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STATE OF THE GRID

QUARTER 1, 2025

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!

Welcome to our latest quarterly newsletter, where we explore the impactful developments and emerging innovations that are reshaping the future of our energy landscape. Discover the exciting progress in sustainable energy solutions and their transformative potential for our energy systems.

Together, we are laying the groundwork for a grid that meets today's needs while paving the way for a sustainable tomorrow.

INDUSTRY EVENTS AND INFORMATION

WEI OPERATIONS CONFERENCE

April 15-18 in Vancouver, BC, Canada

John (JD) Hammerly will represent at this annual in-person conference, which brings together hundreds of energy industry professionals for three days of education and networking. More info here.

CLEANPOWER

May 19-22 in Phoenix, AZ

CLEANPOWER is the American Clean Power Association's annual conference. This event includes both a conference and trade show. CLEANPOWER drives business growth by bringing together key decision-makers and stakeholders across the wind, solar, storage, hydrogen, and transmission industries for discussion, deal-making and networking. More info here.

Energy Thought Summit (ETS)

May 19-22 in San Antonio, TX

ETS25 is gearing up with a new format, introducing town halls on the main stage, primed for audience interaction. ETS participants will explore the latest industry trends, including grid modernization, cybersecurity, customer engagement, regulatory landscapes, and climate resilience. More info here.

Grid Investment Summit 2025

April 30 – May 2 in Austin, TX

Grid Investment Summit brings utility decision-makers together to identify grid investment needs, share best practices, and review lessons learned. Hear from pioneering utilities, independent power producers, developers, as well as innovative solutions providers who can help with the grid modernization process and ensure a return on investment. More info here.

2025 IEEE PES General Meeting

July 27-31 in Austin, TX

This premier power engineering conference will bring together practicing power engineers and academics from all over the world. The conference aims to provide an international forum for experts to promote, share, and discuss various issues and developments in the field of electrical power engineering.

Didn't make it to DistribuTECH 2025?

That's okay. We've got you covered.

The utility industry is evolving rapidly, and DistribuTECH 2025 made that clearer than ever. From the rise of AI and ML-driven solutions to the platformization of major vendors, the conference showcased groundbreaking innovations that are reshaping the energy landscape. Drones, robotics, and grid-edge advancements are transforming operations, while the explosive demand from data centers is forcing utilities to rethink their strategies.

Check out Dr. Vadari's perspective on this annual conference as he unpacks the key trends from DTech 2025, offering insights into how vendors, utilities, and consultants are adapting to an accelerated future.

Read the full article here.

M&A

AEP, FirstEnergy, Dominion joint development venture

PJM Interconnection has selected multiple electric transmission projects to be jointly developed by Dominion Energy, American Electric Power, and FirstEnergy through their newly formed Valley Link Transmission Company joint venture. The projects will span across Virginia, West Virginia, and Maryland. These infrastructure investments aim to address the region's growing power demands, enhance grid reliability, and support economic development. The projects are in early development stages, with detailed plans for permitting, regulatory approvals, and public participation expected in the coming months. Read more.

Constellation to acquire Calpine

Constellation Energy is acquiring Calpine Corporation in a $26.6 billion deal that will create one of the largest power companies in the United States. The merger is expected to help the companies provide cleaner energy to more customers. Constellation will pay $4.5 billion in cash and 50 million of its shares for Calpine and assume about $12.7 billion in Calpine debt. The combined company will have nearly 60 gigawatts of capacity from zero- and low-emission sources. Read more.

Arcadia acquires RPD Energy

Arcadia has acquired RPD Energy, enhancing its enterprise solutions, especially in the energy procurement advisory sector. This acquisition expands Arcadia's capabilities to integrate both onsite and offsite solar into energy strategies. With over 2GW of community solar capacity, Arcadia supports 2,500 organizations with clean energy contracts. The company now offers customized solutions tailored to individual meter loads and market conditions. Services include flexible supply agreements, community solar, direct renewable energy purchases, behind-the-meter solar and storage, and more. Read more.

Pexapark acquires RenewaFi

Pexapark, a provider of price data, market intelligence, and advisory services for renewable energy, has acquired RenewaFi, the platform for renewable energy and battery storage in ERCOT, the grid covering most of Texas. The deal marks Pexapark's entry into the US market, accelerating its mission to bring transparency to

the rapidly evolving global renewable energy market. Terms of the transaction were not disclosed. Read more.

