



**WELCOME TO OUR
Q4 2023 NEWSLETTER!**

Welcome to the Modern Grid Solutions Q4 2023 newsletter, where we curate and share some of the latest insights and trends on the design and operation of a modern electric grid.

We hope you enjoy reading our newsletter and find it helpful for your grid modernization journey. If you have any questions or feedback, don't hesitate to [contact us](#).

Thank you for subscribing to the Modern Grid Solutions newsletter!

Thank you for reading!
Dr. Mani Vadari, President

AT MODERN GRID SOLUTIONS, SMART GRIDS ARE BUSINESS AS USUAL
Differentiated services to utilities and their vendors focusing on Smart Grid and System Operations. Our team brings deep expertise in all aspects covering technology and management consulting.



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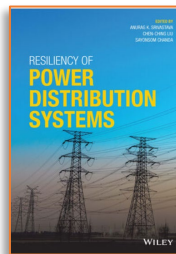
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HOT OFF THE PRESS!

Resilience of Power Distribution Systems

Dr. Mani Vadari, John (JD) Hammerly, and Gerry Stokes co-wrote the last chapter of this new book – [Resilience of Power Distribution Systems](#) - edited by Anurag K. Srivastava, Chen-Ching Liu, and Sayansom Chanda and published by Wiley. The title of the chapter is, "Technology and Policy Requirements to Deliver Resiliency to Power System Networks."



INDUSTRY EVENTS

Upcoming events

CONFERENCE & EXHIBITION: [Distributech International 2024](#)

February 26-29, 2024 in Orlando, Florida

- Once again, the MGS team (Dr. Mani Vadari, John (JD) Hammerly, and Susan Christensen Wimer) will be at Distributech in Orlando. They are looking forward to meeting some/all of you there. If you need to schedule a meeting, please reach out to <mailto:mani.vadari@moderngridsolutions.com>.

- Before the exhibition opening, Dr. Vadari is presenting a "Utility University" course on Monday, February 26, from 8am-12pm PST in Room W204A in the Orange County Convention Center. The course #UU204 is titled "A Primer on Energy Transition to Net Zero – the Opportunity and Challenges." Other instructors include Glenn Pritchard, Mark Carpenter, and Anant Venkateswaran.

CONFERENCE: [IEEE PES General Meeting 2024](#)

July 21-25, 2024 in Seattle, Washington

Dr. Vadari has joined the IEEE Power and Energy Society (PES) 2024 Plenary Committee. He will be involved in reviewing and selecting papers for the Super Sessions. The 2024 General Meeting theme is "The new electric system: reinvention and resilience."

CONFERENCE: [ESIG Spring Technical Workshop](#)

March 25-28, 2024

The 2024 Spring Technical Workshop will be held at the Loews Ventana Canyon Resort in Tucson, Arizona. The workshop will include a focus on a number of key areas, including Resource Adequacy, GFM, IBR, Flexibility, Transmission, EVs, among others.



MERGERS AND ACQUISITIONS

Iberdrola's Avangrid pulls out of PNM Resources acquisition

Iberdrola's U.S. unit Avangrid Inc. has terminated its planned \$8.3 billion acquisition of rival PNM Resources because it could not get all the necessary regulatory approvals to close the deal by Dec. 31, 2023. The deal, worth \$4.3 billion excluding debt, was unanimously approved by PNM's board in 2020 and was expected to create a renewable energy operator with a combined market value topping \$20 billion. The two utility companies had obtained all necessary approvals by the end of December except that of the New Mexico Public Regulation Commission, Avangrid said in a statement. The regulator had rejected Avangrid's proposed acquisition of PNM Resources in 2021, saying the deal's risks outweighed its promised benefits to state ratepayers. Read more [here](#).

Pattern Energy Closes \$11 Billion Financing of Largest Clean Energy Infrastructure Project in U.S. History

Pattern Energy Group LP (Pattern Energy), a renewable energy and transmission infrastructure developer, has closed an \$11 billion non-recourse financing and begun full construction of SunZia Transmission and SunZia Wind, which together is the largest clean energy infrastructure project in U.S. history. SunZia Transmission is a 550-mile ±525 kV high-voltage direct current (HVDC) transmission line between central New Mexico and south-central Arizona with the capacity to transport 3,000 MW of clean, reliable, and affordable electricity across Western states. SunZia Transmission will deliver clean power generated by Pattern Energy's 3,515 MW SunZia Wind facility, the largest wind project in the Western Hemisphere, which is being constructed across Torrance, Lincoln, and San Miguel Counties in New Mexico. Read more [here](#).

Altus Power

Altus Power, an independent developer, owner, and operator of commercial-scale solar facilities, announced two acquisitions in December that expand the company's footprint in the west and southeast U.S., the company said. Altus Power, a clean electric energy technology company that went public with an initial public offering in 2021, said that it had purchased both Unico Solar Investors and Project Hyperion LLC, two companies operating in the clean energy sector. In the Unico Solar deal, Altus Power has acquired the company's two offices in Denver, Colorado and Seattle, Washington, in addition to the company's solar development platform. The leadership team at Unico Solar will join Altus Power, the company said. In the other deal, Altus Power acquired 121 megawatts of solar assets from Project Hyperion. Those solar arrays are primarily located in North Carolina and South Carolina, the company said. Read more [here](#).

