, the more effective and valuable it can be.

Treat Computing as Critical Infrastructure

Compute is now as foundational as water, telecom, and transportation. Every sector depends on it — including the grid itself.

That means integrating compute growth into utilities' Integrated Resource/System Plans (IRPs and ISPs), coordinating siting decisions with transmission planning, and aligning permitting timelines with realistic deployment schedules. It means recognizing that while compute developers choose their locations and their line of sight to value, utilities become the enabler, defining where energy/capacity exists, can be built, or can be delivered.

If we treat compute as discretionary, we fall behind. If we treat it as critical infrastructure, we lead.

The U.S. government is trying to stay ahead of the curve. Its emerging "speed to power" initiative aims to accelerate the development, permitting, and interconnection of large-scale power infrastructure — particularly to meet the surge in demand from AI data centers and advanced manufacturing.[v] It is a meaningful signal that Washington understands the stakes. But it is not enough. These efforts still operate within the same fragmented processes that created the delays in the first place. Speed to power helps at the margins, but without a fully integrated approach across energy, computing, data, and intelligence, we will continue to build the future on top of yesterday's fragmented and archaic operating model.

The Integrated Operating Model: The Destination Within the Journey

A fully integrated system does not have four layers moving independently. It has four layers reinforcing each other.

- Energy provides the foundation for modern computing.
- Computing delivers value guided by long-range visibility.
- Data flows through infrastructure without overwhelming it.
- Intelligence ties the layers together in real time.

When these layers move in sync, the system becomes more than the sum of its parts. New industries emerge. Innovation accelerates. The grid becomes a platform for growth, an enabler, rather than a constraint.

The Path Forward: A System Built for the Next Century

The next decade is decisive. It will determine whether we build the integrated future this century demands or continue to fall behind the pace of innovation.

The opportunity is enormous. The work is achievable. We do not need to reinvent the grid. We need to coordinate the pieces we already know how to build.

- Utilities must plan with visibility, build with urgency, and design for next-century load profiles.
- Large load developers must signal early, commit clearly, and coordinate siting and timelines.
- Policymakers and regulators must align permitting, planning, and incentives with real timelines.
- Industry and technology partners must invest in intelligence and shared infrastructure.

The future we described in Part 1 is not inevitable, but it is only possible if we choose to build it together, in sync, with each layer reinforcing the next.

[i] https://www.enverus.com/newsroom/enverus-releases-2025-interconnection-queue-outlook-to-navigate-backlogged-grid-challenges/
[ii] https://emp.lbl.gov/queues
[iii] https://www.ferc.gov/rm26-4
[iv] https://youtube.com/shorts/wvzJHVmvEwU
[v] https://www.energy.gov/speed-to-power

ABOUT MODERN GRID SOLUTIONS

Modern Grid Solutions (MGS) is a global supplier of deep expertise in the electric industry. Our team, each with over 25 years of industry experience, delivers innovative solutions to utilities, corporate clients, and policymakers. Our experts cover a wide range of areas, including engineering, technology, economics, and operations. We're passionate about helping clients navigate the complexities of the modern grid so they can focus on their core business. Our boutique consultancy stands out for its unique value proposition, where seasoned experts treat clients' businesses as their own.
Read more about MGS.

We focus on delivering value and actionable guidance to our clients, allowing them to flourish in the evolving energy landscape. Our ongoing projects include:

• California Municipal Strategic Modernization Journey Map	• Northwest Utility Transmission Strategic Planning
• Energy Service Provider Assistance	• Data Centers - Developers/Operators
• Business Architect Role	• Decarbonization Strategy
• Vendor Collaboration	• Startup Support

The guy (literally) wrote the books!

Dr. Vadari's books serve as widely used textbooks in universities across the U.S. and beyond. Personnel at several utilities use them as reference books.

- ***Smart Grid Redefined: Transformation of the Electric Utility***
- ***Electric System Operations – Evolving to the Modern Grid. 2nd edition***
- ***Resiliency of Power Distribution Systems*** - Chapter 14, *Technology and Policy Requirements to Deliver Resiliency to Power System Networks*, by Dr. Mani Vadari, Dr. Gerry Stokes, & John (JD) Hammerly.
- ***OMS Unlocked: Pathways to Successful Implementations -*** The e-book and softcover / hardcover books are coming soon. Stay tuned for more news on their release.

Additionally, MGS is the trusted authority for conducting in-depth training sessions on critical industry subjects, including power system fundamentals and grid modernization. Ask us about our training programs.

Don't miss out on our incredible resources!
Head over to our new website and discover our eBook, "Utility Executive Quick Reference Guide," and Dr. Vadari's Blog, "Watt's on Mani's Mind?" And that's just the beginning! Explore much more on our website. Visit us and unlock a world of knowledge from our industry leaders.

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