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POWER SYSTEMS TECHNOLOGY

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TRANSFORMER TECHNOLOGY MAG

SPECIAL SECTION
CIGRE PARIS 2024

DISTRIBUTION GRID DYNAMICS
PROTECTION SYSTEMS, RELAYS AND DRY TYPE TRANSFORMERS

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Power Panel Discussion: **Changing Dynamics of Electrical Steel**

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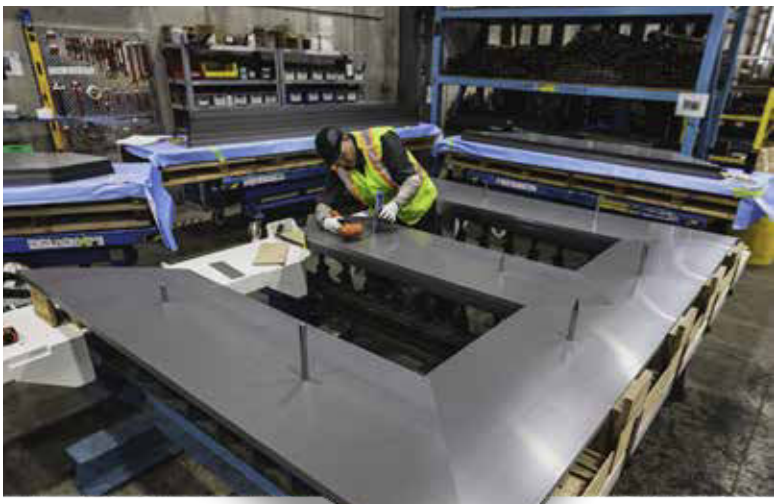
Index

Table of Contents



Index

Table of Contents

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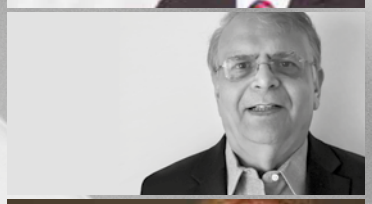

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Reimagining the Grid: A Path to a Sustainable Energy Future

The distribution grid, the intricate network responsible for delivering electricity from power plants to consumers, is undergoing significant transformations in both the United States and Europe. These changes are driven by a confluence of technological advancements, policy shifts, and evolving consumer expectations.

As we navigate through the 21st century, the traditional grid is being reimagined to accommodate renewable energy sources, enhance reliability and sustainability, and empower consumers with more control over their energy usage.

As we navigate through the 21st century, the traditional grid is being reimagined to accommodate renewable energy sources, enhance reliability and sustainability, and empower consumers with more control over their energy usage.

As we report on frequently in Power Systems Technology, one of the most notable changes in the distribution grid is the integration of renewable energy sources. In both the US and Europe, there is a strong push towards reducing carbon emissions and combating climate change. This has led to a substantial increase in the deployment of solar panels, wind turbines, and other renewable energy technologies.

Unlike traditional power plants, which are typically centralized, renewable energy sources are often distributed and decentralized. This shift necessitates a more flexible and adaptive grid that can handle the variable nature of renewable energy production. For instance, solar power generation peaks during the day, while wind power can be intermittent. The grid must be capable of balancing these fluctuations to ensure a stable supply of electricity.

To manage this complexity, advanced grid technologies such as smart meters, sensors, and automated control systems are being deployed. Smart meters provide real-time data on energy consumption, allowing utilities to better understand and manage demand. Sensors and automated controls enable the grid to respond dynamically to changes in energy production and consumption.

For example, if a sudden drop in wind power occurs, the grid can quickly adjust by drawing on stored energy from batteries or ramping up other power sources. These technologies not only enhance the reliability of the grid but also improve its efficiency by reducing energy losses and optimizing the flow of electricity.

Another significant change is the rise of prosumers—consumers who also produce energy. With the decreasing costs of solar panels and home battery systems, more individuals and businesses are generating their own electricity and even selling excess power back to the grid. This trend is particularly pronounced in Europe, where policies and incentives for renewable energy adoption are more robust.

Prosumers contribute to a more decentralized and resilient grid, but they also introduce new challenges in terms of grid management and regulation. Utilities must adapt to a more

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complex energy landscape where power flows are bidirectional, and traditional models of energy distribution are upended.

In addition to technological advancements, policy and regulatory changes are playing a crucial role in shaping the future of the distribution grid. Governments in both the US and Europe are implementing policies to promote renewable energy, improve grid infrastructure, and encourage energy efficiency. For example, the European Union's Green Deal aims to make Europe the first climate-neutral continent by 2050, with significant investments in renewable energy and grid modernization. In the US, initiatives like the Infrastructure Investment and Jobs Act include provisions for upgrading the grid and expanding renewable energy capacity.

The distribution grids in the US and Europe are undergoing a profound transformation driven by the integration of renewable energy, the rise of prosumers, technological advancements, and policy changes. These developments are creating a more flexible, efficient, and resilient grid that can meet the demands of the 21st century.

Consumer expectations are also evolving, with a growing demand for cleaner, more reliable, and more affordable energy. People are increasingly aware of the environmental impact of their energy consumption and are seeking ways to reduce their carbon footprint. This shift in consumer behavior is driving utilities to innovate and offer new services, such as time-of-use pricing, demand response programs, and energy management tools.

The distribution grids in the US and Europe are undergoing a profound transformation driven by the integration of renewable energy, the rise of prosumers, technological advancements, and policy changes. These developments are creating a more flexible, efficient, and resilient grid that can meet the demands of the 21st century. They also present new challenges that require innovative solutions and collaborative efforts from governments, utilities, and consumers. As we move forward, the continued evolution of the distribution grid will be essential in achieving a sustainable and reliable energy future.

Alan M Ross
CRL, CMRP
Managing Editor
APC Media
Technical Director

Alan has decades of experience in the power systems industry and is one of the greatest reliability experts out there.

The Leadership Equation: Balancing Growth and Culture in Energy Sectors

by **Marcus Emmet**

The Talent Surge

As backlogs in nearly every power and energy submarket surge to historic highs, manufacturers and suppliers are responding by expanding their asset footprint and increasing both white-collar and blue-collar employee headcounts. It is essential that senior leadership have ability to carefully and competently manage this expansion, which means companies need to be proactive in assessing where they have leadership gaps or deficiencies. Leaders need to identify where they may be lacking and attract game changing operational, functional and executive leaders who can ensure businesses successfully and sustainability capitalise on this historic growth period.

While demand for manufacturers in the energy sector has been relatively stable for many years, the past two years have seen a new phase of

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Marcus Emmet heads Beaumont Bailey's Smart Infrastructure practice, specialising in senior and executive appointments for global manufacturers of cutting-edge smart technologies that enhance efficiency, sustainability, and performance within the built environment. Leveraging his extensive industry knowledge, Marcus plays a pivotal role in connecting top-tier leadership talent with organisations at the forefront of innovation. His unique blend of technical and industry experience positions him as a trusted partner in advancing the smart infrastructure sector through exceptional executive search solutions.

Leaders need to identify where they may be lacking and attract game changing operational, functional and executive leaders who can ensure businesses successfully and sustainability capitalise on this historic growth period.

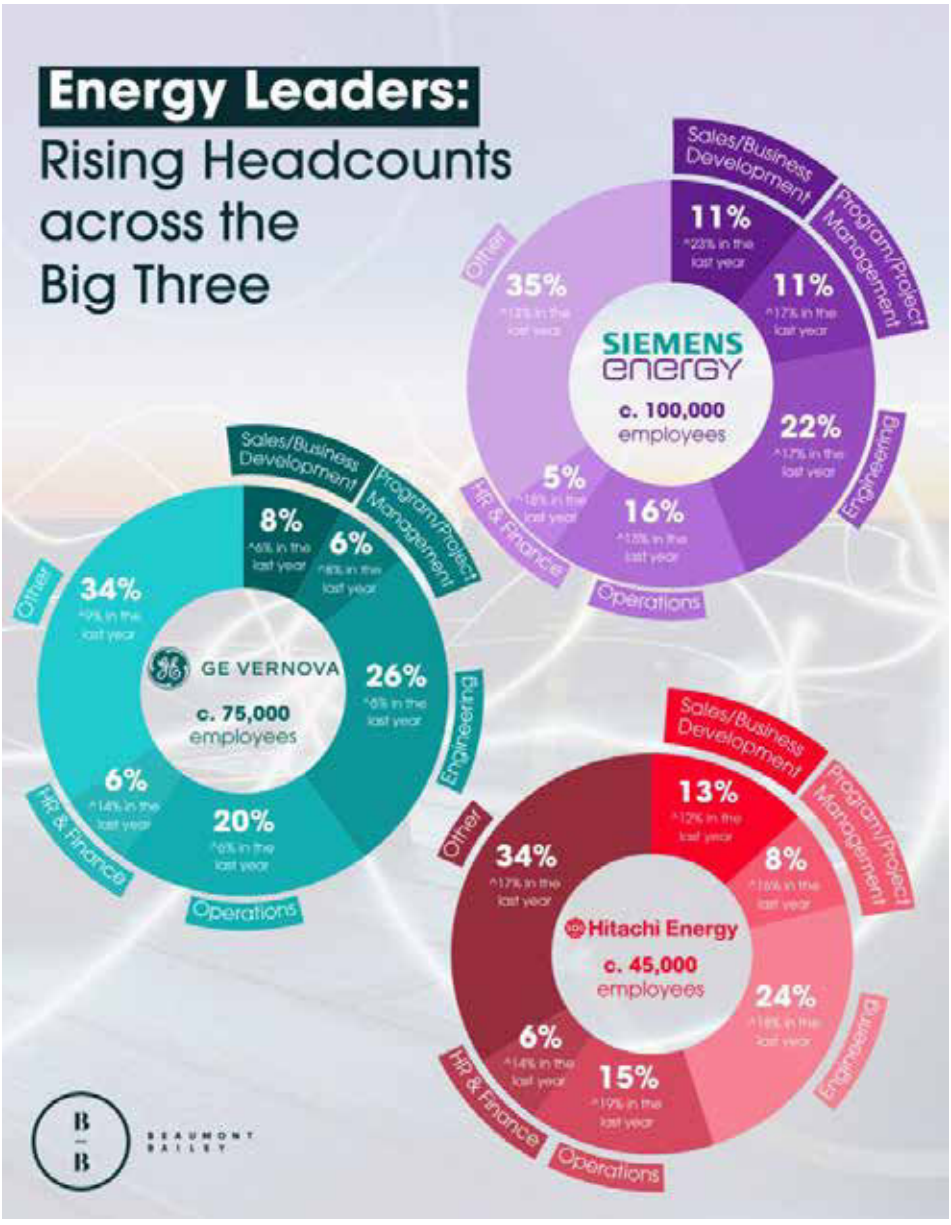
exponential growth in employee headcount. This shift signals that the long-discussed net-zero transition has become one of the dominant labour market trends of the 21st century. As Fatih Birol, Executive Director of the International Energy Agency (IEA), notes, we are witnessing an *"unprecedented acceleration"* that is *"creating millions of new job opportunities all over the world – but these are not being filled quickly enough."*[1]

Indeed, the IEA's latest *World Energy Employment report*[2], highlighted that global energy employment rose to 67 million people in 2022, an increase of 3.5 million from pre-pandemic levels. Looking ahead the International Energy Agency (IRENA) shows in their World Energy Transitions Outlook, that energy transition is expected to create 40 million additional jobs in the energy sector by 2050[3].

Energy's 'Big Three'

Over the past two years alone, Siemens Energy and Hitachi Energy have each increased their headcounts by over 15%, while GE Vernova has seen a rise of more than 9%. This level of growth is more akin to that of a Silicon Valley startup than a global manufacturing giant, but the unrelenting demand is pushing traditional norms aside.

The following breakdown illustrates where this headcount growth has occurred within these businesses:



**Data publicly available from Linked In platform – accessed August 2024*

Unsurprisingly, the engineering and operational teams have seen the most significant increases as companies work to scale up manufacturing and distribution output. These teams are expected to experience even higher intake levels in the coming years as they expand their manufacturing capacity and operational footprints.

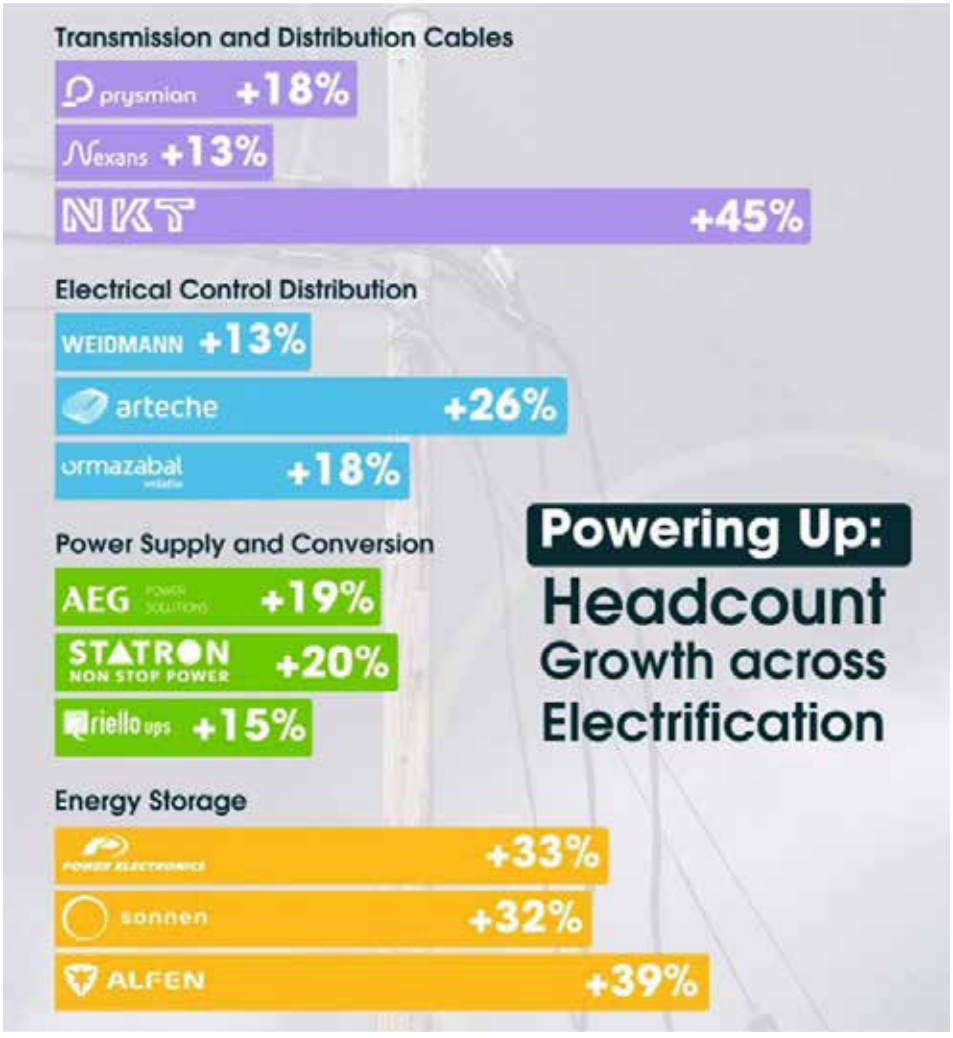
A clear demonstration of this came recently, as Siemens Energy announced plans to recruit over 10,000 employees by 2030 in their Grid Technologies division to address a €30 billion order backlog[4]. This will be supported by a €1.2 billion capital expenditure outlay aimed at building new factories and boosting manufacturing capacity across the US, Europe, and Asia, ultimately expanding the division by two-thirds.