Total acquires several start-ups in the electricity business

France-based energy giant TotalEnergies announced a series of acquisitions of startups aimed at accelerating the development of its electricity business, and supporting its ambition to achieve net zero by 2050. Each of the companies participated in TotalEnergies' On accelerator program, aimed at supporting the development of new companies in the electricity and renewable energy sector, and targeting companies that offer solutions across the electricity value chain, with a particular focus on digital solutions. The acquisitions include energy portfolio management SaaS platform Dsflow, renewable project optimization software platform provides NASH Renewables and AI-driven predictive analytics company Predictive Layer. Read more [here](#).

Blackstone acquires Power Grid Components, Inc.

Blackstone announced that private equity funds affiliated with Blackstone have closed the acquisition of Power Grid Components, Inc. ("PGC") from Shorehill Capital LLC. PGC is a leading domestic designer and manufacturer of a wide range of critical components for protection, monitoring, and safety applications in electrical substations, an essential segment of the electrical grid responsible for managing and monitoring power flows and converting electricity into different voltages. As a supplier of critical components to the grid and partner to many of the nation's largest electrical utilities, PGC advances the global energy transition by improving the reliability, capacity, and safety of the grid, by enabling the deployment of new renewable generation, and by supporting broad electrification trends. PGC was founded in 2017 by CEO Rick McClure and Shorehill Capital LLC. Mr. McClure and the other senior leaders will remain with the business in their current positions following the transaction. Read more [here](#).

NiSource sells 19.9% stake in NIPSCO to fund renewable energy

NiSource has completed sale of a 19.9% stake in its NIPSCO utility for \$2.16 billion as it looks to invest more in wind and solar. Based in Merrillville, IN, NIPSCO, one of the largest publicly traded utility companies in the country, sold a minority stake in the electric and gas utility to Blackstone Infrastructure Partners. Blackstone pledged an additional \$250 million in equity to fund capital needs. The company said it would use the proceeds to invest in a transition from coal-fired electricity to renewable energy as it aims to go from 75% coal generation in 2018 to completely coal-free generation by 2028. Read more [here](#).



Uplight to acquire AutoGrid

Uplight, the technology partner to energy providers transitioning to a decarbonized future, announced an agreement to acquire AutoGrid, a Virtual Power Plant (VPP) and Distributed Energy Resource Management System (DERMS) provider, fundamentally expanding its partners, programs, and ability to create and manage flexible capacity for energy grids around the globe. The combined capabilities of Uplight and AutoGrid will provide utilities and new energy players with a single platform to integrate, orchestrate, and monetize distributed energy resources (DERs). As decarbonization and electrification rapidly change the needs of the energy ecosystem, reliable load flexibility has become essential to managing the grid. Until now, utilities and energy companies have not had a single, unified platform to create grid-scale flexible capacity. According to Uplight, this acquisition solves for that, delivering more residential and business customer participation, more grid-connected devices, and new energy flexibility options to utilities and other players across today's dynamic energy value chain. Read more [here](#).

Yes Energy acquires Anchor Power Solutions

Yes Energy, a leader in North American power market data, announced the acquisition of Anchor Power Solutions, provider of EnCompass, a highly flexible software model for power market forecasting and resource planning covering complex North American power markets. Founded in 2014, Anchor Power's software helps power companies produce market price forecasts and make optimal power supply decisions to navigate changes to the power grid. The EnCompass model evaluates new technologies comprehensively supporting decarbonization and sustainability while factoring in multilayered reliability, regulatory, and policy requirements. Read more [here](#).



KEY HIGHLIGHTS

EU built record 17GW of new wind energy in 2023

According to WindEurope data, the EU built 17 GW of new wind farms in 2023: 14 GW onshore; 3 GW offshore. These numbers are slightly up on 2022 and are the most the EU has ever built in a single year. But it's well below the 30 GW a year that the EU needs to build to meet its new 2030 climate and energy security targets. Germany built the most new wind capacity followed by the Netherlands and Sweden. The Netherlands built the most new offshore wind, including the 1.5 GW "Hollandse Kust Zuid" – for now the world's largest wind farm. Read more [here](#).

NERC alarming winter blackout forecast

According to the North American Reliability Corp (NERC), as much as two-thirds of the United States is at risk of power outages during the coldest months of the year. This forecast is not a new or isolated alarm, but part of a consistent pattern. NERC had also expressed a similar worry for the summer, blaming the extreme heat as a main factor. The frequent occurrence of these alerts reveals a rising trend of fragility in the U.S. power grid, a vital infrastructure that millions rely on every day. Read more [here](#).