ICF acquires Applied Energy Group

Applied Energy Group provides energy management consulting services to address the evolving needs of utilities, government bodies, and grid operators worldwide. The company, a subsidiary of Ameresco, was acquired by ICF International for an undisclosed amount. This transaction aligns with ICF's strategy to extend its capabilities in growth areas, specifically emphasizing its energy markets advisory and technology-enabled services. Read more.

Accenture acquires IQT Group

Accenture is acquiring IQT Group, an engineering managed services provider from Italy, to combine its AI and digital capabilities with IQT's expertise in net-zero infrastructure projects. IQT designs and supervises infrastructure projects for electricity, water networks, industrial efficiency, and telecom operators. Read more.

Nano Nuclear buys bankrupt nuclear startup

Nano Nuclear Energy is acquiring the assets, including the patented Micro Modular Reactor (MMR®) Energy System and Pylon Transportable Reactor Platform of Ultra Safe Nuclear Corp. (USNC) for $8 million after USNC declared bankruptcy. USNC had been working on demonstration reactor projects in Illinois and Canada and aimed to build the first operational advanced nuclear reactor in the U.S. Nano's acquisition comes at a time when companies like Meta, Google, and Amazon are investing heavily in advanced nuclear reactor startups to support their data centers. Read more.

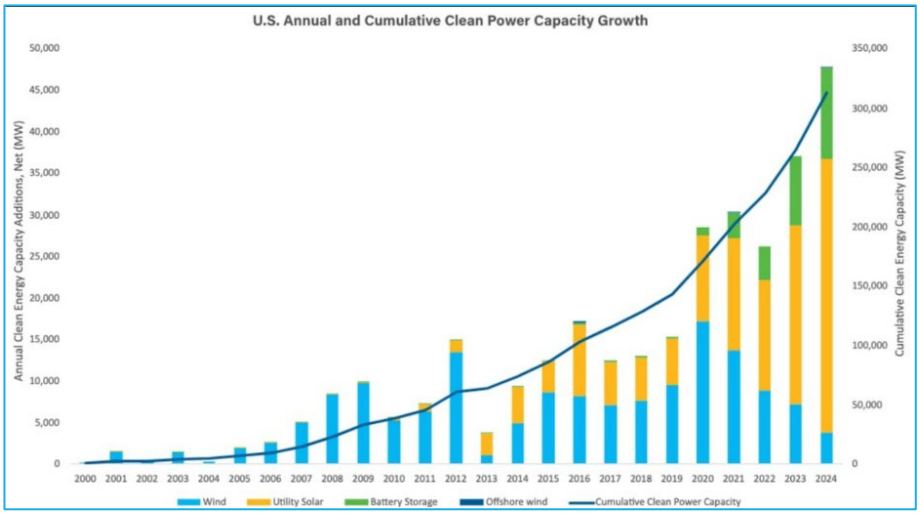
KEY HIGHLIGHTS

PJM approved a $6.7 B transmission expansion plan

On February 26, the PJM Board of Managers selected several electric transmission projects worth $5.9 billion to be developed by Dominion Energy, AEP, and FirstEnergy. These projects aim to enhance grid reliability in a constrained region of the United States. The companies will work together under the Valley Link Transmission Company joint venture. The plans were proposed through PJM's Regional Transmission Expansion Plan (RTEP) Open Window process in September 2024. PJM determined that the joint venture's projects best met the grid's reliability needs. Read more.

GSA awards historic electricity contract

The U.S. General Services Administration (GSA) announced a historic long-term purchase of electricity, including carbon pollution-free electricity from Constellation New Energy, Inc. This energy procurement is the largest in GSA history. GSA estimates it will comprise over 10 million megawatt-hours (MWhs) over the contract's ten-year term, providing electricity equivalent to powering over one million homes annually. Starting in April, the procurement will deliver electricity to 80 federal facilities in several mid-Atlantic and Midwest states and the District of Columbia. Read more.



World's first commercial fusion power plant

Commonwealth Fusion Systems (CFS) announced plans to build the world's first grid-scale commercial fusion power plant at the James River Industrial Park in Chesterfield County, Virginia. CFS has partnered with Dominion Energy Virginia for non-financial collaboration, including development and technical expertise and leasing rights for the site. Dominion Energy Virginia currently owns the site. CFS conducted a global search for the site of its first commercial fusion power plant, known as ARC, which the company will independently finance, build, own, and operate. Read more.