Similarly, in June 2024, Hitachi Energy, also amassing a $30 billion backlog, recently committed €4.5 billion to be spent across manufacturing, engineering, digital, R&D, and partnerships in all major business lines by 2027[5]. This is additional to the $1.5 billion investment to ramp up global transformer production, including the addition of 2,000 new employees in Sweden and 4,000 in India, announced in April 2024. GE Vernova is expected to make a similar investment commitment in the coming year.

Industry Wide

The recent surge in headcount and asset ramp up is not limited to the big three; our research suggests this trend is actively playing out across manufacturers throughout the energy and electrification value chain in Europe and the US.

The graphic below highlights the growth of various European headquartered organisations across different segments of the energy and infrastructure sectors over the past two years:



Data publicly available from Linked In platform – accessed August 2024

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Growth is even larger in the United States – Deloitte recently reported[6] that as of late 2023, nearly 300 new clean technology and semiconductor facilities were announced for development. These projects represent over $430 billion in investments and include the creation of more than 234,000 new manufacturing jobs, before 2031.

The Challenges Facing Leadership Teams

While all this is extremely positive for the industry, this growth poses several challenges that leaders must successfully overcome. From our market conversations, it is clear which the top priorities that leaders have are:

Organisational Structures and Operational Complexity

In times of growth, senior leaders are responsible for ensuring that the organisational structure evolves in a way that supports scalability without becoming overly complex. For leaders to succeed in this environment, they

must be collaborative in assessing the current structure and identifying potential bottlenecks that could arise as a company expands. We found that, in cases where the opportunity to correct existing inefficiencies hasn't already been taken in the years leading up to this point, then bringing leaders from outside of their organisation, can be hugely effective in identifying and executing strategic changes that long serving individuals might be blind to, or are unwilling to address in a proactive manner.

Another observation we've made in recent times is that many organisations are fostering a renewed culture of empowerment for middle management, to bridge the gap between executive leadership and frontline employees. This has led to decisions being made closer to the action, with the purpose of avoiding escalation to higher levels of the organisation – this flexibility and quick decision making is an organisational cultural trait which has become crucial in a dynamic and evolving market.

Acquiring and Developing Leadership

As the "Big Three" and their high-growth counterparts scale operations at an unprecedented pace, the key to maintaining organisational resilience and sustaining growth lies in the development and acquisition of strong and confident leadership teams.

Many organisations we've worked with have seen great success when they look externally to address talent gaps and see the addition of fresh perspectives at senior level, often from adjacent industries, a vital component of their growth strategy. The willingness to be pre-emptive when it comes to hiring senior level talent can vary immensely, however we've found a mindset shift is occurring across both public listed multinationals and privately owned legacy businesses. This resulted in an uptick in the demand for transformative leadership and the scramble for top talent is certainly well underway.

As technologies across the value chain evolve, in areas such as solution services for example, businesses are embracing cross-industry talent with diverse backgrounds. We've built up an extensive and ever-growing network of leaders from industries that have already undergone digital transformation and customer experience revolutions who bring fresh perspectives and innovation. Having placed and seen the enormous impact they've had in this sector and strongly encourage clients to consider leaders from outside the industry to drive transformation projections and bring in the cultural change necessary for sustained success.

Another observation we have made in recent times is the changing face of leadership in the modern world. Demand for leaders with evolved emotional intelligence and strong inter-personal skills is on the rise. Leaders who prioritise authenticity, empathy and adaptability are often favoured by boards. This approach is not limited to senior leadership - it is being encouraged and applied across entire organisations and promoted as essential skills for all employees.

Demand for leaders with evolved emotional intelligence and strong inter-personal skills is on the rise. Leaders who prioritise authenticity, empathy and adaptability are often favoured by boards.

With 40% of the current skill requirements in advanced manufacturing evolving in the next five years[7], we anticipate many of our clients actively developing managerial and soft skills throughout their workforces. This investment and targeting of skills is aimed at created a teams that are well-equipped to handle fast-paced change and an influx of human capital.

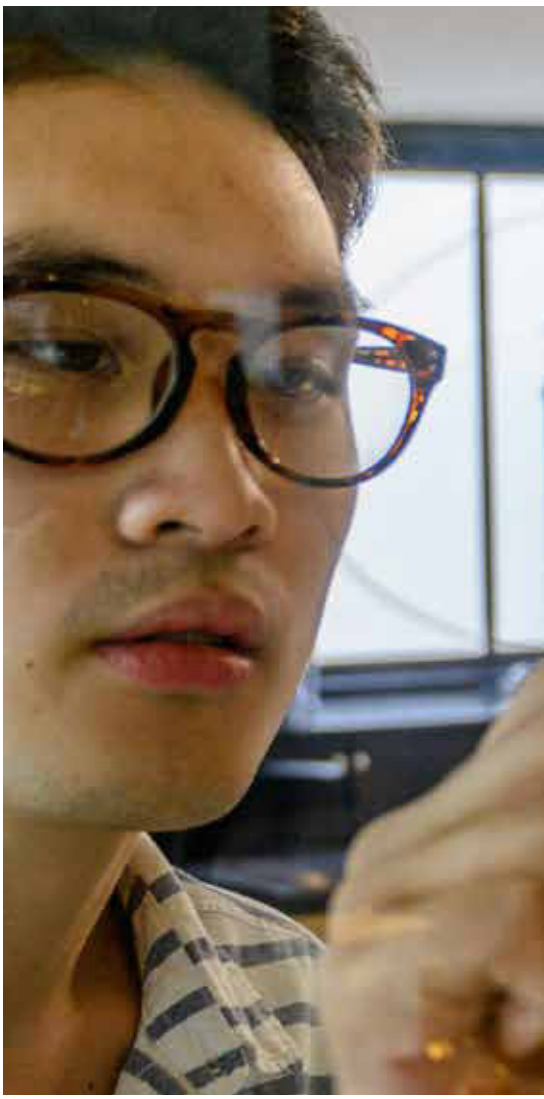

Photo: Pexels

The addition of new employees, especially in such large numbers, risks disrupting the cultural fabric of an organization... leaders need to spend more time articulating value and strategic objectives frequently across various channels.

Maintaining Company Culture

Perhaps the most prominent challenge facing leaders in the past 18 months is how they maintain the core identity and culture of their businesses whilst they scale at pace. The addition of new employees, especially in such large numbers, risks disrupting the cultural fabric of an organisation.

Although all Siemens Energy, GE Vernova and Hitachi Energy are

recent post spinoff organisations, the founding principles that have driven their historical success remain intact and relevant. Thus, leaders have been taking numerous steps to ensure there is no dilution or fragmentation of these values. First class leadership in these circumstances is demanding more than ever consistent and clear communication. To maintain engagement across all generations of the workforce, there is a growing emphasis that leaders need to spend more time articulating value and strategic objectives frequently across various channels.

Indeed, a multinational organisation we've worked with for some time, has in the last year placed a greater responsibility on executive leaders to be more actively visible than they have been previously – face to face, but also by regular internal newsletters, digital platforms, workshops and townhall meetings to reinforce the message that these principles are not just corporate rhetoric, but are integral to how the company operates.

Conclusion

The rapid growth in the energy sector presents both opportunities and challenges for senior leadership. Successfully navigating this landscape requires leaders who can manage complex organizational structures, empower middle management, and maintain the company's core identity. Proactive identification and development of leaders with strong emotional intelligence and adaptability are crucial. Attracting talent from diverse backgrounds, including adjacent industries, can bring fresh perspectives and innovative solutions.

The sector's success hinges on leaders who balance growth with sustainability, embrace change while preserving core values, and lead with competence and compassion. As the industry scales, the cultivation of such transformative leadership will be pivotal.

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SPECIAL SECTION:
Industry Insights and Grid Innovation

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For power system expertise

Niclas Wetterstrand, Global Industry Director - Utilities - Power Protection, Megger

Dr. **Diego Robalino**, Global Industry Director - Power Transformers, Megger

Dr. **Bahadir Basdere**, President and CEO Trench Group

Seamus Allan, Product Portfolio Manager Dynamic Ratings

John Gounaris, Vice President
G&W Electric

Holger Ketterer, CEO
SGB-SMIT Group

Stéphane Page, CEO
Condis. Power Grid Solutions

Jacco Smit, Senior Advisor Technology Cable and Lines
Chairman national CIGRE SC B1 Cables

Amanda Olson, Vice President
Burns & McDonnell

Usama Ahmed, Technical Director - T&D Insulators
and Solutions, Jiangsu Shemar Electric Co., Ltd.

Bob Hobson, Associate Technical Consultant for
UG and Submarine Cables, Burns & McDonnell

Brady Jenkins, Senior Vice President
Jiangsu Shemar Electric Co., Ltd.

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Editor's Note: Sadly, I was not able to make it to Paris for the CIGRE 2024 event, one of the most important organizations globally, bringing together professionals from all segments of our industry for one reason, the betterment of society. But with the help of Ben Lanz one of our Executive Editorial Board Members and the staff at APC Media, we were able to capture great interviews with key leaders on the value of CIGRE and the Paris event. Enjoy!

Ben Lanz: We're here at CIGRE 2024 in Paris and my first guest is Seamus Allan of Dynamic Ratings. Seamus, what excites you about being at this event?

Seamus Allan: I love that CIGRE brings together people from all over the world to share their challenges, discoveries, and solutions. It's a place where utilities can stop reinventing the wheel. Utilities tend to work in isolation, but here we can come together, share solutions, and learn from each other. I'm a part of a working group on dynamic thermal modeling of power transformers, and it's amazing to see experts from all over the world sharing their models and experiences. It's an incredible learning and networking opportunity.

Ben Lanz: It sounds like a great environment for collaboration, right?

Seamus Allan: Yes, I would encourage everyone to get involved in industry organizations, come out of their offices, and share knowledge. There's so much we can learn from each other, and events like this accelerate that process. The more we collaborate, the faster we can solve the emerging problems we're all facing. I'd recommend investing in learning, relationships, and networking. It will benefit everyone.

Ben Lanz: My next guest is Dr. Bahadir Basdere the CEO of the Trench Group. Dr. Basdere, how valuable is CIGRE to you personally and to the industry as a whole and where do you see the industry moving and what are you seeing here at CIGRE Paris?

Dr. Bahadir Basdere: The industry is developing well, and there's a lot of excitement around new products and solutions. We're seeing more innovations in power quality and digital solutions. For example, there are drones for maintaining transmission lines and mobile robots for servicing HVDC converter stations without needing to shut them down. These innovations are reducing costs and making the industry more efficient. Service will play a crucial role in meeting the increased demand, as it will help extend the life of existing equipment.

Ben Lanz: It sounds like Trench is well-positioned to meet the growing demands. You mentioned extending the life of existing equipment—can you tell us more about that?

Dr. Bahadir Basdere: Yes, we have over 1.1 million components in the grid, and we know exactly where they are, and which customers are using them. We're planning to offer proactive service on these components to help our customers run their equipment for longer, in a reliable manner. This is crucial because, as much as the industry is growing, we can't build new capacity fast enough to meet the demand. Extending the life of existing components is a key part of the solution.

Ben Lanz: Your passion for the industry really comes through. Do you have any final thoughts for our readers?

Dr. Bahadir Basdere: Besides all the growth and demand, we shouldn't forget about the most valuable resource we have people and their knowledge. We need to attract young people to the industry, especially in areas like high-voltage electrical systems, production, and manufacturing. Engineers are essential for designing the grid, and skilled workers are needed to build the components. Ensuring we have knowledgeable people is key to coping with the industry's growth.

Ben Lanz:My next guest is Holger Ketterer, Group CEO at SGB-SMIT.

Holger, it seems that long-term collaboration sounds essential. Lead times are a real challenge, but those strong relationships must help mitigate that. You're here at CIGRE 2024. What value do you see in attending this event?

Holger Ketterer: CIGRE is unique. It's not just a trade show where manufacturers connect with suppliers or customers. It's a place where both come together. You see a lot of Transmission System Operators (TSOs), Distribution System Operators (DSOs), and suppliers. The conversations here are not just between sales and supply chain teams but involve deep technical expertise. The poster sessions and technical committees are great for interacting with customers and suppliers. It's a real community, and that makes it a special event.

Ben Lanz: The collaboration and sense of community are strong here. It seems CIGRE has grown from being a primarily transmission-focused event to one that also encompasses distribution and generation.

Holger Ketterer: Indeed. It has developed into an event that covers all aspects of our industry, from transmission to distribution to generation. It's fantastic to see everyone here, sharing knowledge and working together on the industry's future.

I would encourage everyone to promote our industry, especially to the younger generation. We need more engineers and skilled labor to meet the challenges ahead. We should start talking about the energy sector's importance even in schools—let young people know that this is an exciting field to work in. We need passionate people who want to be part of solving some of the world's biggest challenges, from sustainability to technological innovation.

Ben Lanz: From sustainability to data and AI, everything requires power, and that makes this industry so crucial, right?

Holger Ketterer: Exactly! The shift from fossil fuels to electricity is the foundation of today's megatrends. It's what's driving the transformer boom, along with other developments like data centers, which were barely on the radar years ago. The future is electric, and transformers are central to that.