World added 50% more renewable capacity in 2023 than in 2022

The world's capacity to generate renewable electricity is expanding faster than at any time in the last three decades, giving it a real chance of achieving the goal of tripling global capacity by 2030 that governments set at the COP28 climate change conference last month, the [IEA says in a new report](#). The amount of renewable energy capacity added to energy systems around the world grew by 50% in 2023, reaching almost 510 gigawatts (GW), with solar PV accounting for three-quarters of additions worldwide, according to Renewables 2023, the latest edition of the IEA's annual market report on the sector. The largest growth took place in China, which commissioned as much solar PV in 2023 as the entire world did in 2022, while China's wind power additions rose by 66% year-on-year. The increases in renewable energy capacity in Europe, the United States and Brazil also hit all-time highs.

NREL's Standard Scenarios includes 53 possible futures for how the U.S. electricity sector could evolve through 2050

The National Renewable Energy Laboratory (NREL) released its 2023 Standard Scenarios, which shows how the U.S. electricity sector might change through 2050. The scenarios can guide power system planning and enable dialogue using a common set of assumptions. The Standard Scenarios is one of several annually updated NREL products designed to support decision-makers in the U.S. electricity sector. Every year, NREL uses its Regional Energy Deployment System (ReEDS) model to create the new scenarios, considering the latest projections for technology costs and performance from NREL's Annual Technology Baseline. Now in its ninth installment, the Standard Scenarios includes 53 possible futures that are available to view or download from NREL's Scenario Viewer. "The goal of the Standard Scenarios is to give an annually updated picture of where the U.S. electric grid may be headed," said Pieter Gagnon, NREL grid researcher and lead author of the Standard Scenarios. "The report and accompanying data sets give users an understanding of what might get built, what associated greenhouse gas emissions may be, and how much it might all cost—across a wide range of possible futures." Read more [here](#).

National Grid announces operations of longest land and subsea interconnector

The £1.7 billion project is a joint venture between National Grid and Danish System Operator Energinet and has the capacity to transport enough electricity for up to 2.5 million* UK homes, bringing over £500 million of cumulative savings for UK consumers over the next decade* due to cheaper imported power from Denmark. Construction on Viking Link, National Grid's sixth interconnector, started in 2019, with more than four million working hours spent to get to this point. Viking Link will bring huge benefits for UK consumers including cheaper, lower carbon power and increased energy security as the UK can call on additional power from Denmark when needed. Read more [here](#).

Duke Energy Renewables business rebrands as Deriva Energy

Deriva is the new name for Duke Energy's unregulated commercial renewables business, which was acquired by Brookfield in a transaction announced on June 12, 2023, and completed on October 25, 2023.

Chris Fallon, President of Deriva Energy, said: "Today is a significant milestone for our business and opens an exciting new chapter in our history. We are now an independent developer, owner, and operator of clean energy projects, with the backing of Brookfield, one of the world's largest owners and operators of renewable power. As part of Brookfield, we have access to capital for growth and a wealth of operating expertise, which will enable us to continue our leadership in clean energy for many years to come."

Brookfield is one of the world's largest owners and operators of renewable power plants, with approximately 90,000 megawatts of combined operating and pipeline capacity across all major U.S. power grids. Read more [here](#).

First US HVDC connection between three electricity markets

ALLETE, Inc. and North Plains Connector LLC, a subsidiary of Grid United LLC, signed development agreements for the North Plains Connector project, a new, approximately 400-mile high-voltage direct-current (HVDC) transmission line from central North Dakota to Colstrip, Montana. The North Plains Connector will be the nation's first HVDC transmission connection between three regional U.S. electric energy markets—the Midcontinent Independent System Operator, the Western Interconnection and the Southwest Power Pool. Open to all sources of electric generation, the project will create 3,000 megawatts of transfer capacity across all three energy markets, easing congestion on the transmission system, increasing resiliency and reliability, and enabling fast sharing of energy resources across a vast area with diverse weather patterns. Read more [here](#).

New meter designed to enhance distribution system management for utilities

Xylem unveiled a new residential electric meter with advanced grid edge capabilities. The Sensus Stratus IQ+ enables enhanced utility distribution system management and improved customer engagement as utilities prepare for EV charging growth, the company said. The Stratus IQ+ meter monitors energy consumption in near-real time, and advanced functionalities allow for data to be recorded, transmitted and received with only a keystroke. This smart meter provides commercial and industrial (C&I) strength capabilities in a residential meter, resulting in improved communication and faster delivery of more data. Read more [here](#).



World's longest land and subsea interconnector powers up

The world's longest land and subsea interconnector started commercial operations on 29 December 2023. National Grid's new Viking Link electricity interconnector became operational transporting power between the UK and Denmark. The link has a capacity of 1.4 GW and stretches for 475 miles under land and sea to join Bicker Fen substation in Lincolnshire with Revsing substation in southern Jutland, Denmark. The £1.7 billion project is a joint venture between National Grid and Danish System Operator Energinet and has the capacity to transport enough electricity for up to 2.5 million UK homes, bringing over £500 million of cumulative savings for UK consumers over the next decade due to cheaper imported power from Denmark. Construction on Viking Link, National Grid's sixth interconnector, started in 2019, with more than four million working hours spent to get to this point. Read more [here](#).