Helion plans for fusion power facility in Central WA

Speaking of fusion, Everett, WA-based nuclear fusion power company Helion announced it's looking to develop a 50-megawatt fusion power plant on land in Malaga, WA, owned by Chelan Public Utility District. Helion has a purchase agreement with Microsoft to provide 50 megawatts of power to the software company, which is building data centers in the valley. No agreement had been signed, but any use of PUD land for this project will likely include a lease for the land, said Rachel Hansen, Chelan PUD spokesperson. Read more.

The good news… 93% of new energy capacity that came online last year was solar, wind, and storage

The American Clean Power Association (ACP) released its 2024 Snapshot of Clean Power, a preview of the upcoming full Clean Power Annual Market Report. The data shows the clean energy industry shattered records in 2024, deploying an unprecedented 49 GW of capacity—a remarkable 33% increase over the previous record of 37 GW set in 2023. In addition, the U.S. installed nearly 50 gigawatts of new solar power capacity last year, representing a 21% increase from 2023, according to a new report from the Solar Energy Industries Association (SEIA) and Wood Mackenzie. That's a record and the largest annual increase in grid capacity from any energy technology in the U.S. in more than 20 years. Read more.

Now for the bad news… renewables growth falling short of 2030 goal

While the world added more renewables last year than ever before, we're still not on track to triple capacity by 2030. According to the International Renewable Energy Agency (IRENA), 585 gigawatts of renewable energy capacity were installed in 2024, marking the largest increase in renewable energy capacity to date. Renewables accounted for about 93% of all global power additions, with solar alone making up three-quarters of the installations. However, "current growth rates indicate that the world is not on track to triple installed renewable power capacity to 11 TW by 2030," said Francesco La Camera, IRENA's International Director General. Read the IRENA report here.

IRA tax credit repeal could drive up electricity prices, lead to power shortfalls, report says

The Clean Energy Buyers Association (CEBA) released a study by NERA Economic Consulting showing that repealing federal clean energy tax credits (§48E and §45Y) would raise U.S. residential electricity prices by nearly 7% by 2026, costing the average household over $110 more annually. American businesses would see a 10% increase in electricity bills, with costs likely passed on to consumers through higher prices for goods and services. Repealing the credits would also reduce grid capacity by 167 GW, critical for supporting industries like artificial intelligence and advanced manufacturing. Read more.

Alabama Power to build state's first utility-scale battery storage system on retired power plant site

A former coal-fired power plant in Alabama's Walker County is set to be transformed into a large battery storage facility. Construction on Alabama Power's Gorgas Battery Facility will start this year, with completion expected in 2027. It will house lithium-ion phosphate batteries with a two-hour duration capable of storing 150 megawatts of electricity, equivalent to the capacity needed to power about 9,000 homes. It will connect directly to the grid. This will be the state's first-ever utility-scale battery energy storage system. "This facility will help Alabama Power understand how we can best use battery systems on our electric grid so that customers have power when they need it," said Jeff Peoples, CEO of Alabama Power. The Gorgas coal-fired facility was retired in 2019. Read more.

America can recycle 90% of wind turbine mass, according to new DOE report

A new report from the U.S. Department of Energy (DOE) outlines recommendations for recycling and reusing decommissioned wind energy equipment and materials. The research reveals that existing U.S. infrastructure could process 90% of the mass of decommissioned wind turbines. However, the remaining 10% will need new strategies and innovative recycling methods. This research will help guide over $20 million in funding previously announced from the Infrastructure Investment and Jobs Act to advance technologies that address this gap. Read Part 1 of the report here (PDF).

TS Conductor announces new facility in South Carolina

TS Conductor announced it will open its second US manufacturing facility near the Port of Savannah in Hardeeville, South Carolina. Production is scheduled to begin by the end of 2025 to meet the growing demand for the company's advanced conductor technology, which enables utilities to double or triple their transmission capacity while reducing costs for customers. The three-phase project represents a total investment of $134 million and is expected to create approximately 462 advanced manufacturing jobs with above-average wages. Phase one is scheduled to begin operations by the end of 2025. Read more. Watch TS CEO Dr. Jason Huang's TED Talk here.