Ben Lanz: My next guest is Dr. Diego Robalino, the Global Industry Director - Power Transformers at Megger. Diego, from a power transformer perspective, what are the specific challenges you're observing in the industry? What are people discussing?

Dr. Diego Robalino: During the A2 subcommittee discussions, particularly on dielectrics, we've noticed that the failure rates of bushings are continuously increasing, as shown in the new reliability document from CIGRE. This challenge is intriguing because it highlights an issue with a component rather than the transformer itself.

CIGRE is a fantastic opportunity to share our experiences. I encourage everyone to participate in technical sessions like CIGRE. There are so many experts with diverse expertise contributing to solving industry issues. If anyone has questions, please come to us—we'd be more than happy to help.

Ben Lanz: Also joining me from Megger is Niclas Wetterstrand, Global Industry Director for Utilities - Power Protection. Niclas, what are the highlights from your presentation at the conference?

Niclas Wetterstrand: One notable aspect is the increasing use of low power instrument transformers in the industry. We need to simulate these differently compared to

Photo: Pexels

traditional instrument transformers due to their lower output ratios. We've collaborated with partners to ensure accuracy at these lower ranges and developed completely new test equipment, which is currently a prototype here at the show. We also presented a paper on this topic together with Siemens at the conference.

It's a pleasure to be here at CIGRE Paris. I'm excited about the innovations happening in the industry. There's so much going on, and we are passionate about solving the challenges we face.

Ben Lanz: Jacco Smit joins me now. He is the Senior Advisor Technology Cable and Lines at Tenet, and Chairman of the national CIGRE SC B1 Cables and a member of CIGRE CAG B1. Jacco what is your experience with CIGRE?

Jacco Smit: I've been coming to CIGRE for many years, and I see that it plays a crucial role in developing and accelerating standards. We work through working groups to address technical challenges, which eventually lead to new standards and codes. The expertise we have across countries is invaluable; we can leverage the best knowledge worldwide without reinventing the wheel.

I'm proud to share my insights through interviews like this. I believe that knowledge sharing, and collaboration will be crucial as we move forward. The grid does not come to you—you must go into it.

Ben Lanz: My next guest Is John Gounaris, Vice President at G&W Electric. John is there anything that you're highlighting here at CIGRE or in the marketplace regarding these solutions?

John Gounaris: Yes, as part of the exhibition piece of CIGRE, we've been showcasing a product that addresses some of the new challenges faced in the grid—our 72 kV Viper® - HV. This is a vacuum interrupter with solid insulation, meaning there's no oil, gas, or SF6 involved. It can perform sectionalizing, circuit breaking, and reclosing functions, and it can be mounted directly on a pole without needing a substation.

What we found through collaboration with our utility partners is a need to extend sectionalizing and protection capabilities outside the substation. We could do this with distribution but found a gap in the sub-transmission market. After a lot of innovation and patience, we were able to bring this product to market a couple of years ago, and it's been quite successful for us.

Ben Lanz: That's quite a story! Given the dynamics of power flow, renewables, distributed generation, and climate change impacts, this tool is useful for utilities in solving various challenges.

John Gounaris: Absolutely. It's been rewarding to educate customers about this product. The unique aspect of this time is that utilities are facing problems without clear solutions. They're not approaching us with a specific need; instead, they have challenges and are looking for help. This opens the door for us to educate them on solutions we can provide, which is a different approach to sales but also a fulfilling one.

Ben Lanz: I imagine that's a significant part of why you're here at CIGRE. What excites you about being at SE 24 in Paris, France?

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John Gounaris: Our commitment to CIGRE goes back many years. This technical community excels at knowledge sharing and is dedicated to serving the power industry, which is currently undergoing transformational change. Organizations like CIGRE play a crucial role in educating the industry, highlighting mega-trends, and showing where technology is headed.

For us, being involved with CIGRE is key to our innovation efforts. We want to stay close to CIGRE, participate in working groups and committees, and really drive those initiatives forward.

Ben Lanz: We are joined now by Usama Ahmed, Technical Director - T&D Insulators and Solutions at SHEMAR and Brady Jenkins, Senior Vice President AT Jiangsu Shemar Electric Co., Ltd. What excites you about being here at CIGRE? I know Shemar has made a huge investment in your booth and other aspects. Can you tell us about that?

Usama Ahmed: Absolutely. CIGRE is a global event. I've met people from all over the world here. Beyond our booth, we've made technical contributions, presenting three technical papers and engaging in various working groups. It's been a collaborative experience for us.

Brady Jenkins: I echo Usama's sentiments. CIGRE is a fantastic event for us. Coming from North America, many people may not think of this, but we have significant customers coming from North America to Paris. It's essential to build high-level relationships, and this event allows us to connect with the right people in a condensed timeframe. This year has been exceptionally rewarding.

Usama Ahmed: I'd say it's been a fantastic experience connecting with our customers, and we hope to return with even more innovations and solutions.

Brady Jenkins: It's always refreshing to see other manufacturers and like-minded people working towards modernizing and improving our industry. This event has showcased more progress and innovation than I've ever seen at previous shows, which is promising for our field.

Ben Lanz: Stéphane Page joins me now. Stéphane is the CEO @ CONDIS | Power Grid Solutions. Stéphane what value do you see in this CIGRE Paris conference?

Stéphane Page: This is the largest trade show in our industry, held every two years, and it's always a highlight! You can't wait to be back here once the previous session ends. The blend of technical sessions, poster sessions, and the commercial showcases is truly unique and outstanding. If you want to understand trends in our markets, this is definitely the place to be, with all your customers and suppliers attending. Plus, it's set in Paris—a great interactive place to be!

Also, it is an exciting time for us in this industry. If I had a time machine, I'd jump back to being a young engineer again today because the challenges are incredibly exciting—electrification, digitization and optimization of the grid are all fascinating opportunities for a company like ours. Being privately-owned gives us the freedom to explore emerging niches, positioning ourselves at the forefront of these changes. I'm grateful to have witnessed so much progress in the industry and to experience this fantastic era in our field.

Ben Lanz: We are joined now by Bob Hobson, Associate Technical Consultant for UG and Submarine Cables with Burns & McDonnell and Amanda Olson, Vice President at Burns & McDonnell. Thank you both for joining me. What value do you see in attending the CIGRE conference from a cables' perspective?

Bob Hobson: The European market is much further along in utilizing underground cables compared to the U.S. They have more experience with direct-buried cable systems, while we have historically used pipe-type cables. The environmental conditions differ significantly—Europe has more farmland that accommodates easier cable burial, while the U.S. often faces challenges with urban sprawl.

Ben Lanz: It sounds like there's much to learn from the European approach.

Amanda Olson: Yes, I got involved with the CIGRE community early in my career through a Next Generation Network program for people with ten years or less experience. It was my first professional experience in an industry society, and the relationships I built have been invaluable. For example, a utility member I know reached out to peers after an earthquake at a nuclear facility. They were initially looking at the wrong repair procedures but got crucial insights from colleagues, which completely changed their repair approach and allowed for a successful restart without incident.

That's the power of connections in this industry, and it showcases the immense value of networking and collaboration in solving complex challenges.

URGENT CALL FOR ACTION

JFE SHOJI POWER CANADA CALLS FOR GREATER GOVERNMENT INVESTMENTS IN ELECTRICAL TRANSFORMER MANUFACTURING

Worker assembling power transformer core at JFE Shoji Canada's manufacturing plant in Burlington, Ont.

In 2015, Canada joined 194 other countries in signing the Paris Agreement and pledging our commitment to combat climate change. However, despite Canada's attempts to be seen as a leader in sustainable growth, our continually rising greenhouse gas emission levels tell another story.

To achieve this goal, a transformational shift towards electrical energy is required. Modernizing the electrical grid to handle increased renewable energy inputs and to ensure reliability is estimated to require around **CAD 150 billion**. This includes electrical equipment like transformers, switchgear, and capacitors that no one ever hears or thinks about. Investment in new transformers is crucial for expanding the grid's capacity to handle increased electricity flow, especially as the grid doubles to accommodate electrification and renewable energy inputs.

Canada has also stated a goal of being a leader in the development and production of clean energy technologies, and for this to be a key strategic component in our economic plans. For us to fulfill this goal, we must take proactive action in building the supply chains for critical components of our plans.

A recent audit on Canada's progress toward the UN's Sustainable Development Goal on clean and affordable energy showed **little to no plans** to increase our electrical transformer production or to improve our electrical grid. If Canada is to meet its international obligations and goal of "achieving universal access to affordable, reliable, sustainable and clean energy for all by 2030", expanding our electrical grid and transformer capacity is *non-negotiable*.

The government's goals for 2030 are ambitious: saving 600 petajoules of energy annually through improved efficiency, and generating 90%, eventually 100%, of our electricity from renewable, non-emitting sources. With 2025 just two months away, the window for action is closing fast, leaving only five years to implement the necessary changes.

The government is heavily investing in the electric vehicle (EV) and clean energy sectors, including charging stations and battery production. With electricity demand expected to double in the next 25 years, however, and the 2030 deadline of this strategy rapidly approaching, the strain on our grid is of great concern. Federal initiatives are already in place for these sectors, despite having no significant plans to expand our grid. The focus on job creation and economic growth in this sector has overshadowed the more pressing issue at hand - **our dire need for large-scale investments in electrical infrastructure**.

More specifically, we are facing an increasingly urgent need to invest and expand in manufacturing efforts for a growing number of electrical components like transformers, as well as facing the challenge of ensuring their supply chains aren't at risk. If we fail to make these investments in a timely manner, our ability to efficiently transport electricity from power plants to end users will be severely compromised.

Ron Harper, President and CEO of JFE Shoji Power Canada, is leading the way in Ontario by calling on both industries and government officials to fortify the electrical grid and build resilient local supply chains for critical equipment, like transformers, that our power grid depends on.

Harper points out a rather pressing issue: "The demand for electricity is set to skyrocket, especially with the rise of data centers required to support our rapidly expanding AI infrastructure," he says. "There's a severe shortage within the supply chain for key materials necessary for electrical transformers, like the electrical steel needed for transformer production, and North America currently has only one producer."

Photo: JFE Shoji Canada

Harper emphasizes the important role of electrical transformers in managing voltage changes for safe and efficient power transmission. However, he warns that over 70% of the transformers in North America are already past their originally intended replacement dates. As our transformers continue to age, the risk of failures and their catastrophic consequences increases dramatically.

When considering the anticipated doubling of our electricity usage within the next quarter century, Harper argues that our current efforts are only addressing part of the solution. Increased transformer production, along with replacing our old transformers and expanding their capacity, is imperative for our country to fulfill our energy demands and reach our goals by 2030.

Our reliance on foreign suppliers puts us in a tricky situation, though. If the key products and raw materials are not being produced domestically, we run the risk of other nations refusing to sell to us, having to pay exorbitant prices, or facing prolonged delivery times. Other risks include the possibility of foreign suppliers going out of business or being unable to deliver shipments due to geopolitical priorities and conflicts, natural disasters, or energy shortages.

Being well aware of this, Harper stresses the importance of local production. He reveals that over 70% of the electrical steel produced globally is currently being produced in China, Korea, and Japan. North America has one producer, along with a small producer in Brazil that doesn't require overseas shipping. To support North America's electrification, **we must** develop local supply chains for everything from raw materials to finished transformers.

To further highlight how pressing this issue is, the Conference Board of Canada warns that we are nearing a significant shortage of electrical transformers. This severely threatens North America's electrification efforts unless immediate action is taken.

Aerial view of JFE Shoji Power Canada with Burlington skyline in the background

GEORG precisioncut TBA machine in operation

As this window begins to close on the opportunity to meet our broader net zero goals, JFE Shoji Power Canada is at the forefront of this challenge, working to increase awareness and pushing for expanded manufacturing capacity. Setting up new electrical steel manufacturing operations in North America could take 3-5 years, but Harper asserts it's a necessary investment. "We need new production facilities to build out our electrical grid," he says.

Local manufacturing of transformers must be a central part of our clean energy economic development.

Harper is actively lobbying the federal government to include electrical transformer manufacturing in the clean investment tax credits, to reduce our reliance on foreign suppliers and improve supply chain resilience. Such incentives could attract much-needed manufacturing to Canada and strengthen our energy infrastructure.

When discussing the potential for increased competition for JFE Shoji Power from these investments, Harper is clear: "**The demand for electrical power and the supply chains that support the grid will be immense. Yes, more competition will come but expanding the supply chain is crucial - and it won't be accomplished by just one or two companies.**"

For decision-makers in industries that stand to be most affected by the shift to a net-zero economy, the time to lead is now. The stakes are simply too high to ignore this issue any longer; the current state of our electrical grid demands our immediate attention and investment. Every moment we put off addressing our aging transformers and the lack of local production capabilities is one moment closer to an energy crisis.

As we face this substantial challenge, we can be reassured and motivated by paraphrasing **The Six Million Dollar Man**: "We can rebuild [it]. We have the technology."

Photo: JFE Shoji Canada

Improving and expanding our grid is not a problem we cannot solve. We have the technology, tools, and knowledge to fix our infrastructure, and we can rebuild it to be capable of supporting our clean energy demands. A challenge of this magnitude is something that requires everyone's support, though, **especially from the industries directly involved or affected by this**.

This is where your leadership comes in. With just five years left to meet our 2030 targets, the decisions made today by our industry leaders will have repercussions for decades. The actions taken during this time will be a significant drive in the changes we need to establish a foundation for sustainable growth and industry resilience.

This is not merely a call for participation. It's a rallying cry for those with influence to make a real difference. We need powerful leaders to push our government for stronger actions and to prioritize **local** manufacturing of essential components, like transformers. When powerful people lead, others will follow. Decisions made by those with authority can set new industry standards, which often results in a much broader collective effort towards positive change.

JFE Shoji Power Canada stresses an important final point: "Our grid is at a crossroads, and without immediate investment in electrical infrastructure and the supporting supply chains, the risk of operational disruptions and power shortages will only escalate. The technology to rebuild and strengthen our grid is within reach. What's needed now is bold leadership."

JFE Shoji Power Canada team assembling power transformer core

Will our society step up and meet this challenge? Or will we look back, knowing we had the chance to act, but chose not to? The future is ours to shape. If we act now, we have the power to overcome this challenge and build a stronger, more sustainable future for everyone.

Canada's energy future depends on a stronger, more reliable grid, and JFE Shoji is leading the charge, but we need your help in advocating for smarter infrastructure and renewable energy solutions.