Energy tech giant Kraken named winner of Platt's Grid Edge Award

Kraken, the end-to-end platform for future energy, was named winner of the Grid Edge Award at the 25th Annual Platts Global Energy Awards. S&P Global Commodity Insights honored industry excellence in 21 performance categories and winners from nearly a dozen countries at the Platts Global Energy Awards gala. The Awards program, now in its 25th year and often described as the "Oscars of the energy industry," recognizes corporate and individual innovation, leadership, and performance in the energy and petrochemical sectors dedicated to achieving excellence. With its all-in-one, smart operating system, Kraken offers utility users the power to manage distributed energy resources, operate virtual power plants, and intelligently optimize entire networks on a single platform. Kraken streamlines all aspects of the grid – from generation to supply, CIS billing, meter data management, customer service, optimization and asset management. Read more [here](#).

Global smart grid market to reach \$173B by 2030

The global market for Smart Grid estimated at US\$49.8 Billion in the year 2022, is projected to reach a revised size of US\$173 Billion by 2030, growing at a CAGR of 16.8% over the analysis period 2022-2030. Software, one of the segments analyzed in the report, is projected to record 18.4% CAGR and reach US\$80 Billion by the end of the analysis period. Growth in the Hardware segment is estimated at 14.8% CAGR for the next 8-year period. A new report offered by Research and Markets assesses the competitive market presence, categorizing players worldwide as strong, active, niche, or trivial in 2023. It explores advancements in the energy sector, leading to the development of smart grid solutions. Read more [here](#).

Top ten global large-scale solar PV developers announced

Mercom Capital Group (Mercom), a clean energy communications and research firm, has released its Annual Global Report announcing the ten leading global large-scale solar PV developers. The report, which includes data from July 2022 to June 2023, used set criteria to compile the rankings and ranked developers with projects in at least two countries. Other key criteria included the operational capacity of a project, projects under construction, and projects with awarded PPA contracts. Large-scale projects with 1 MW or more were considered. With a total capacity of 41.3 GW, France-based TotalEnergies emerged as the top solar PV developer in the world based on its operational, under-construction, and awarded (PPA-contracted) projects. Adani Green Energy, an India-based renewable energy developer, ranked second with 18.1 GW, followed by Canada-based Brookfield Renewable Partners with 18 GW. Read more [here](#).

PNNL creates Center for Artificial Intelligence

The Department of Energy's Pacific Northwest National Laboratory has created the Center for AI @PNNL to coordinate the pioneering research of hundreds of scientists working on a range of projects focused on science, security and energy resilience. Researchers at PNNL were among the first to dive into artificial intelligence decades ago. But AI has surged in the past year with the ready availability of generative AI, which allows almost anyone to produce sophisticated—though sometimes errant—text and images with just a small amount of data. At the same time, AI is a vital tool for serious researchers as well as a subject all its own for scientists to create, explore and validate new ideas. AI also presents an exciting opportunity for PNNL scientists to advance a critical area of science and chart the path forward. Read more [here](#).

ComEd named most reliable electric utility in America

In recognition of ComEd's successful efforts to provide industry- and nation-leading reliability for the more than 9 million people it serves in northern Illinois, PA Consulting yesterday awarded the electric company the 2023 ReliabilityOne® Outstanding System Reliability Award, as well as the 2023 ReliabilityOne® Award for Outstanding Reliability Performance in the Midwest Region. All utilities operating electric delivery networks in North America are eligible for consideration for the ReliabilityOne® award. PA Consulting selects eight metropolitan service regional awards including Northeast, Mid-Atlantic, Midwest, Plains, Mountains, West, Southeast, and Southwest. The ReliabilityOne® National Reliability Award is

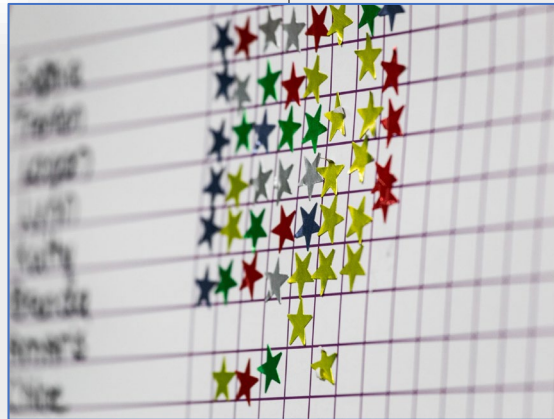
given to the regional award recipient that has demonstrated sustained leadership, innovation and achievement in the area of electric reliability. Read more [here](#).

Itron joins the Green Button Alliance to help empower consumers to manage their energy consumption and support decarbonization efforts

Itron, Inc. announced that it has joined the Green Button Alliance™ (GBA) as a Participating Member. GBA is a non-profit and U.S.-based organization that fosters the development, compliance and widespread adoption of the Green Button® energy and water data-access and -sharing protocol. The Green Button Connect My Data® and Green Button Download My Data® standards enable energy and water users to digitally access their usage data, manage energy consumption more efficiently and conserve resources, while ensuring customer data privacy. By joining the GBA, Itron will help maintain the evolving landscape of advanced metering infrastructure and grid edge data. Itron has shipped more than 8 million distributed intelligence (DI)-enabled endpoints, which have the capability to capture real-time data from electric vehicle chargers, solar panels, appliance load profiles, transformer loading and more through DI applications. Read more [here](#).