Energy sector gets a D+ on infrastructure report card

The energy sector received a "D+" in the American Society of Civil Engineers (ASCE) 2025 National Infrastructure Report Card, indicating urgent needs for modernizing aging systems and expanding transmission capacity to support the growth of renewable energy. Weather-related outages dominate disruptions, highlighting the need for resilience. While federal initiatives have spurred progress, substantial investment is crucial to ensure reliability as electrification grows. The overall report evaluates the state of U.S. infrastructure across 18 categories, assigning an overall grade of "C," the highest since the report's inception in 1998. This improvement reflects the positive impact of the Infrastructure Investment and Jobs Act (IIJA) of 2021, which provided significant funding for transportation, water, and energy systems. However, challenges remain. Read the executive summary here.

FEATURED ARTICLE

AI, GRID EDGE AND THE RACE FOR POWER: KEY TAKEAWAYS FROM DTECH 2025

By Mani Vadari, President, Modern Grid Solutions

The 2025 Distributech (DTech) conference was held in Dallas, Texas, from March 24-27, continuing its impressive growth. Attendance exceeded 20,000; the final numbers are still forthcoming, but the trend remains strong, with 15-20% growth across all categories. Booths ranged in size, with OATI once again hosting the largest, and a dedicated area showcasing promising startups.

Modern Grid Solutions maintained a strong presence, engaging with industry professionals and vendors, exploring new technologies, and fostering new relationships. The days were packed with breakfast meetings at 7 AM, followed by visits to vendor booths and discussions throughout the day, and networking events in the evenings. The Modern Grid Solutions team attended notable industry gatherings hosted by GE Vernova, Slalom, Accenture, and Aspen Tech.

The push toward platform-based solutions

Major vendors are shifting toward platform-based architectures, aiming to serve as the industry's central integration point. While booth presentations highlighted their latest technologies and brightest minds, distinguishing substance from marketing hype remains a challenge.

Common characteristics of platform-based solutions included:

- Modular systems and component designs for greater flexibility
- Cloud readiness, allowing deployment in the cloud or on-premises
- Scalability, ensuring solutions can accommodate utilities of various sizes without compromising cost or performance
- Standards-based integration, enabling compatibility with third-party components
- Lower deployment costs and total costs of ownership through standardization and modularity.

The landscape continues to be dynamic, with the accelerated innovation reflecting vendors' race to keep pace with the rapidly evolving needs of both existing and new customers.

Artificial Intelligence (AI) & Machine Learning (ML) everywhere

The AI/ML/Generative AI bug has firmly entered the utility industry, sparking discussions across vendors, utilities and consulting firms. Utilities are trying to figure out how to use these new tools to address existing and emerging problems. Vendors are trying to determine how to incorporate these newer techniques into their toolsets. Lastly, consulting companies are trying to figure out how to stay relevant in this new age by helping educate their clients on the benefits of these new mechanisms. Key observations:

- The hype cycle ranges from the absurd (AI will replace OMS) to complete skepticism (AI has no role in the utility industry).
- A pragmatic approach has emerged, with vendors embedding AI/ML to augment their tools either by creating point enhancements or setting the problem definition in order to solve a tightly defined problem.
- Customer experience improvements, leveraging AI/ML techniques already widely used in other industries, are gaining traction.

The bottom line: AI/ML adoption is inevitable but will evolve gradually, starting with non-critical applications before progressing to mission-critical systems. Initially AI will provide directional insights rather than precise solutions

Drones and robotics: Beyond the hype

Numerous exhibitors showcased innovations centered on drones and/or robotic solutions, emphasizing task over technology to address utility challenges:

- Fly-over transmission line inspections for infrastructure health.
- Fly-over transmission and distribution line vegetation assessments for wildfire risk mitigation.
- Walk-around (robots) or fly-around (drones) perform substation surveys, mapping components and their nameplate information to enable improvements in the information collected and recorded in GIS and related databases.
- Fly-over post-storm damage assessment, delivering fast, actionable insights. Cost-efficient labor solutions, integrating a broad range of sensors (visual, thermal, etc.) in a single inspection, enabling frequent inspections.

Rather than re-inventing technology, vendors are adapting solutions from other industries – such as advanced image processing and AI-driven diagnostics – to serve the unique needs of utilities.

Grid edge and distributed energy growth

The grid-edge revolution is in full swing with the creation of both centralized and distributed architectures (supported by products and vendors). Key priorities include:

- Enhanced visibility and control at the edge
- Optimized energy consumption at the edge
- Seamless integration of distributed and centralized architectures
- Localized optimization for microgrids and VPPs (virtual power plants)

The industry's collective recognition of grid-edge evolution is driving a renewed focus from meter vendors, control system vendors, microgrid/VPP vendors, and new innovative startups.