JFE

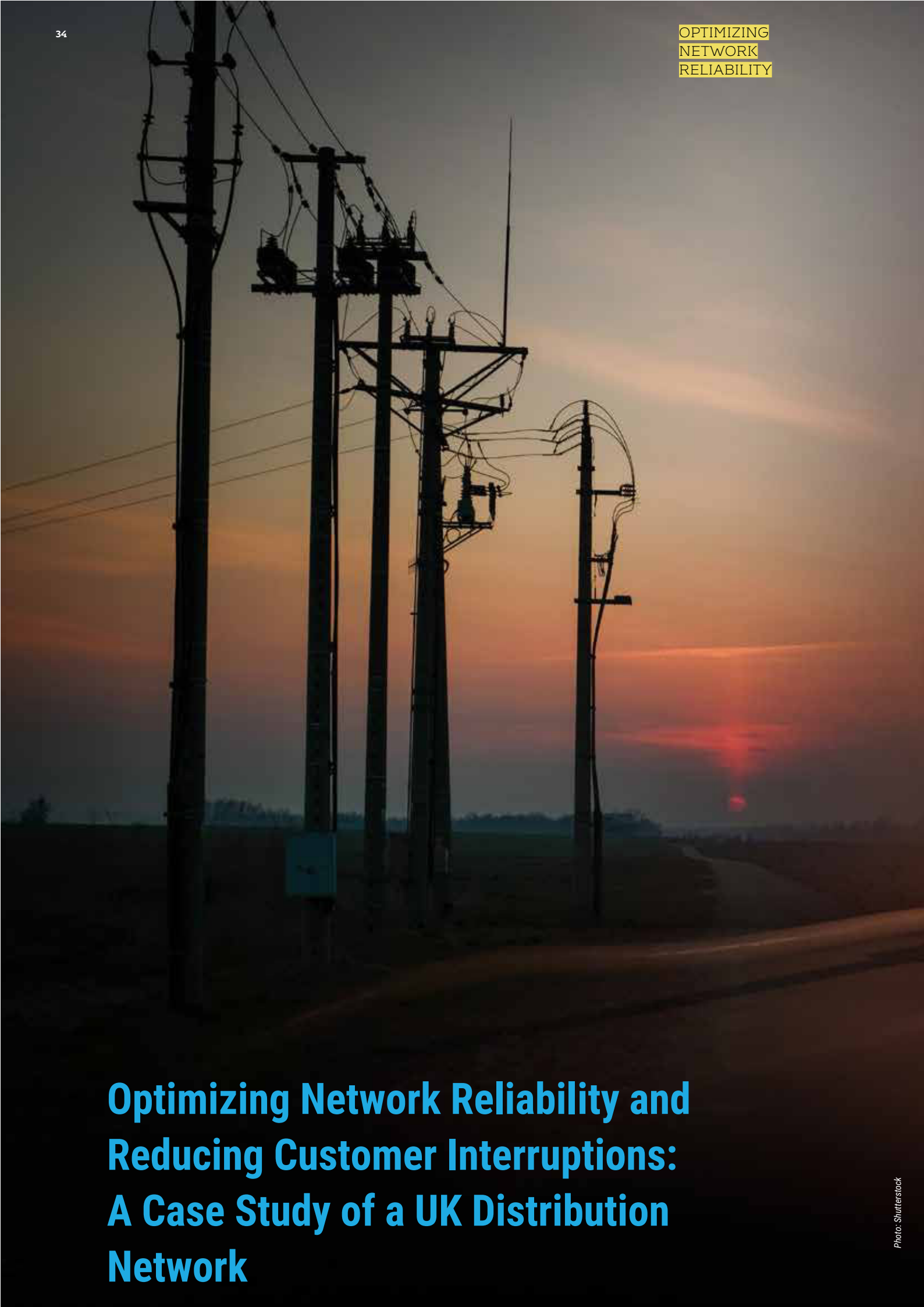
Visit jfeshojipower.com to learn more about our work and how you can take action.

Follow us on social media to connect with a community that shares your vision for a sustainable, stable future.

@jfeshojipowerca

JFE Shoji Power Canada Inc.

Photo: JFE Shoji Canada



Optimizing Network Reliability and Reducing Customer Interruptions: A Case Study of a UK Distribution Network

Photo: Shutterstock

The resilience of electrical networks is more important than ever in an era characterised by the acceleration of climate change's effects and a global transition towards low-carbon energy sources. As a basic requirement for modern society to operate efficiently, reliable electrical infrastructure is not merely something to be desired.

David Mills, PhD, CEng, MIET, Director, Net Zero Transition Team - EA Technology, UK

Dr. David Mills is an accomplished electrical engineer with extensive experience in power systems consultancy and net zero transition strategies. With a PhD in Electrical Engineering from the University of Southampton, David leads the Net Zero Transition team at EA Technology. He specializes in developing innovative solutions to integrate renewable energy and enhance grid reliability. His strategic leadership in managing complex projects across the UK, Ireland, and Australia has established him as a key figure in advancing sustainable energy practices and shaping energy network developments to meet future demands.

Waqas Javed, PhD, CEng, SMIEEE, FRSA, FHEA, Senior Consultant & Team Lead, Network Reliability, Net Zero Transition - EA Technology, UK. Dr. Waqas Javed is a distinguished electrical engineer with over a decade of experience in power systems analysis, specializing in smart grid technologies and sustainable energy solutions. Holding a PhD from Glasgow Caledonian University and a post-doctorate from the University of Glasgow, Waqas has deep expertise in dynamic studies, fault analysis, and the application of AI in smart grids which is pivotal in advancing the net zero transition. Currently, as a Senior Consultant and Team Lead at EA Technology, he leads innovative projects that advance the net zero transition, focusing on enhancing grid reliability and integrating advanced technologies into electricity networks. His technical expertise and strategic insights significantly contribute to the development of sustainable energy practices.

Achieving Net Zero presents complex challenges for industries worldwide.

The Net Zero Transition team at EA Technology work in collaboration with a range of clients globally, to provide essential consultancy services to the energy industry.

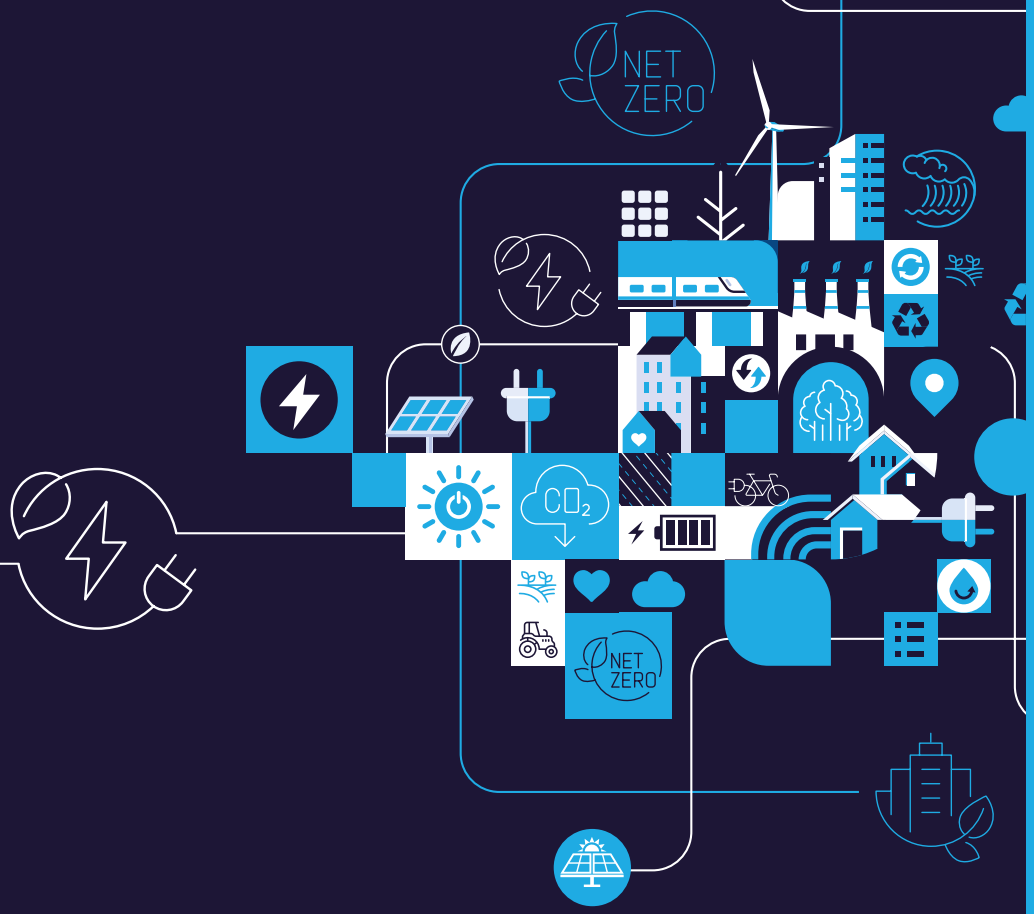
With multidisciplinary expertise, the team assists businesses across a spectrum of sectors - including electricity Distribution Network Operators, Local Authorities and commercial enterprises. The team leverages a wealth of expertise and provides tailored insights to support the journey to decarbonisation.

This analysis, insight and innovation ensures our clients are able to understand the impact of emerging low carbon technologies on their system, requirements for electricity network capacity and how to ensure a resilient system for the future.

At EA Technology we are here to support you in the delivering a net zero future for your customers, solving a range of challenges and ensuring you can:

- Drive innovation and create a competitive advantage.
- Increase investor confidence by showcasing commitment to sustainability.
- Deliver the right energy infrastructure to ensure a cost-effective and reliable electricity supply.

Learn more about the Net Zero Transition Team, Scan the QR code below.



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Comparing forecasts with historical faults of a UK distribution network demonstrates an improved solution to identify where asset health improvements can have the greatest impact on reducing customer interruptions. The study explores how future loading and climate change impacts may affect reliability and prioritize solutions, automation schemes and demand flexibility to offer the greatest supply reliability.

The resilience of electrical networks is more important than ever in an era characterised by the acceleration of climate change's effects and a global transition towards low-carbon energy sources. As a basic requirement for modern society to operate efficiently, reliable electrical infrastructure is not merely something to be desired. The increasing frequency of adverse weather events coupled with the intermittent nature of renewable energy sources like solar and wind means that power networks resilience becomes increasingly important [1].

Utility businesses are getting increased focus on minimising customer interruptions. In addition to interfering with routine tasks, power outages have serious negative effects on the economy, impairing corporate operations, stopping industrial processes, and resulting in millions of dollars' worth of lost output. Outages impact public safety, critical services, and even communication networks on a societal level, underscoring the necessity of resilient networks.

A key component of the electricity distribution infrastructure is the medium voltage distribution network, transmitting power before the final step-down transformer to the customers low voltage connection. In the UK this is typically 6.6 or 11 kV. This section of the grid is under significant strain as the demand for power grows due to urbanisation, population expansion, and the electrification of transportation and heating. In addition, increased frequency of extreme weather events like heatwaves, storms, and floods—all of which have the potential to harm network components.

Utilities may reduce customer interruptions (CIs) and customer minutes lost (CMLs) by using predictive maintenance and automation, which allows them to move from reactive to preventative methods. A more robust and flexible distribution network may be achieved by accounting for load increase, equipment wear, and environmental constraints. Through improved system dependability and customer satisfaction, this method better equips utilities to handle future challenges in the 11 kV network.

Background

Proactive infrastructure investment, predictive maintenance plans, and technology advancements to detect, anticipate, and minimize potential issues are necessary to maintain reliability. The 11 kV distribution network must have adaptability to accommodate increasing demand while maintaining resilience and reducing consumer disruptions as the UK moves towards a low-carbon energy future.

Proactive infrastructure investment, predictive maintenance plans, and technology advancements to detect, anticipate, and minimize potential issues are necessary to maintain reliability.

The 11 kV distribution network must have adaptability to accommodate increasing demand while maintaining resilience and reducing consumer disruptions as the UK moves towards a low-carbon energy future.

In GB, the dependability of power distribution networks is evaluated using key performance indicators such as customer interruptions (CIs) and customer minutes lost (CMLs) [2] [3]. These measurements are essential for comprehending network performance and promoting changes to reduce interruptions with the distribution networks receiving regulatory incentives for their improvement.

The two globally recognized indices, SAIFI (System Average Interruption Frequency Index) and SAIDI (System Average Interruption Duration Index), are frequently used to convey these metrics [4]:

SAIFI determines the average number of outages per customer, indicating the frequency of disruptions, whereas SAIDI evaluates the average total time consumers encounter interruptions, usually in minutes or hours, representing how well the network recovers from failures. SAIDI and SAIFI together offer a thorough understanding of network resiliency.

Methodology

The case study is carried out to investigate the potential reliability challenges for a set of 11 kV feeders in UK network. The feeders are modelled in the EA Technology, Target Model® (hereafter known as Target)

Figure 1:
Target Model Capability

which has the capability to simulate various network conditions depending on the failure rates of the electrical assets. Target performs the reliability analysis by also finding the optimum location for system automation to improve network's reliability (Figure 1).

Network Feeders Data

Two random feeders' data is established similar to the UK distribution

Network named Feeder X and Feeder Y. Feeders data for modelling is presented in Table 1 and Table 2.

To enable the modelling evaluation, load attached to each feeder requires load profile where each customer is assigned a load profile with 48 half-hour demand values.

Asset Failure Rates

Determining failure rates at individual assets, feeder, or network-wide granularity is crucial for asset failure analysis. Increased granularity improving accuracy but requiring more historic failure and condition data to inform correctly.
By concentrating on the most important assets and feeder portions where failure rates have the greatest potential impact, this enables more informed decision-making and increases network resilience.

Results

In this analysis, reliability metrics are quoted in number of customer interruptions (CI) per year and customer minutes lost (CML) per year.

Total CI = ∑ (Substation Interruptions x No. of customer supplied) [5] (1)

Total CML = ∑ (Substation outage in minutes x No. of customer supplied) [5] (2)

Target Model® Reliability Analysis for Feeder – X

The reliability results forecast by Target for feeder X are summarised in Table 3 before any further actions are taken to enhance customer reliability outcomes.