DoE invests \$3.5B in infrastructure upgrades, microgrids and smart grid

The U.S. Department of Energy (DOE) unveiled a major \$3.46 billion investment in 58 projects that aim to unlock more than 35 GW of renewable energy in 44 states. The selections include a mix of system-hardening upgrades, wildfire and weather resilience measures, and tech deployments for distributed energy resources (DERs), battery energy storage systems (BESS), and microgrids. U.S. Secretary of Energy Jennifer Granholm called it the "largest-ever direct investment" in grid infrastructure, marking the first round of selections under the \$10.5 billion Grid Resilience and Innovation Partnerships (GRIP) program. It's funded by the Bipartisan Infrastructure Law, which allocates more than \$20 billion for power grid upgrades. Read more [here](#).





FEATURED ARTICLE



Digital Twins: An idea whose time has come

By: PSC Consulting

The concept of a twin of a physical system is decades old. But it's only recently that computing power has grown sufficiently to enable the digital replication of highly complex and dynamic systems. In this overview, we look at how this innovative and crucial technology for the energy sector is rapidly becoming an essential tool for the design, maintenance and development of energy assets.

“Houston, we have a problem”

Anyone who has seen the 1995 docudrama Apollo 13 will have witnessed one of the first real-world applications of the concept of a digital replication of a physical system. The 1970 flight was planned as NASA's third manned landing on the moon. But a major fault in the oxygen system meant that the three crew depended on improvised systems and procedures that were first tested on a twin of their spacecraft at Mission Control in Houston, TX. While more a hybrid analog/digital model than a full digital twin, the successful recovery of the astronauts demonstrated how changes to complex systems – with minimal margins for error – could be tested and proven remotely before being applied to the main system.

Models, shadows and twins

University of Michigan Professor Michael Grieves first proposed the concept to industrial-scale processes and systems in 2002. Originally referred to as a ‘doppelganger’ process – a pun on doppelganger – the phrase ‘digital twin’ was first coined by NASA's Principal Technologist John Vickers in 2010. As defined by the Institute of Electrical and Electronics Engineers (IEEE), a digital twin does more than create a static digital model of a system or process; it dynamically receives and communicates data with the physical system in a two-way flow. (A one-way flow of information from the system to the digital representation is defined as a “digital shadow”).[1]

Uses and benefits

Digital twins can provide a range of benefits using technology based on Industrial Internet of Things (IIoT) protocols. Shell, for example, uses digital twin technology combined with AI to minimize the number of maintenance staff needed on-site – including on offshore platforms – as well as carry out predictive maintenance that can reduce costs.[2]

In the renewables sector, digital twins are set to become increasingly important as the grid becomes more distributed and more complex to manage efficiently. As PSC's Adam Maloyd recognized in a 2022 [blog post](#), “digital twinning could offer a robust way of testing the impact of technological innovations on a grid,” thereby avoiding significant risks as new technologies are introduced.

Meeting complex challenges

One example of an ambitious digital twin project along the lines mentioned in Adam's blog post is the ENSIGN Energy System Digital Twin. This is currently under development in a research and development program led by the [University of Strathclyde](#) and [SP Energy Networks](#), in partnership with many other companies and bodies.[3] ENSIGN will use data from the UK grid to help in the design of a multi-vector energy network twin. This includes wind, solar, tidal and non-electrical energy sources as part an integrated, reliable, resilient and affordable system. Findings from the 4-year research project will be made available to distribution network operators and their wider supply chain both in the UK and internationally. Other uses of digital twins include the ability to actively manage low-voltage distribution grids, as evidenced by the recent launch of the Siemens LV Insights X system.[4]

In theory, the ability to create a digital twin for any system – apart from the costs involved – is limited only by the computing power available and the technical capabilities of the team creating the twin. Other factors include the reliability and timeliness of the data feeds to and from the physical asset.

Success factors

The success of any digital twin relies on the quality of data it receives and feeds back into its physical counterpart. Not only does the data need to be standardized, it needs to be handled securely. As well as being commercially

sensitive, the data could be a valuable target for hackers or hostile states. This means that the IT infrastructure that supports a digital twin needs to be robust, with exceptionally reliable connectivity and levels of cybersecurity across the whole network.[5]

Another success factor is the age-old measure of whether or not the expected results are worth the investment. It should provide measurable benefits that outweigh costs. So, the first task in the process of designing a digital twin is to set clear objectives and perform a basic cost/benefit analysis. The technology might be ‘rocket science,’ but the business case can be firmly brought down to earth.

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FEATURED ARTICLE



The Journey to Increased Transmission Capacity

By JD Hammerly, CEO of The Glarus Group

Carbon-free electrification requires massive transmission investment to move renewable electricity from where it is produced to consumers. In parallel, our digital society's electrical load will grow dramatically because electrifying everything from residential HVAC and cooking to transportation and industrial energy use will double today's demand. The increasing reliance on electricity also brings much higher reliability expectations on electricity supply as traditional fossil-based energy use and electricity supply decline.