Data centers: A new kind of power consumer

With AI advancements accelerating, data center expansion is triggering massive energy demand, presenting unique challenges:

- Major tech companies such as Microsoft, Google, and Amazon require large quantities of power, but are less sensitive to cost.
- These companies demand immediate energy availability and are willing to explore non-traditional sourcing methods.
- Some opt for off-grid solutions, purchasing power independently.

This urgent need is forcing utilities, vendors, and consulting companies to rapidly develop new solutions catering to an entirely different customer profile than traditional customers.

Key companies that caught our attention

Carbonix: Carbonix delivers an all-electric fixed-wing VTOL Power Lift drone capable of executing rapid aerial surveys across vast and difficult terrain whilst maintaining high accuracy and even higher confidence. They come equipped with a choice of payload sensors to suit different industries and applications. Additionally, they offer a high-end LiDAR solution for topographic mapping, particularly in areas where vegetation canopy cover can reduce visibility.

inGeniti: inGeniti intends to create, globally deploy, and support innovative new optimization solutions to resolve key electricity and water issues. Their solutions will work for any electricity usage device, anywhere – even without data networks - for all electricity grids, for all consumers and utilities in residential, commercial, industrial, and agricultural sectors, and for the watering of all types of agricultural crops, anywhere. Their solutions are already available or will be launched shortly.

Lindsey Systems: In an age when companies that started a few years ago are now worth billions of dollars, it was very refreshing to stop by and learn from Lindsey Systems, which for over 75 years has been providing thoughtful solutions to the electric power industry. Their products include hybrid systems that combine specialty sensors with analytic, web-based software. In addition, their sensors are high-accuracy distribution class current and voltage sensors integral to many utilities' "Smart Grid" implementations.

VTScada by Trihedral: VTScada is an award-winning all-in-one HMI and SCADA software platform for industrial applications of any size. With industry-leading features like integrated version control, real-time configuration, and bi-directional synchronization, their unique approach to software and service has resulted in growth in sales, installations, and new customers every year for the last 37 years. Their industries of focus include Water/Wastewater, Power Generation, Manufacturing, Agriculture, Oil & Gas, Airport Systems, Food & Beverage, Tank Farm Monitoring, Broadcasting, Marine, Flood Control, Power Transmission and Power Distribution.

Final thoughts

The Electric Power System industry continues its juggernaut drive through a dynamic and fast-changing landscape, shaped by ongoing advances in platform-based solutions, AI/ML integration, automation technologies, grid-edge innovations and surging energy demands from data centers. The mix of domestic and international participation in all dimensions, attendees, and vendors, made it clear that the movement represents a train with a full head of steam towards a future that promises rapid transformation, fueled by the convergence of technology, adaptability and dramatic market shifts. DTech 2025 and its continued increase in attendees, exhibitors, and display of vendor innovations has made it the industry's must-attend event even for international attendees.

FEATURED ARTICLE

REVAMPING T&D UTILITIES: THE ERA OF RENEWABLE-AWARE OPERATIONS

By Dr. Mani Vadari

This abridged article is the first in a comprehensive series on the transition to renewable-aware operations (RAO) within the energy sector. It delves into renewable energy sources like solar, wind, and green hydrogen, highlighting their impact on the grid and the challenges of integrating them. The subsequent articles will shift focus to the crucial role of grid operators, the importance of real-time monitoring and control, key capabilities necessary for RAO, infrastructure upgrades, grid operations software, training, regulatory considerations, vendor responsibilities, and case studies of successful implementations, community engagement, and addressing diversity and equity in grid modernization.

PART ONE
Renewable Energy and its Impact on the Grid

Introduction to Renewable Energy Resources

Renewable energy resources, such as solar (PV, CSP), wind, green hydrogen, and storage, have the potential to lower costs, improve reliability, reduce emissions, and expand energy options. Known as Inverter-Based Resources (IBR) and Variable Energy Resources (VER), these resources can vary in size from small installations like rooftop solar panels to large solar farms and wind farms. Smaller installations connect directly to the distribution system, while larger ones connect to the transmission network, helping efficiently manage and distribute renewable energy.