Optimum Switch Placement Analysis for Feeder – X

There are five normally closed switches being used in Feeder -X for substations 1, 3, and 5, as can be observed in Figure 2. However, there is no switch between connection point C and the primary substation. This means may lead to total outage of substation 2 (losing supply to all the customers for SS-2) in case when

Table 1:
Feeders Data

Feeder Name	Distribution Substation Representation	No. of Distribution Substations (11/0.415) kV	Distribution Transformer Type	Overhead Lines (OHL)	Underground Cables (UGC)	No. of Switches
X	< 10	4	Ground Mounted	0	1.04 km	6
Y	>100	109	Pole Mounted	44.8 km	2.26 km	103
		12	Ground Mounted			

Table 2:
Distribution Feeder Discrimination

Feeder	%age OHL	%UGC	%age Pole Mounted Tx.	%age of Ground Mounted Tx.	No. of Customers	Normally Open Switches
X	0	100	0	100	437	1
Y	95	5	90	10	881	4

Table 3:
Reliability Analysis for Feeder - X

Elements	Value	Units
Total no. of Substations	4	Count
Total no. of customers	437	Count
Total CI per year	17.7	Count
Total CML per year	5897	Minutes
Relevant Substation for worst affected customers	SS-3	Name of substation
Relevant Substation having longer CMLs	SS-2	Name of substation
Number of faults per year	0.04	
SAIFI	0.04	
SAIDI	14.52	

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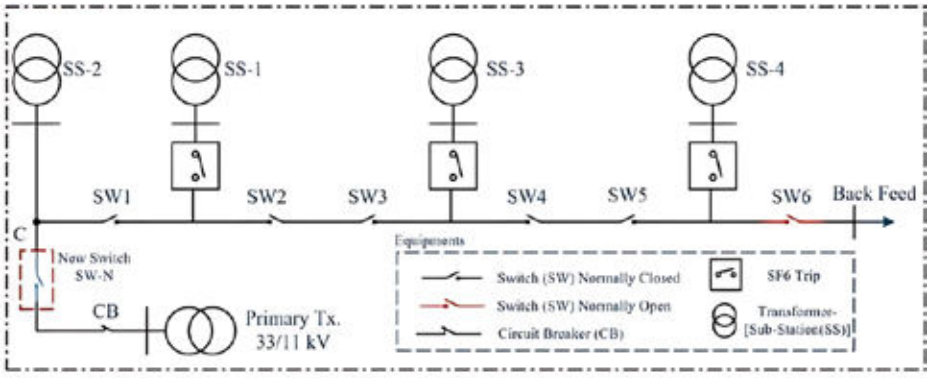


Figure 2:
Feeder - X with Switch Enforcement

fault arises on the line coming from primary transformer.

Hence, a switch has been placed on the line as shown in Figure 2 which will isolate the fault on that line by operating the circuit breaker of the primary transformer. In this case, the supply to SS-2 can be maintained from the back feed side of the network.

Figure 3 demonstrates clearly that by adding a switch at the specified location reduces the CMLs significantly for substation-2 (SS-2).

This also leads to the reduction in SAIDI values for SS-2.

Target Model® Reliability Analysis for Feeder – Y

For feeder Y, Target estimated the reliability metrics as presented in Table 4.

Target simulations identified the assets which are contributing the most towards the outages by calculating the CIs and CMLs for feeder – Y. This helps to identify the specific lines which lead to the maximum number of customers lost if that line fails. Figure 4 and Figure 5 represents the CIs and CMLs respectively sorted by line ID.

Network planners can then evaluate whether intervention to one of these circuits can increase their customers' supply reliability by combining these two figures. For instance, taking asset repair, network expansion, or network reconfiguration into consideration. All of these are intended to lessen the likelihood or impact of asset failure on customer reliability. For example, Line 47 contributes the largest number of CMLs which allows to plan asset replacement in advance to minimise the impact.

Furthermore, from Figures 4 and 5, it can be observed that Line 237 identified as the common contributor towards high CIs and CMLs in the network. Hence, this takes the higher priority for Line 237 to be considered for improvement. In this network, Line 237 is an overhead line running across several agricultural fields supplying a small settlement. In this instance, by reducing the probability of failure (PoF) of the line assuming that some upgrade may be considered from the planning engineer. To determine the efficacy and timing of any action, all of these choices are simulated while accounting for variations in asset health, consumer demand, and weather patterns.

Simulation results after the Line 237 upgrade, shows the level of CIs and CML improvement for the asset.

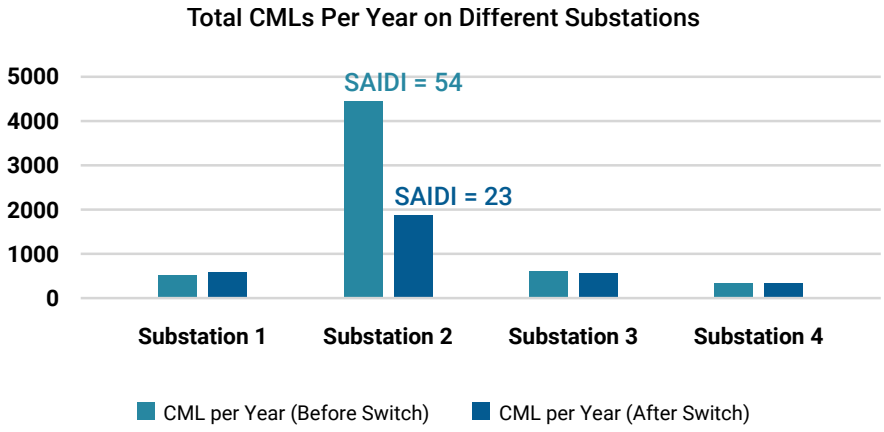
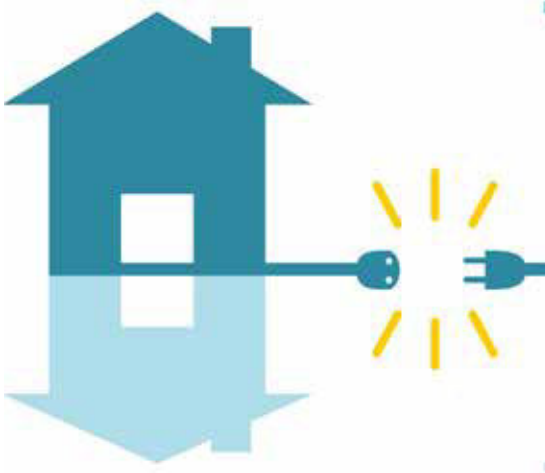


Figure 3:
Customer Minutes Lost (CMLs) for Feeder - X

Table 4:
Reliability Analysis for Feeder - Y

Elements	Value	Units
Total no. of Substations	121	Count
Total no. of customers	881	Count
Total CI per year	3091	Count
Total CML per year	345,575	Minutes



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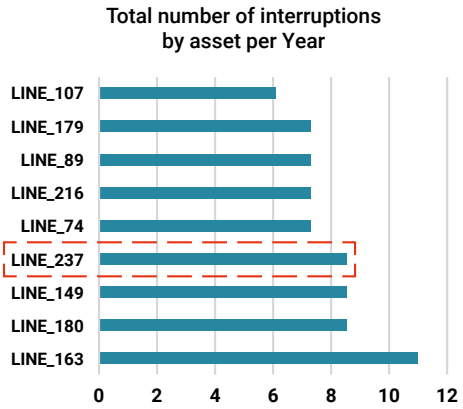


Figure 4:
CI Contribution by Asset

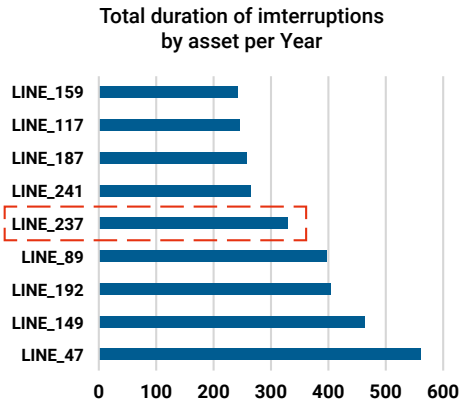


Figure 5:
CML Contribution by Asset

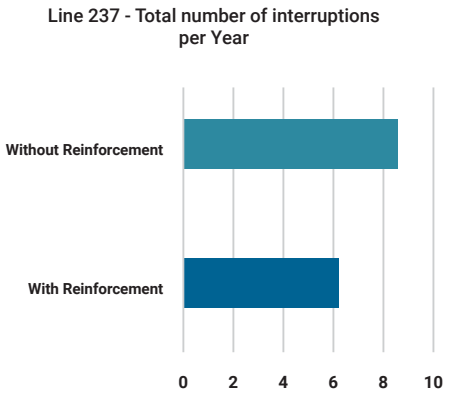


Figure 6:
CI for Line_237

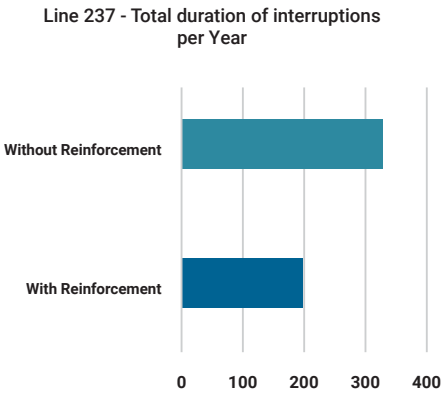
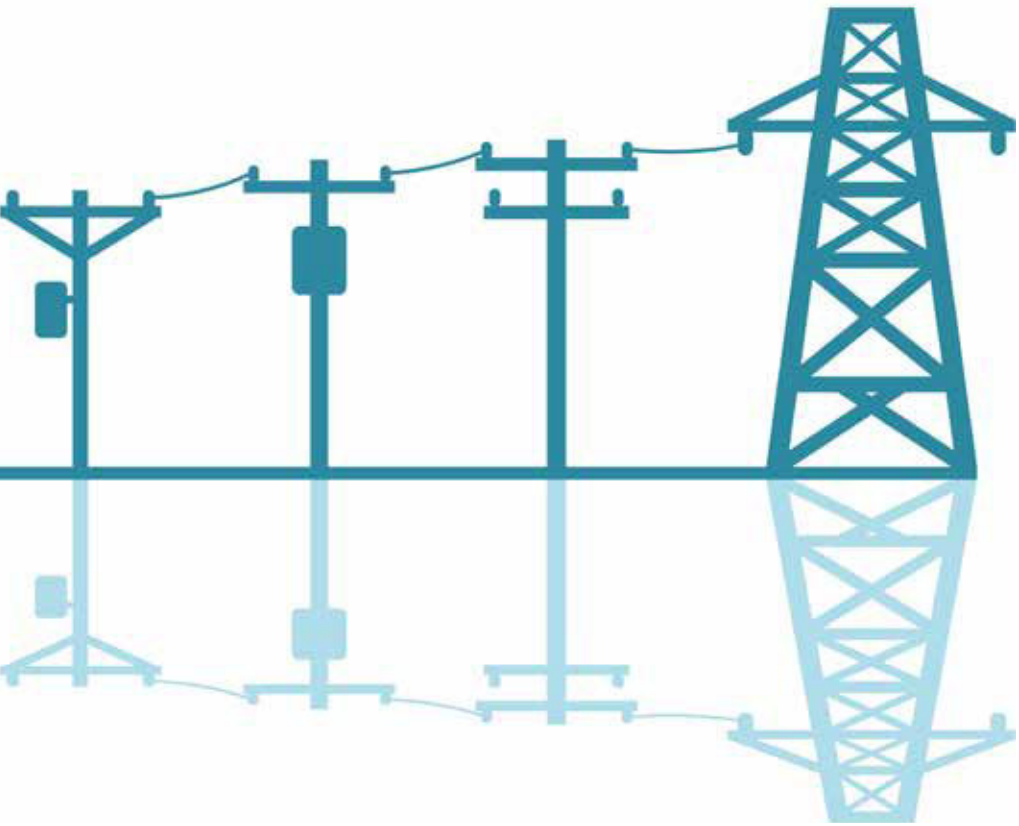


Figure 7:
CML for Line_237



Conclusion and Analysis

This study has shown how network operators may better forecast the supply reliability that their customers encounter through combining historic failure data, changes in asset health and future demand on electricity distribution networks. This has enabled distribution networks in the UK to identify priority areas for network reinforcement and opportunities to introduce automation for further reliability improvements.

An examination of a simple feeder (X) demonstrated how the addition of a new switch might dramatically reduce the duration of customer interruptions (CML). This offers a useful tool to network operators looking to cost-effectively prioritise network automation to improve customer supplies.

In the study for a more complex feeder (Y), the study showed how impact of future asset health conditions can be mitigated. Hence, this investigation shows how each asset influences future CIs and CMLs, giving the network operator the ability to prioritise circuits for repair or replacement.

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2024 International Conference of

Matthew Carrara is President of Doble Engineering and ESCO Utility Solutions Group (USG) and leads Doble's vision and growth strategy.

Matthew Kennedy is Senior Director, Solutions & Project Management at Doble Engineering.

Doble Clients

Robert Brusetti leads Doble Engineering's professional services organization, including client service, field testing, transformer consulting and lab services in North America.

Nicholas Chiccarelli is Laboratory Operations Manager at Doble Engineering.

Alan Ross: My first interview is with Matt Carrara, the President of Doble. Matt, thank you for inviting us here to the Doble Client Conference 2024.

Matt Carrara: Our pleasure Alan. We appreciate you and APC Media being here.

AR Matt, we met a year ago when you first joined Doble and did an interview. What has changed in that year and how has the experience been?

MC Yes, you and I met, I think it was at DistribuTech, when we did the interview and I was three months into the role, new to the industry, wondering what you were going to ask me and how I was going to respond. My main focus for the last 12 months was to learn about the business and the people first and then focus on the industry. The first six months was really an internal learning for me, getting to know the people, getting to know the culture and for the last six months I've been really focused on learning what's going on in the industry.

AR Before we talk about the client conference, let's talk about the industry. I believe that our industry, the power industry, has gone through more change in the last 5-7 years than we have in the past 50 years, maybe even 100 years. Where is the industry today?

MC We celebrated our 100-year anniversary in 2020, and 2023 was the 90th year for the client conference, so a lot of history, a lot of legacy, and a lot of knowledge.

I think where we are right now, we know that the infrastructure is a challenge, and we know there's a huge amount of demand that is required of the grid. One of the things that I spoke about in my opening at the conference was last year they had forecasted a demand increase for the grid over the next five years.