With transmission so critical to the energy transition, investing in new transmission and better utilizing existing transmission is crucial. New transmission lines take years to permit, site, and construct and are hindered by slow regulatory approvals, societal siting concerns, and supply-chain constraints. After permitting and siting have been resolved, building transmission takes time, so achieving higher utilization of the existing transmission grid brings benefits before new transmission can be commissioned. Therefore, increased utilization of existing transmission becomes paramount to the next decade's success in transforming the energy landscape.

A transmission conductor's thermal profile dictates how it responds to various amounts of energy flow. The greater the flow, the higher the temperature. The higher the temperature, the more the conductor sags. This relationship becomes critical as our society transitions to geographically diverse carbon-free supply and electricity use grows. Establishing operational line limits avoids thermal conductor damage and prevents the conductor from sagging into the vegetation under the transmission line as it heats up, which will cause a fault, take the line out of service, and avoid wildfires. Losing a line during high electricity demand spreads more load onto other transmission lines, moving them closer to their operational limits and creating a cascading effect.

Operational line ratings, which cap the usable capacity of transmission lines, limit the higher throughput of existing transmission. How these limits are established becomes central to increased transmission utilization. For several decades, transmission operators estimated each transmission line's seasonal upper thermal limits using analysis and experienced engineering judgment.

In July 2025, FERC 881 goes into effect. It dictates more frequent recalculation of maximum thermal limits based on the conductors' characteristics and current weather conditions surrounding each transmission line. This change will expand transmission line utilization by setting thermal line limits more precisely. These more precise limits will enable higher transmission utilization across the year, moving more electricity, much of which will be carbon-free, to serve the increasing demand.



Further, during extreme heat events, more frequent limit recalculation avoids potential thermal damage and line sag by identifying those rare times when limits must be reduced to protect the transmission line.

Although analytics-driven FERC 881 requires ambient adjusted line ratings and represents a step toward enabling higher transmission line utilization than historical practices, more of the journey lies ahead. Advanced conductors with embedded sensing will soon supply real-time thermal information, identifying the location and magnitude of the highest temperature across the line. Increasing line utilization based on empirical data from real-time sensing will allow setting limits to the safe maximum because they are not based on forecast weather conditions and engineering judgment.

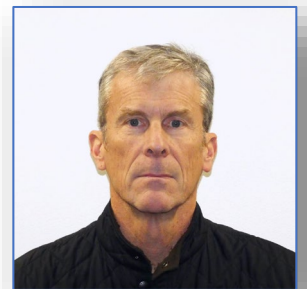
Because of the thermal profile difference, these advanced conductors will also provide increased transmission throughput, as much as three times the throughput of a conductor at the same voltage. This innovative conductor technology also reduces electricity losses.

Lastly, reconductoring at the same voltage preserves a line's structures and requires only minor permitting modifications, avoiding the delays associated with greenfield transmission investment. This breakthrough conductor also benefits greenfield transmission designs because it is lighter and has much lower sag under heavy load, allowing longer spans and fewer structures required to support the line. Achieving energy decarbonization will fail without new and more efficient utilization of existing transmission, making advanced conductors vital during this transition.



MEET THE EXPERTS

Ever since university, Ethan Boardman has pursued the goal of helping generate and deliver electric energy as efficiently, reliably, and environmentally friendly as possible. In grad school Ethan worked for BPA to evaluate the potential impacts of residential wind turbines on the grid and this provided an early insight into the complexity and challenges of DER integration into the grid. Upon graduation, Ethan had the opportunity to join ESCA (Energy Systems Computer Applications) Corporation and work with a collection of some of the pre-eminent developers of energy management systems. For the next 40 years, Ethan has worked on the development, implementation, productization, and delivery of some of the most successful transmission and distribution energy management systems to meet the challenges of the increasingly complex electric utility industry.



Ethan Boardman



WHAT's on MANI's MIND?

US faces test of its climate credibility at COP28

Here's what the UNFCCC (United Nations Framework Convention on Climate Change) had to say about what was achieved at the COP28 UN Climate Change Conference in Dubai, the United Arab Emirates November 30 – December 13, 2023:

"Some 85,000 participants, including more than 150 Heads of State and Government, were among the representatives of national delegations, civil society, business, Indigenous Peoples, youth, philanthropy, and international organizations in attendance. COP28 was particularly momentous as it marked the conclusion of the first 'global stocktake' of the world's efforts to address climate change under the Paris Agreement. Having shown that progress was too slow across all areas of climate action – from reducing greenhouse gas emissions to strengthening resilience to a changing climate to getting financial and technological support to vulnerable nations – countries responded with a decision on how to accelerate action across all areas by 2030. This includes a call on governments to speed up the transition away from fossil fuels to renewables such as wind and solar power in their next round of climate commitments."