Fuel cells produce electricity using oxygen and hydrogen, with water and heat as by-products. They offer clean energy with high efficiency and versatility for various applications but can be expensive and pose production, storage, and transportation challenges. When using hydrogen from renewable sources, fuel cells can produce clean energy with low pollution.

Solar power is a popular Distributed Energy Resource (DER) with installations at residential, commercial, and grid-scale levels. Photovoltaic (PV) cells convert sunlight directly into electricity, while concentrated solar power (CSP) uses mirrors or lenses to focus sunlight into heat. Solar power offers clean energy but produces intermittently and requires large land areas. Environmental impacts include land use, habitat loss, and hazardous materials in manufacturing.

Wind turbines convert mechanical energy from wind to electrical energy and can range in size from a few kilowatts to over 15-20 MW for commercial applications. Wind energy has no greenhouse gas emissions and is a mature technology. However, it requires site permitting, produces intermittent energy, and needs a large footprint. Environmental impacts include land use issues, challenges to wildlife, noise pollution, and visual impacts.

Electric Energy Storage (EES) technologies store previously generated electric energy and release it later, enhancing grid stability and integrating renewable energy sources. Popular technologies include Lithium-Ion (Li-On) batteries. EES provides grid stability, balances supply and demand, and offers backup power during outages, but it has high costs, limited energy capacity, and reliance on rare materials. Environmental impacts include mining-related degradation, water contamination, and risks from improper disposal.

Demand Response (DR) is a strategy to manage and reduce energy consumption during peak periods by adjusting electricity demand. It helps balance supply and demand, enhances grid stability, and reduces the need for additional power plants. DR offers cost savings, grid reliability, and flexibility but requires active participation from consumers and relies on advanced metering infrastructure.

Hybrid systems combine technologies to improve performance and efficiency and reduce weather variability. Solar and wind farms often couple with onsite storage to store excess energy. Hybrid systems enhance efficiency, provide a consistent energy supply, and reduce reliance on the grid, but they involve high initial costs and complexity. Environmental impacts include reduced greenhouse gas emissions and resource extraction for storage components.

Hydrogen, the simplest and most abundant element, can be produced from natural gas, water, and biomass. It provides clean energy in fuel cells but is expensive and energy-intensive to produce, store, and transport. Environmental impacts include significant degradation from non-renewable hydrogen production.

Key Characteristics of Renewable Energy

Renewable energy sources like solar and wind are small, modular, and geographically dispersed, with solar panels ranging from 250 to 400 watts and wind turbines from a few kW to 15-20 MW. They generate less pollution and have variable output depending on sunshine and wind availability. Most renewable energy sources generate direct current (DC) and require conversion to alternating current (AC) for grid integration. They can be configured as stand-alone or grid-tied systems and have different ownership models, including utility-owned, consumer-owned, or developer/private-owned.

Challenges Posed by Integrating Renewables into the Grid

Renewable energy sources present challenges for utilities, such as high installation costs, advancing but immature technologies, and supply volatility impacting grid stability. Increased customer control over generation sources requires new interconnection and safety requirements. The interconnection backlog, integration into existing infrastructure, and need for enhanced support further complicate the process. Utilities must ensure safety, comply with regulatory requirements, and adapt to customers becoming suppliers, creating reliability issues with bidirectional power flow.

Customers face challenges integrating renewable energy into the grid, including potential grid overloads, interconnection delays, cost fluctuations, and disruptions from extreme weather events. Renewables change the utility-customer relationship, introducing business and technical challenges. Innovative solutions and regulatory changes are required to ensure a smooth transition to renewable energy.

Summary

This article condenses the full eBook chapter, focusing on the impact of solar, wind, and green hydrogen on the grid while highlighting the benefits and challenges of technologies such as fuel cells, solar power, wind turbines, electric energy storage, and demand response. The chapter emphasizes the complexities of integrating these sources into the grid by examining key characteristics of renewable energy, such as its small, modular nature, variable output, and DC generation. Both utilities and customers face significant challenges during this transition, requiring innovative solutions and regulatory changes for smooth and efficient integration. Reflecting on these insights, a coordinated effort is essential for navigating the renewable-aware era.

Stay tuned for the next article in this series and the complete eBook!

DID YOU KNOW...