Photo: Shutterstock

It came out at the end of last year that the actual growth was twice what was forecasted. One of my messages was the challenge of creating budgets for OpEx, CapEx, managing hiring practices; all while the government is bringing down funding for utility companies. All of a sudden, you realize, I need twice as much. So right now, I think the challenge in the industry is on funding, on components, on people, and on how we continue to grow and expand the grid, balancing the need for more power when budgets are not keeping up.

> I think the challenge in the industry is on funding, on components, on people, and on how we continue to grow and expand the grid, balancing the need for more power when budgets are not keeping up.
> **Matt Carrara**

AR You have a perspective from other industries that might be very helpful for where we are. Do you see capital coming into the industry that might make up that gap, between government investment and the need for expansion?

MC Well, we certainly see a lot of capital coming in on wind and solar. As you know, we have a group that is in that space right now. What we're finding is it's not about investment, it's not about money. It's the time for the permitting to take place. Again, there's another chokehold in that area. But yes, a lot of wind farms and solar farms are being handled and managed by private organizations.

There is a graphic that I recently saw that shows how long it takes for the money, once a project is identified, to roll down in the organization. It showed 70 to 80 steps, and they can stop anywhere along the way. So, it's not just the available money but funneling the project through the process. That's a big thing we have to fix. 70 to 80 steps for permitting. That is a huge bottleneck.

AR Where do you see the industry going over the next 5-7 years?

MC Well, I think the challenge is the same as when we spoke last year. It's what to do with the data. Because part of the issue is you have a group of individuals in the industry that are now retiring and moving on to the latter part of their life or their career, and you have all these new people coming into the industry. There is a big knowledge, expertise, and experience gap between those who are retiring and the new people coming into the industry. What we find is that they are coming to us for training, for information. What can we do with all the data for them? Can we do the analysis for them? I think you're going to see a big migration of data continuing over the next one to five years. But the challenge is that someone needs to find a way to aggregate all that data, which makes sense to the utility company because we're being tasked with making the decision for them that they could then validate before they make a change or make an adjustment. To me, it's data.

AR Matt, we will be publishing our entire interview in February 2025, but for this Special Feature on the International Conference of Doble Clients, how has it been thus far and what has stood out for you?

MC I just looked at it before I came over to the interview and we have 1,400 people who came this year. That is huge, the biggest we've had ever in the history of the event.

AR You must have a message, for what you want internally your people to focus on. Just give me a quick rundown.

MC The quick message for me was getting people that attend this show and those who did not attend the show, to come next year. We're trusted partners. We're helping the utility system get through this journey. We're giving them the data and the information and the testing they need to secure and make sure that their assets are reliable and resilient.

But at the end of the day, the message was, “We want to be your partner”. We have done a really good job this year. This is, like I said, the biggest show ever. At the end of the day, people are coming to this show, so we're pushing the learning, the conferences, the training.

There is a lot of collaboration, with over 642 specific clients in the utility industry, sitting in sessions, exchanging ideas, talking about storm preparedness, and how to react for when a transformer goes down. Also, we are sharing about how to react to another situation via

domestic terrorism, or maybe when someone puts a virus in the system. All of those conversations are going on here. For us, we hope the show gets bigger and bigger, and we want to show that our 100 years of data and experience can help them as we move forward.

For us, the Doble message is trust and partner.

AR Is there cross-collaboration between utilities that are here? Are they being able to share with each other?

MC Most of the committees that people are sitting in are people from various types of utility companies. I've noticed that the collaboration and the discussions are open because they're all facing the same challenges. If they can learn from each other, help them see the grid and help them keep the lights on and can be part of it, I think it's wonderful.

AR Thank you so much, Matt.

MC Thank you, Alan. Let's do this again next year. Every year.

AR My next guest is Robert Brusetti, the Vice President of Professional Services in North America at Doble.

Robert thank you for joining us at the 2024 Doble Client Conference. I understand it's the largest attendance you've ever had.

Robert Brusetti: Yes, it is. It's a very impressive attendance that we have this year. It covers a lot of the North American client base.

In the fall, we have a smaller meeting, about 150 people, primarily managers and asset managers, engineers. We get together and we decide on the program for this event. It's a full week of sharing experiences and challenges. We put that all together and it ends up creating this program.

We have 51 technical papers throughout the week here with Doble presenting about a third of them. Another third are papers that Doble engineers and clients collaborate on, and the other third are our clients themselves or an OEM that has be asked to address an issue and possibly a solution.

It all goes back to why it is so successful. There's an appreciation that there's not a lot of avenues for power engineers to continue to evolve in their profession. And the people in the industry realize this is an opportunity to grow professionally.

> It all goes back to why it is so successful. There's an appreciation that there's not a lot of avenues for power engineers to continue to evolve in their profession. And the people in the industry realize this is an opportunity to grow professionally.
> **Robert Brusetti**

AR What do you think is unique about this conference, Robert?

RB Because we don't build the products that generate, transmit, and distribute electricity, it affords us the opportunity to take an independent view of the whole process. This is why there are a lot of people here because we set expectations, and we review every presentation before it is presented to make sure it is technically solid.

AR Robert, thank you so much and thank you for putting this conference on and inviting us to come here and film.

RB Thank you, Alan, for the opportunity to present our point of view.

AR My next guest is G. Mathew Kennedy, Senior Director, Solutions and Product Management at Doble. Matt, thanks for joining us. As mentioned previously by some of your fellow leaders at Doble, this is the largest conference you have ever had. What are some of the key ideas you are hoping to share with your clients, focusing on the solutions component of your job?

Matthew Kennedy: Thanks for having me, Alan. There is so much to share. Let's start with a few key principles.

To use some of the "buzz" words for a moment, Artificial Intelligence (AI) and Machine Learning are things we are really looking at. If you can take information that is already there and you can layer and analyze it in a machine learning environment, you can start to really predict

how that asset is going to perform over time. I used to think that was going to be an impossible thing. I don't think that anymore. You see it. I can see it. I can taste it. I want it so bad. But I think we're going to start small. We're going to start with smaller components, the higher mechanical systems, like load tap changers that are inside of the transformer that are a little more problematic, some of the higher stress devices like bushings we can start to model, but we'll start to build that model out. Then we can interconnect models together. That is where digital twins become essentially digital twin maps. You're mapping systems together,

> Our goal at Doble, when it comes to resiliency, is that we have to make sure that when we are providing our analysis, our tools for a customer so they can analyze an asset, that they know that the systems that they are investing huge amounts of capital into are going to be able to provide that backup function into the system.
>
> **Matthew Kennedy**

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and that is going to be where you really start. That will become very operationally important to a utility.

AR I've come to add to my simple "Safety and Reliability are two side of the same coin" talk, the idea that sustainability and resilience are the other two sides of the same cube. Talk a little about resilience and what you are seeing presented here at the conference?

MK Our goal at Doble, when it comes to resiliency, is that we have to make sure that when we are providing our analysis, our tools for a customer so they can analyze an asset, that they know that the systems that they are investing huge amounts of capital into are going to be able to provide that backup function into the system. Resilience, I see, is really about making sure that you have backup systems that can essentially feed around, bypass or hook into, whenever another system might fail.

But it's also about trying to predict when an asset might be switched out ahead of time, so you can make those decisions. Our role in that, providing resiliency, is making sure that they have the tools they need for those assets that are out of service. If you have a system that's out of service waiting to be put in place, you don't have a service monitoring on those. You have to go back to those first, the older methods of analyzing it. So that's important to have. We must make sure a customer is looking at that and saying, "What can I do if these assets are out of service?" Or maybe they are merely not as highly loaded, so what can I be doing to make sure that if they have to be put into a primary position, they're ready to handle the load?

AR My next guest is Nicholas Chiccarelli, Lab Services Manager at Doble. This is the best attendance you've ever had, 1,400 people. Talk a little bit about your role, your experience. What do you see here about halfway through the conference as we do this interview?

Nicholas Chiccarelli: I am seeing a lot of excitement. I think that's really what it's about. I see a lot of people connecting. I think this conference brings people together to have conversations, not just by email or phone calls. I just had a conversation with one of my customers that I've talked with for a while, and we have some key things that we want to work on together. I saw him stand up and he was asking a question in one of the sessions. I thought, "Oh, my goodness I need to introduce myself." I immediately made a beeline right for him. I think that is what it is all about. You are making that personal connection. I think that's what really drives a lot of us is going out and making those personal connections. Now someone feels comfortable coming to me after we have put a face to a name. When they have a question, they think "I need to call Nick" or some other person they met here. Having that level of connection and driving innovation and making sure you're making the right decision, informed decisions on whatever it is you're working on, whether it's any of our protection products or any professional service question; those are the things that we offer here.

> "Having that level of connection and driving innovation and making sure you're making the right decision, informed decisions on whatever it is you're working on, whether it's any of our protection products or any professional service question; those are the things that we offer here.
> **Nicholas Chiccarelli**

AR Are there any specific things that stand out based on your role at Doble?

NC Because our customers, our clients, don't know everything about the oil in their transformers, that is where they come to us. That is where we really fit in. We can then guide them in the right direction. And we can sometimes do that through our professional service staff and our client service engineers to communicate through them to make sure the customer gets what they want which most often is good information to make good decisions. They might not know how to express what they want. They know there is an issue, and then we can get involved in trying to figure out what that is and how to remedy it.

AR A big thank you to all the interviewees from Doble for sharing their insights. This was but a brief glimpse of the Doble Client Conference. The full video interviews, as well as other attendees, will be available on our You Tube channel.

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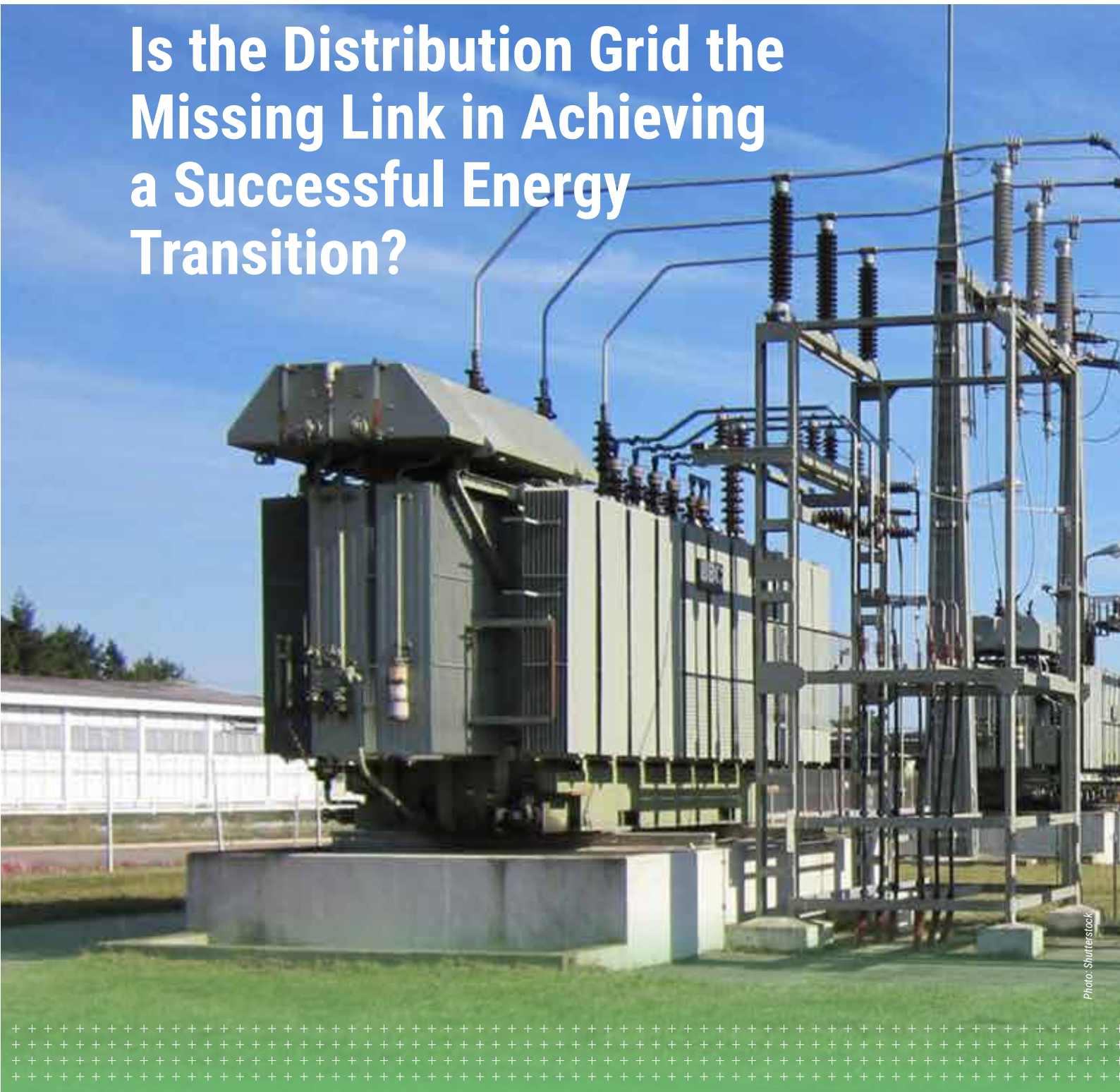
Is the Distribution Grid the Missing Link in Achieving a Successful Energy Transition?

By 2030, electricity demand in the United States is projected to surge significantly, reaching 4,300 TWh, according to PTR forecasts. This increase is driven by the widespread adoption of electric vehicles (EVs), the rapid expansion of data centers, and the electrification of heating and cooling systems. Simultaneously, integrating distributed energy resources (DERs) such as solar photovoltaics (PV), wind turbines, and battery storage—is accelerating. Utility-scale solar PV and wind capacity are expected to expand to 625 GW, including 365 GW from solar PV alone. These shifts are trans-forming the energy landscape and placing unprecedented pressure on the existing power infrastructure.

Historically, the bulk transmission network has overshadowed the US distribution grid—the complex network of power lines and equipment that delivers electricity from substations to industries, businesses, and homes. Once viewed as a passive conduit for one-way electricity flow from centralized power plants to consumers, the distribution grid is rapidly evolving into an active, intelligent network capable of real-time response and management. This transformation is essential due to the convergence of several key factors reshaping the power grid landscape.

Transitioning from a passive to an active grid is not merely a technical upgrade; it is a strategic necessity to meet evolving electricity needs while driving economic growth and promoting environmental sustainability.