Driven by climate change, the energy transition (including moving away from fossil fuels toward renewable generation) is meant to be achieved relatively quickly. However, it shouldn't be shocking to anyone that our progress has been slow. We are making progress, but not enough and not quickly enough.

Usually, it's a good thing to be at the top of a list, but in the case of two key climate-related metrics, the production of GHG-emitting fuels and the emission of GHG itself, the US is number 1 and 2, respectively. The fact is that China, the United States and India are the world's biggest GHG emitters, producing 42.6% of all emissions, while the 100 least emitting countries only produce 2.9%. The top 10 countries are responsible for more than two-thirds of global GHG emissions, as shown in this sobering visual from the World Resource Institute (top). Without substantial efforts to combat climate change from these top emitters, the world cannot achieve its climate goals.

As a nation, the United States may be a global leader with a GDP of \$26.95 trillion, but how can the US tell other countries to reduce their GHG emissions while not making sizeable improvements of its own? Why should anyone listen to us as the second-highest GHG-emitting country?

Yes, we have recent initiatives such as the IRA (Investment Reduction Act) and other pollution reduction policies. But they aren't enough. We need to lead by example which means we need to do more than what we've managed until now.

Per data from [Climate Watch](#), the energy sector produces over 73% of all GHGs. The three main areas of GHG emissions are electricity/heat, transportation and buildings.

Here are some thoughts on Mani's mind for consideration about how we are doing in these areas.

Electricity

While utilities are doing a great job of reducing coal-fired plants, much of that is moving to natural gas, which, while being better than coal, is still a GHG-emitting fuel. We need to aggressively move towards renewable sources of energy, make storage more viable for common utilities at grid scale (i.e., more available, cheaper, more stable, and available for longer durations), and look at other alternatives such as nuclear. Yes, some of these may be more expensive, but we can look at other mechanisms to support those who cannot afford the higher cost. Affordability should not be an impediment to progress.

Transportation

Transportation needs to move aggressively towards electrification. Range anxiety is being solved (slowly but surely), and costs are coming down. There are a lot of alternative and excellent options available from more and more manufacturers. The current mandate of electrifying all personal vehicles by 2025+ (in many states) is not enough. Moving commercial vehicles (parcel delivery, metro buses, school buses and so on) to electric is one that can be achieved even faster through incentives. We need to do it sooner and faster. We also understand the impact of this on first-responder vehicles such as fire trucks, ambulances, utility bucket trucks, etc. Some of these may need to stay on internal combustion engines for much longer.

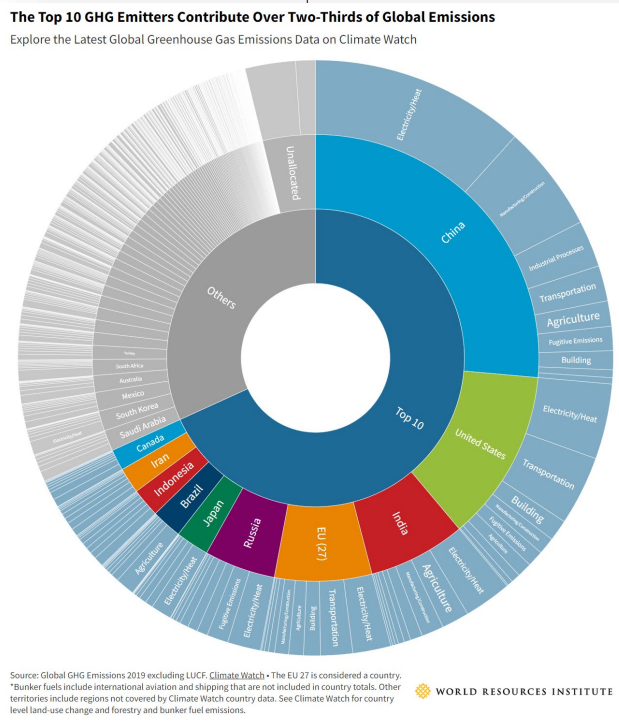
We are encouraged by the US current administration's recent announcement of \$32.5 million in funding to advance transportation electrification as part of the U.S. National Blueprint for Transportation Decarbonization. And we need to do more.

Buildings

Buildings can get to GHG-free quicker if utilities and transportation move. The primary source of building GHG emissions is heating, and we need to provide better alternative technologies such as heat pumps.

Bottom line: We need to walk the talk

This issue of reducing GHG cannot be a government-only issue; it cannot be a regulation-only issue. Without people embracing this change and internalizing it, we cannot succeed. But, I'm optimistic that if we work together across sectors and our communities, the US can be a leader in more than GDP. Let's prove to the world that we can lead by example, not just with rhetoric.





MORE ABOUT MODERN GRID SOLUTIONS

Modern Grid Solutions

Modern Grid Solutions (MGS) is a cost-effective, global, supplier of deep expertise and board-experienced domestic resources. Our team members have been industry colleagues for over 25 years. Our approach focuses on delivering actionable guidance, direction, and value based on the depth of our team's expertise in North America and worldwide.