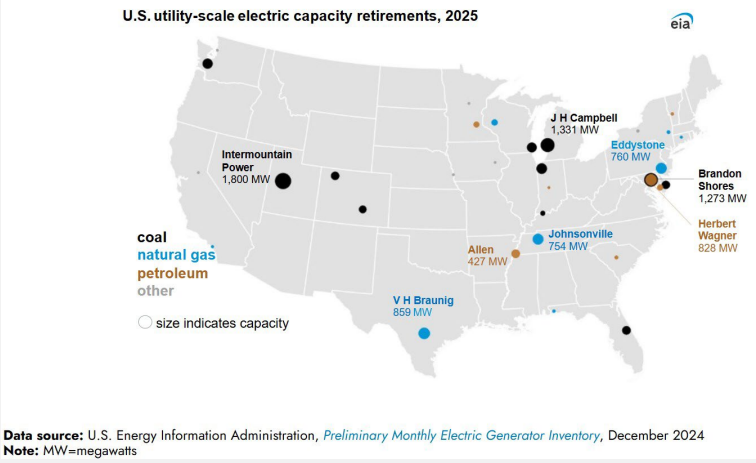
U.S. electricity generators plan to retire 12.3 GW of capacity in 2025?

Per the Energy Information Administration, in 2025, U.S. electricity generators plan to shut down 12.3 gigawatts (GW) of capacity, which is 65% more than the amount retired in 2024. Last year, 7.5 GW was taken offline, the lowest amount since 2011. Most planned retirements for 2025 are coal-powered plants (66%), followed by natural gas (21%).

Coal: Electric companies plan to retire 8.1 GW of coal power, which is about 4.7% of all coal plants in the U.S. The biggest coal plant set to close is the Intermountain Power Project in Utah, which has 1,800 megawatts (MW) of capacity. Two other large coal plants closing are J H Campbell in Michigan and Brandon Shores in Maryland.

Natural Gas: This year, 2.6 GW of natural gas plants are scheduled to retire, which is about 0.5% of the total natural gas fleet. Most of these are older, less efficient single-turbine plants. The largest retirements will come from plants in Texas and Pennsylvania, with 16 older turbines in Tennessee also retiring and being replaced by newer, more efficient ones.

Petroleum: About 1.6 GW of petroleum-fired plants are set to retire. The biggest closure will be at the Herbert A Wagner plant in Maryland, followed by the Allen plant in Tennessee.



Several factors are driving the retirement of U.S. generating plants in 2025:

- **Environmental Regulations**: Stricter environmental regulations make operating older, polluting plants more costly, pushing companies to retire them and invest in cleaner energy sources.
- **Economic Factors**: The cost of maintaining and operating older plants, especially coal-fired ones, is high. Many of these plants are less efficient and more expensive than newer, cleaner technologies.
- **Shift to Renewables**: There is a growing shift towards renewable energy sources like wind and solar, which are becoming more cost-effective and environmentally friendly. Policy incentives and technological advancements support this shift.
- **Grid Reliability**: As more renewable energy sources are integrated into the grid, there is a need for flexible and reliable backup power. This has led to the retirement of older, less efficient plants and the adoption of newer, more efficient technologies.
- **Market Dynamics**: The energy market is evolving, with increased demand for electricity from sectors like AI and cryptocurrency data centers. This demand is driving the need for more efficient and reliable power sources.

Overall, the retirement of older fossil fuel plants and the rise of renewable energy sources are part of a broader trend towards a cleaner and more sustainable energy future.

WHAT'S ON MANI'S MIND?

Energy Storage: Advancements for the Modern Power Grid

Energy storage has emerged as a critical component of the modern power grid, playing a pivotal role in enhancing grid stability, resilience, and the integration of renewable energy sources. As the world transitions to cleaner energy solutions, the need for reliable and efficient short- and long-duration energy storage systems has never been greater. These technologies enable us to store energy generated from renewable sources like solar and wind and release it when needed or when market conditions are optimum. This ensures a consistent and reliable power resource that is dispatchable, thereby increasing the value it provides the grid operator.

Advancements in Battery Technologies

Lithium-Ion Batteries: Lithium-ion (Li-ion) batteries have become the gold standard in energy storage due to their high energy density, fast charging capabilities, and declining costs. Innovations are looking at replacing traditional lithium-cobalt electrodes with lighter, energy-dense materials like lithium-polymer, lithium-air, lithium-titanate, and lithium-sulfur; these batteries are becoming more efficient.