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ONCE VIEWED AS A PASSIVE CONDUIT FOR ONE-WAY ELECTRICITY FLOW FROM CENTRALIZED POWER PLANTS TO CONSUMERS, THE DISTRIBUTION GRID IS RAPIDLY EVOLVING INTO AN ACTIVE, INTELLIGENT NETWORK CAPABLE OF REAL-TIME RESPONSE AND MANAGEMENT.

Saqib Saeed is a highly accomplished market research professional and a data storyteller in the international energy industry. With over a decade of experience in the field, he currently serves as the Chief Product Officer at PTR Inc. His expertise lies in the power grid and e-mobility equipment sectors. Saqib has overseen numerous global market research studies throughout his career and provided valuable insights to key decision-makers at various Fortune 500 companies. He is a member of the editorial board for Transformers Magazine and a member of the Advisory board of CWIEME Berlin and Middle East Energy. In addition to his market research career, Saqib has worked as an Electrical Engineer in the manufacturing sector.

TRANSITIONING FROM A PASSIVE TO AN ACTIVE GRID IS NOT MERELY A TECHNICAL UPGRADE; IT IS A STRATEGIC NECESSITY TO MEET EVOLVING ELECTRICITY NEEDS WHILE DRIVING ECONOMIC GROWTH AND PROMOTING ENVIRONMENTAL SUSTAINABILITY.

Key Drivers for Modern Distribution Grid

The following drivers are fundamentally transforming electricity consumption patterns, which is resulting in unique requirements on the existing grid infrastructure.

Widespread Adoption of Renewable Energy

PTR forecasts utility-scale solar PV capacity to exceed 365 GW by 2030, a significant increase from 2023 levels. This growth will be driven by substantial federal tax credits, grants, and investments from the Inflation Reduction Act (IRA) and the Infrastructure Investment and Jobs Act (IIJA), which together are allocating a significant portion of $450 billion to the clean energy sector.

The increase in DERs is already evident, as demonstrated by the interconnection queue for renewable generation and storage projects, which grew by 30% in 2023, reaching 2,600 GW. Even though the lack of transmission grid development is a key factor behind this massive interconnection queue, a large portion of this planned renewable capacity will be connected to the distribution grid. Integrating such a vast amount of new capacity will require a more flexible and responsive distribution grid capable of managing intermittent generation and maintaining grid stability.

Increased Electricity Demand Fueled by EV and Data Center Segments

According to PTR, electricity consumption in the US is expected to rise by 7.5% between 2023 and 2030, reaching approximately 4,300 TWh by the end of the decade. Two key contributors to this growing demand are the massive surge in EV charging requirements and the exponential growth of data centers.

- **Massive EV Charging Requirements:** PTR projects the active fleet of EVs in the U.S. to expand sixfold between 2023 and 2030, necessitating the deployment of millions of new charging points by the decade's end. This could result in a 15-fold increase in electricity demand originating from the transport sector.

  These charging points will be fast chargers with bidirectional power flow capabilities. Additionally, technology is evolving rapidly, with megawatt (MW) scale chargers expected to reach the market by 2025, offering ultra-fast charging for heavy-duty vehicles and large fleets.

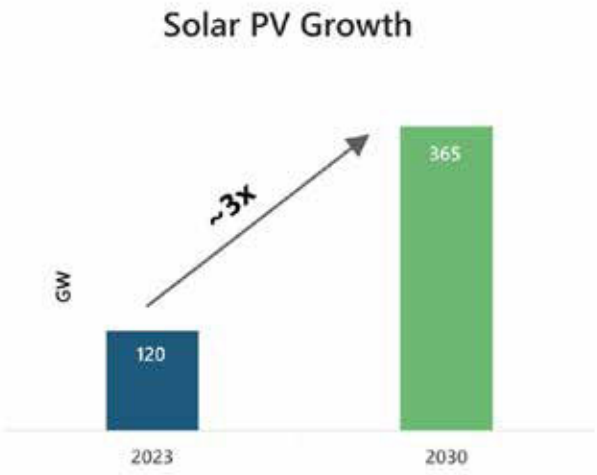

Figure 1:
Solar PV Installed Capacity Forecasts.
Source: PTR Inc.

ELECTRICITY CONSUMPTION IN THE US IS EXPECTED TO RISE BY 7.5% BETWEEN 2023 AND 2030, REACHING APPROXIMATELY 4,300 TWH BY THE END OF THE DECADE. TWO KEY CONTRIBUTORS TO THIS GROWING DEMAND ARE THE MASSIVE SURGE IN EV CHARGING REQUIREMENTS AND THE EXPONENTIAL GROWTH OF DATA CENTERS.

PTR's DC public charger forecast projects higher demand for faster EV chargers, which are expected to grow at a CAGR of 28%, while low-power DC chargers will expand at a slower CAGR of 19%.

However, the distribution grid wasn't built to handle concentrated, high-demand installations. It was designed for steady, predictable power use, not for managing large and unpredictable loads from such high-power infrastructure.

- **Exponential Growth of Data Centers:** Advancements in generative AI and increasing reliance on cloud computing are driving the country's rapid expansion of data centers. PTR research suggests that in 2023, data centers accounted for 2-3% of total US electricity consumption; by 2030, this is expected to rise to nearly 6%, with peak power demand potentially doubling due to increasing computational needs.

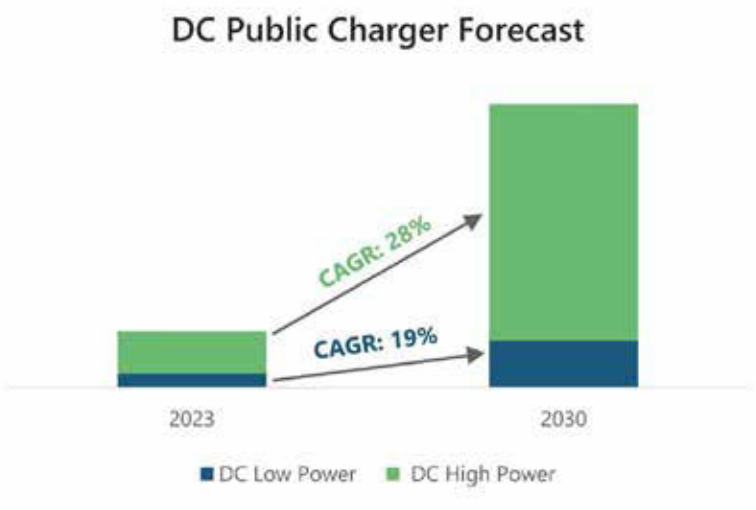

Figure 2:
Projected Growth of DC Public Chargers (2023-2030).
Source: PTR Inc.

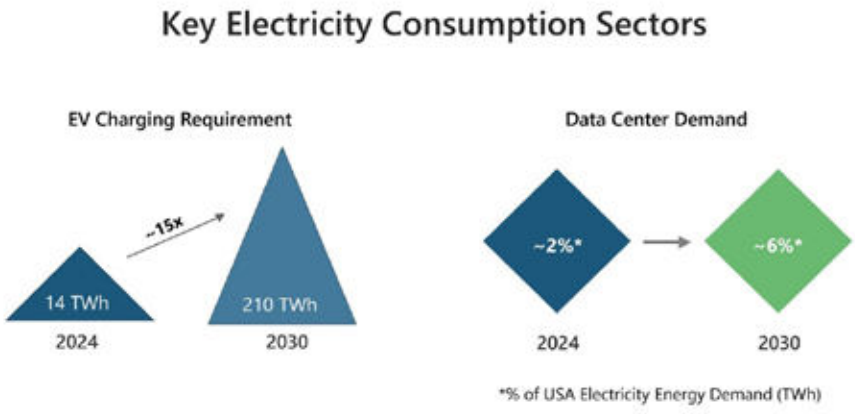

Figure 3:
Projected Electricity Consumption Growth in Key Sectors.
Source: PTR Inc.

Rising Climate Threats Highlight the Urgency of Strengthening the Aging Grid

The growing frequency of extreme weather events due to climate change—such as hurricanes, heat-waves, and wildfires—puts additional strain on the already aging distribution grid, as evident by the increased power disruptions. According to PTR's research, utilities allocated 10% of their investments in 2023 to enhancing grid resilience, a figure expected to double to 20% by 2030. This underscores the urgency of modernizing the grid to handle rising demand better, integrate renewables, and increase resilience against climate-related threats.

The Consequences of Neglecting Distribution Grid Modernization

Failure to modernize the US distribution grid poses significant technical and financial risks that could adversely impact grid stability, the pace of the energy transition, and long-term investment costs.

Grid Instability and Reliability Issues

An outdated distribution grid is more susceptible to instability and

THE GROWING FREQUENCY OF EXTREME WEATHER EVENTS DUE TO CLIMATE CHANGE—SUCH AS HURRICANES, HEATWAVES, AND WILDFIRES—PUTS ADDITIONAL STRAIN ON THE ALREADY AGING DISTRIBUTION GRID, AS EVIDENT BY THE INCREASED POWER DISRUPTIONS.

reliability problems. Unstable grids with insufficient network capacity and inadequate reactive power management face increased voltage and frequency fluctuations risks. These fluctuations can lead to more frequent power outages, voltage sags, and other supply faults, severely impacting electricity supply security.

- **Reactive Power Management and Inertia Deficiency:** Reactive power is essential for maintaining voltage levels for efficient electrical power transmission. Without adequate reactive power control and grid inertia, the system becomes more prone to voltage fluctuations and frequency deviations. The increasing penetration of DER, which often lacks inherent inertia, exacerbates this issue.

- **Network Capacity Challenges:** Rising electricity demand is putting a significant strain on the current grid. Without upgrades, the grid's capacity becomes a bottleneck, preventing it from supporting the increased load. This slows down the adoption of new technologies and leads to reliability issues.

AN OUTDATED DISTRIBUTION GRID IS MORE SUSCEPTIBLE TO INSTABILITY AND RELIABILITY PROBLEMS. UNSTABLE GRIDS WITH INSUFFICIENT NETWORK CAPACITY AND INADEQUATE REACTIVE POWER MANAGEMENT FACE INCREASED VOLTAGE AND FREQUENCY FLUCTUATIONS RISKS. THESE FLUCTUATIONS CAN LEAD TO MORE FREQUENT POWER OUTAGES, VOLTAGE SAGS, AND OTHER SUPPLY FAULTS, SEVERELY IMPACTING ELECTRICITY SUPPLY SECURITY.

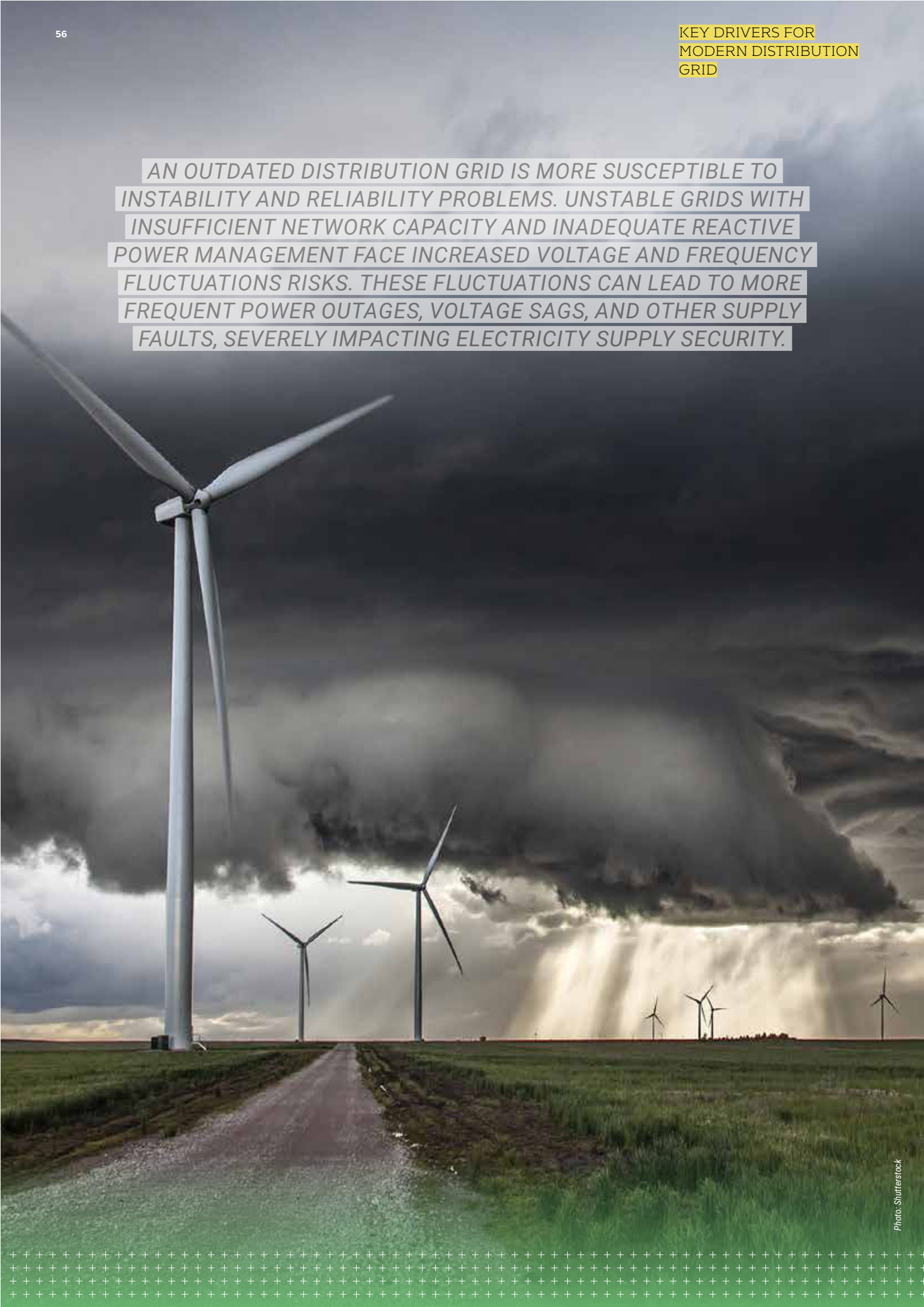

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Figure 4:
The Consequences of Neglecting Distribution Grid Modernization.
Source: PTR Inc.

- **Challenges in Managing DERs:** The increasing penetration of DERs requires sophisticated real-time control systems for effective management. Traditional grids lack the necessary infrastructure to handle two-way power flows and the variability associated with renewable energy sources. Without advanced distributed energy management systems, the grid struggles to balance supply and demand, leading to inefficiencies, potential overloads, and increased risks of blackouts.