MGS has assembled a team of leading experts all having between 25 - 45 years of experience delivering complex, innovative technology, business, regulatory and finance solutions to electric utilities, corporate clients and policymakers. Our experts bring expansive breadth and tremendous depth in engineering, technology, economics, operations, and commercial areas directly applicable to utilities, suppliers, regulators and policymakers.

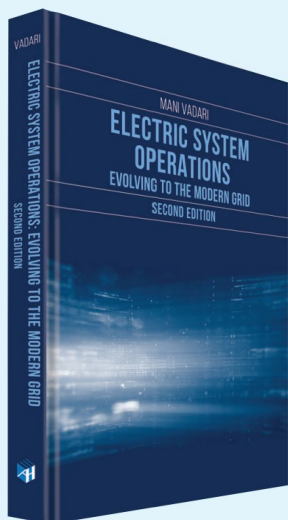
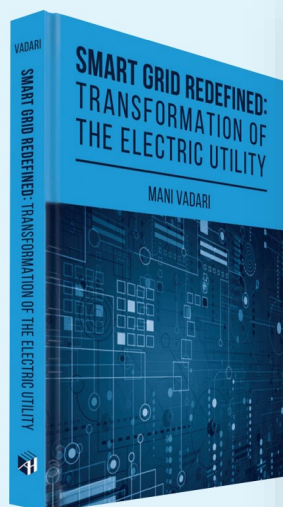
At MGS, our focus is on our clients and helping them connect the dots to make the modern grid possible. This is our obsessive passion and we've mastered the details so that our clients can keep their main focus on their businesses. And, in return, our clients value our boutique consultancy because of our unique value proposition. At MGS, all our consultants are seasoned experts offering their undivided attention and treating our clients' businesses as if they were our own.

BUSINESS EXPERTISE AREAS	TECHNICAL EXPERTISE AREAS
<p>For Utilities and Policy Makers</p> <ul style="list-style-type: none"> • Strategy, tactics, and process redesign • Business, technical and enterprise architecture • Transmission and distribution roadmaps • Grid modernization plans • Project and program management • Strategic change management • RPS Support <p>For Suppliers and Corporate Clients</p> <ul style="list-style-type: none"> • Business model design and analysis • Electricity market entry and go-to-market • Market analysis, volumes, and trends • Competitive landscape analysis • Alliances, divestitures, and acquisitions • M&A, Project finance, structured products 	<p>For Utilities and Policy Makers</p> <ul style="list-style-type: none"> • T&D system operations – EMS, DMS, OMS • Generation operations • Energy markets – design and deployment • Energy and REC tracking system • T&D Automation and smart grid solutions • GIS and asset management solutions • Generation planning and renewables integration • Big data management and analytics • Solution and vendor selection <p>For Suppliers and Corporate Clients</p> <ul style="list-style-type: none"> • Solutions design and implementation • Portfolio review and analysis • Adjacency analysis and technology management • Energy, REC and emissions trading

Ongoing MGS Projects

- Assisting a major Canadian municipal utility with the redesign of their system operations capability and the control center to meet the needs of the anticipated future.
- Assisting a major Northwest utility with transforming their planning capabilities to address the influx of Distributed Energy Renewables, Non-Wired and Non-Piped Alternative solutions and to address the needs of the Washington State Clean Energy Act (SB 5116)
- Assisting with a major multi-OpCo distribution operations transformation – Control center consolidation, ADMS implementation and operations standardization.
- Assisting multiple startup companies in the areas of IoT and Blockchain.

- Business Architect role at a major East Coast multi-jurisdictional, multi-state utility with implementing a DER dispatch (People, Process and Technology) solution across Transmission and Distribution.
- Assisting a major east coast gas utility with their decarbonization strategy.
- Assisting several system operations vendors with the development of their product implementation strategies.
- Assisting several energy service providers (consulting companies) by providing deep expertise in the areas of System Operations, Wholesale/ Retail Market Operations, and Power System planning.



Electric System Operations – Evolving to the Modern Grid, Second Edition

Dr. Vadari's book is titled, "[Electric System Operations – Evolving to the Modern Grid, Second Edition](#)." The key chapters covering EMS, OMS, ADMS, and DERMS now include industry case studies to move the discussion from theoretical to evidentiary with real-world, relatable content.

Smart Grid Redefined: Transformation of the Electric Utility 3.0

This book by Dr. Vadari has been released and is now available in all leading bookstores and [online](#). The Chinese edition is available in China.

Resilience of Power Distribution Systems

Dr. Mani Vadari, John (JD) Hammerly, and Gerry Stokes co-wrote the last chapter of [this book](#) titled "Technology and Policy Requirements to Deliver Resiliency to Power System Networks."

Both of Dr. Vadari's books are regularly used as textbooks in several universities in the U.S. and abroad. They are also popular with many major utilities. Ordering in bulk offers significant savings... and a lot of knowledge.

MGS is the go-to expert for delivering detailed learning sessions on the hottest topics in the industry, such as power system fundamentals, grid modernization, smart cities, and advanced distribution management systems (ADMS). If you need one or more of these courses delivered by our senior staff, please [let us know](#).



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