Solid-State Batteries: Solid-state batteries hold promise for higher energy densities and improved safety compared to traditional lithium-ion batteries. By replacing the flammable liquid electrolyte with a solid compound, these batteries enhance ion migration and address challenges like low charge retention and operational inefficiencies in extreme temperatures. Solid-state batteries also support high-voltage, high-capacity materials, enabling greater energy density, portability, and shelf life. Their power-to-weight ratio makes them ideal for electric vehicles.

Flow Batteries: Flow batteries, such as vanadium redox flow batteries, offer long-duration energy storage suitable for large-scale applications. Redox flow batteries have longer lifespans than lithium batteries as the current flow does not degrade the membrane. They are easily scalable and offer great potential for utility-scale renewable energy integration. Advances in redox chemistries focus on cost-effectiveness and greater energy density.

Iron-Air and Zinc-Based Batteries: Emerging technologies like iron-air and zinc-based batteries offer long-duration storage and are being tested for grid applications. Indian startup Offgrid Energy Labs, for example, has developed ZincGel, a proprietary battery technology using a highly conductive zinc electrolyte and carbon-based cathode. This zinc electrolyte is self-healing, temperature-stable, and does not evaporate, ensuring a longer life. It also offers high coulombic and round-trip efficiency, making it a safe, eco-friendly, and non-flammable alternative to lithium-ion batteries.

Gravity Storage

Gravity storage technology harnesses gravitational force to store energy by lifting heavy weights during times of surplus energy production and releasing them to generate electricity when needed. Unlike traditional battery storage, gravity storage systems have minimal environmental impact, high energy capacity, and long lifespans.

Novel solutions utilize existing infrastructure, such as disused mines and oil wells. One of the latest advancements in gravity storage technology involves using composite blocks made from soil and waste materials. This original approach not only stores energy by lifting and lowering these blocks but also helps with waste management.

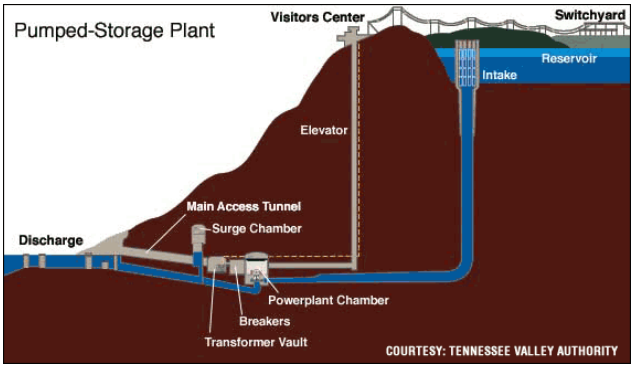
Pumped Hydro Storage

Pumped hydro storage uses excess electricity to pump water uphill, storing potential energy. This water is then released to generate electricity during peak demand times.

Innovations in pumped hydro storage include submersible pump turbines and motor generators, utilizing abandoned mines or open-pit mines as reservoirs, closed-loop systems that don't rely on natural water sources, hybrid systems combining pumped hydro with other energy storage technologies like batteries, variable speed turbines for increased efficiency, and advancements in underground excavation techniques using tunnel boring machines to access suitable sites that were previously inaccessible.

Energy Storage as a Service

Energy Storage as a Service (ESaaS) is a business model that allows organizations to benefit from energy storage systems without purchasing or maintaining the equipment themselves. Instead, they enter into a service agreement with a provider who owns, operates, and maintains the energy storage system. The customer pays a subscription or usage-based fee for the energy storage services, which can include storing excess energy, managing energy consumption, and providing backup power. AI-based



platforms are optimizing storage management, making reliable power accessible with zero asset investment.

Conclusion

Advancements in energy storage technologies are altering the power grid, enabling greater integration of renewable energy sources, enhancing grid stability, and contributing to a sustainable future. Continued innovation and investment in these technologies are essential for building a resilient and modernized power grid. As we move towards a cleaner energy future, energy storage will play a pivotal role in ensuring reliable and efficient power delivery, benefiting both the environment and the economy.

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, allowing them to 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 on-going projects include:

• **Canadian Municipal Utility Transformation**	• **Northwest Utility Planning Transformation**
• Multi-OpCo Distribution Transformation	• **Energy Service Provider Assistance**
• 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 US and beyond. Major utilities also favor them.

- ***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, Gerry Stokes, and John (JD) Hammerly.
- ***Enhancing OMS Implementation Success Rates*** Our online book and e-book 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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