Slowing the Pace of Energy Transition

An outdated and inflexible distribution grid significantly hampers the US's progress toward a sustainable energy future and delays decarbonization efforts. This bottleneck could jeopardize the achievement of critical climate goals, such as the 50-52% reduction in GHG emissions by 2030 and the commitment to net zero emissions by 2050.

Furthermore, the push to achieve a 100% carbon-free electricity mix by 2035 and ensure that all new light-duty vehicles sold are zero-emission by 2035 could be significantly delayed without modernizing the grid. If these targets are missed, the US risks losing its competitive edge in the global race for clean energy leadership.

Escalating Investment Costs

Delaying grid modernization raises technical challenges and increases costs over time. Postponing upgrades can lead to skyrocketing expenses, with reactive maintenance and emergency overhauls being far more costly than planned improvements. As the grid deteriorates, frequent failures will drive up maintenance costs. Without timely upgrades, deferred maintenance and disruptions will lead to higher utility rates and economic losses, burdening utilities and consumers.

Strategies to Lead Energy Transition in the US

To address these challenges and capitalize on the opportunities, stakeholders must adopt comprehensive strategies for grid modernization.

Invest in Smart Grid Technologies to Enhance Resiliency

Deploying advanced solutions such as Advanced Metering Infrastructure (AMI), AI-driven grid management, and energy storage integration is essential for improving grid performance and resiliency.

Additionally, upgrading physical infrastructure, including overhead line hardening, undergrounding, and capacity expansion, will strengthen the grid against physical and environmental stressors.

Embracing microgrid solutions can also improve reliability, ensuring that power systems remain robust despite demand fluctuations and extreme weather events.

Moreover, integrating grid-enhancing technologies, such as Dynamic Line Rating (DLR) and intelligent communication systems, will allow for real-time monitoring and control, further optimizing grid efficiency and adaptability. Standardizing technologies will ensure seamless integration and scalability as future advancements emerge.

Incorporate Cybersecurity Protocols

Ensuring robust cybersecurity is non-negotiable for modern grid infrastructure. Following guidelines from agencies like the Department of Energy's (DOE) Office of Cybersecurity, Energy Security, and Emergency Response (CESER) will help safeguard the grid against potential cyber threats, which are expected to rise as the grid becomes more digitalized and interconnected.

Leveraging Legislation for Grid Resilience

Initiatives like the DOE's Grid Modernization Initiative (GMI) and the Grid Deployment Office (GDO)'s Grid Resilience and Innovation Partnerships (GRIP) program, which offers $10.5 billion through various financial instruments funding, provide critical frameworks for enhancing grid flexibility and resilience, creating opportunities for utilities to improve infrastructure and reduce operational risks.

Conclusion

The urgency to modernize the US distribution grid has never been more unmistakable. With electricity demand surging, the rapid adoption of renewables, and the increasing impacts of climate change, it's critical that stakeholders act now to upgrade and future-proof the grid. Investing in innovative technologies and infrastructure today will ensure a resilient, reliable, and sustainable energy system for the future.

PERSPECTIVES

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Meat and Potatoes Transformer Maintenance

With supply chain issues, long lead times, and the cost of being down due to an electrical failure, the need for maintaining and monitoring your power transformers is becoming increasingly more important. Developing a maintenance program, and implementing it on a scheduled basis, will help system operators monitor critical assets and deploy corrective actions before a failure may occur. With the tools at hand and the technology available, owners of these assets can develop comprehensive maintenance programs to determine the overall health of their units.

When developing a maintenance program for a transformer, we like to break it down into six main categories:

- Insulating fluid
- Physical and mechanical condition
- Auxiliary controls and indicators
- Winding construction
- Winding insulation
- Bushings

At the base of any good transformer maintenance program, is testing of the transformers insulating fluid. Abnormalities occurring within the transformer can almost always be detected early on via an analysis of the transformer oil. Oil sampling can be performed online without interruption to operation and the information gathered can be invaluable to catching potential problems at their inception. We typically recommend performing oil sampling, at minimum, on an annual basis. Regular sampling will help develop a trend of continuing transformer health. For high value units we also recommend considering an online oil monitoring system that can sample the oil on a continuous basis and alarm facility managers at the earliest onset of an issue. Similar to blood test results, transformer oil samples can give insight to many underline issues and testing should be completed on a routine and frequent basis.

At the base of any good transformer maintenance program is testing of the transformer's insulating fluid. Abnormalities occurring within the transformer can almost always be detected early on via an analysis of the transformer oil. Regular sampling will help develop a trend of continuing transformer health.

Verifying the physical and mechanical condition of the units is also a useful tool that can be completed on a frequent basis with little interruption to normal operation. Verifying positive pressure on gas blanketed transformers, inspecting for leaks, and assuring fans, coolers, and pumps are all operating, may seem routine but is an integral part of a transformer maintenance program. Most of these checks can be performed online and can be completed by site personnel with minimal training in transformer maintenance. So long as you know where to look and what to look for, regular physical and mechanical inspections can help detect the onset of potential issues before they become an emergency.

The final part of a comprehensive transformer maintenance program is to test the physical attributes of the windings, the insulation quality, and bushing conditions. All these tests are to be performed offline and are typically recommended to be performed every three to five years.

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The main tests recommended to be performed are the following:

- Power factor testing
- Winding Resistance testing
- Turns Ratio Testing
- Sweep Frequency Response Analysis
- Bushing power factor and Capacitance Tests

We tend to put special emphasis on the power factor testing of the winding insulation and bushing tests. Power factor testing is a test that can be used for trending and can give insight to deterioration of winding insulation. Bushings are sometimes considered the "weak point" of a transformer and power factor and capacitance test results can be compared to nameplate values. Deviation from expected results can allow system operators to plan for bushing replacements before a failure occurs and potentially compromise the entire unit. Similar to online oil monitors, online bushing monitoring systems exist and should be considered for high value assets.

No equipment will last forever but implementing and performing a comprehensive transformer maintenance plan can help prolong the life of your critical assets by catching and correcting issues at their inception. Investments in maintenance today will save costly unplanned outages in the future.

Author:
Bradley Webb
Business Owner
Substation Solutions, LLC

Bradley Webb: With over 16 years of hands-on experience in medium and high voltage electrical systems, Bradley Webb is the dedicated owner and operator of Substation Solutions, LLC. His career spans crucial roles in asset safety, strategic planning, and team leadership within high-stakes industries. As a seasoned professional, Bradley combines technical proficiency and business acumen to deliver exceptional substation maintenance, repair, and consulting services. Known for his meticulous approach to safety and quality, he has established Substation Solutions as a trusted provider for utility companies, industrial plants, and renewable energy facilities. Bradley's prior tenure at Pacific Gas & Electric as an Electric Standards & Work Methods Specialist solidified his expertise in asset management, maintenance standards, and safety protocols, enabling him to lead industry advancements at Substation Solutions. His commitment to client satisfaction, innovation, and strategic growth has driven his company's success, fostering long-term partnerships and a reputation for reliability.

Design for the Future, Design for Success, Design for Safety

Editor's Note:
Design for Safety and Success

Whenever you come across something that makes you ask yourself, "why hasn't this been common best practice all along?," more than likely it is because it took a practitioner to see the light and to make it a Better Practice. That practitioner is Martin Robinson, author of this article and one of the most respected professionals making the connection between reliability and safety today.

At our company, we have charter policies and procedures, values and all the things that successful companies have, but one of the most important is "Work Safe, Home Safe." It is not a mantra printed on wall posters but a deep commitment at every level of the company.

We took the principles of Monitor, Inspect and Manage that Martin is sharing and made it part of our reliability program for our transformer fleet and, of course, many of our line managers asked the very same question from above, "why hasn't this been common best practice all along?".

Safety and reliability: Two sides of the same coin! Who would have thought? Enjoy Martin's powerful insights.

Adopting a Monitor, Inspect, and Manage approach is a proactive way to avoid the concerns at hand by maximizing the value of workforce time and skill.

The critical importance of electrical power to every aspect of our world cannot be exaggerated. It must be generated and distributed effectively to end-users, and any disruption in that process means loss of operations, money, and in extreme cases, life. Therefore, the reliability of electrical power creation and distribution must be continually safeguarded and improved. This does not happen by chance or through reactionary-maintenance tasks, and it must be focused on from the early design stages and continue through the life of the assets tasked with these functions.

Adopting a Monitor, Inspect, and Manage approach is a proactive way to avoid the concerns at hand by maximizing the value of workforce time and skill. Scalability is no longer an issue when, instead of going through the time

Modal Amplified™, a camera-based Modal Test and Analysis solution, enables a new shift from the time-consuming sensor mapping, placement, fixation, and animated modeling of typical Modal Testing to instant capture, visualization, and analysis on real-life structures

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and cost of expanding their workforce, plant managers can apply condition-based reliability technologies to maximize their available workforce skills and availability. These reliability technologies can be specified with the specification engineer and Original Equipment Manufacturer at the initial design/build stage or retrofitted into existing equipment through a simple and inexpensive process.

Additionally, by taking the Reliability Engineering by Design (RED) approach espoused by the Safety and Reliability Association (SaRA), coupled with the Monitor, Inspect and Manage approach as detailed in this article, we will create a practical system approach to asset reliability.

When we, as practitioners, connect reliability and safety, we build momentum, access more resources, and create an environment where ensuring transformer reliability inherently enhances safety.

Monitor

With the use of a monitoring system on transformers and throughout substation electrical equipment, asset conditions can be continually collected, trended, and assessed. Monitors feed data through a gateway to software and apps, allowing the information to be continuously accessed from workstations and mobile devices.

When the new equipment arrives from the manufacturer with these monitors built-in, customized parameters can be set for the specific operating and environmental conditions the asset is exposed to that keep it within a "safe zone" to maximize functional reliability. When the asset condition data exceeds the custom parameters, alarms can notify electrical technicians of a possible issue that may require inspection. Keeping human interaction with equipment to only instances where confirmation inspections of potential faults are deemed necessary minimizes workers' risk and eliminates the human-error threat to asset functionality.

As stated earlier, when we, as practitioners, connect reliability and safety, we build momentum, access more resources, and create an environment where ensuring transformer reliability inherently enhances safety. And safety continues to play a more prominent role relative to electrical systems.

Inspect

Once the wireless monitoring system notifies technicians of a possible issue with a transformer or other piece of electrical equipment, the use of pre-installed inspection windows on the asset allows a safe, efficient method of inspecting and assessing any possible issue during an energized condition. Once solely designed for thermographic inspections using infrared cameras, advancements in manufacturing have led to the inclusion of ports that allow for ultrasound and partial discharge technologies to be incorporated into the inspection. Visual, infrared, and ultrasound inspections can be done simultaneously by a single employee.

Additionally, this design protects inspectors from arc flash/electrocution risk, removes the need for bulky and expensive PPE, and allows the inspection to be accomplished more efficiently. Not only does this represent a significant process improvement driven by original design, but it also falls in line with the most recent NFPA 70E updates and continues to protect critical assets from human interaction/mistakes that may cause failure.

Manage

The data collected during inspection can be stored through intelligent asset management tags attached to the pre-installed inspection windows. From the asset location, information can be transmitted into a dashboard system accessible from workstations and mobile devices.

Customizable routes can be established before, and condition reports generated after data analysis to further increase efficiency. These designed aspects allow managers to assess operations and decide how best to increase Mean Time Between Failure (MTBF).

Proper Training

One major issue facing the industry is a coming wave of retirements from the workforce, with fewer new workers entering the industry than the pending need created by this exodus. As the electrical industry expands worldwide, creating the need for a larger workforce, the problem is multiplied. The only way to succeed is to capitalize on reliability technologies designed into the system that allows the industry to do more with less.

While Designing for safety and reliability from the equipment side should drive the overall process toward continuous improvements, the proper tools are only as useful as the hands wielding them. Hardware and software designed/specified by the engineer and constructed by the OEM are ineffective if the people responsible for their oversight are not adequately trained.

Shifting to an engineered reliability system for the electrical maintenance team means training new and veteran staff alike. With "Monitor, Inspect, Manage," the use of technology allows single individuals to accomplish inspection tasks with minimal training. Specialized skill sets of electrical-focused staff can be used for actual necessary maintenance/repair activities.

Another Covid-era issue with learning is that most educational institutions have transitioned to online models. The electrical world can benefit from adding this type of education and certification to on-the-job training programs. These online systems offer on-demand educational and training resources that teach the use of these specific reliability technologies. The workflow is streamlined, which means that the skill-set requirements can be minimized to particular tasks.

While Designing for safety and reliability from the equipment side should drive the overall process toward continuous improvements, the proper tools are only as useful as the hands wielding them.

Conclusion

As the old saying goes, "if you fail to plan, then you should plan to fail." From the inception of equipment design and manufacture, all possible measures to ensure asset reliability should be specified and implemented. These measures

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should prove themselves to be learnable, repeatable, and continued throughout any workforce changes to cement the successful practices into the very culture of the role requirements.

Transformers and other critical electrical power assets being monitored remotely cut down on technicians' routine tasks focused on engineering and electrical operations by providing around-the-clock coverage. When an alarm notification is received, inspection windows allow an individual technician to easily do visual, infrared, and ultrasound, and partial discharge assessments of the energized equipment. The data collected on the asset can then be stored, trended, and analyzed through the management software. This process increases the Mean Time Between Failure (MTBF) by allowing for planned shutdown and maintenance only when it is necessary.

Staffing issues brought about by the combination of an expanding market and a shrinking labor pool can be overcome by streamlining operations through technology. Both hardware and software involved can be easily integrated at minimal expense. The employees responsible for their use can be trained through a combination of online and on-the-job training.

Author:
Martin Robinson
Founder, owner, and CEO
IRISS Inc.

Martin Robinson is the founder, owner, and CEO of IRISS Inc., a leading manufacturer of infrared inspection windows. Robinson focuses on innovation and is a pioneer of Electrical Maintenance Safety Devices (EMSDs) that help protect technicians from harm while protecting their companies' bottom line. He holds several patents for condition-based maintenance devices and has designed multiple maintenance programs that include infrared, ultrasound, partial discharge testing, non-destructive testing (NDT) and energy management strategies. He holds a NEBOSH certificate in Occupational Safety and Health, an IAM Certificate in Asset Management, is a certified Level III Thermographer, a Certified Maintenance and Reliability Professional (CMRP) and a Certified Reliability Leader (CRL). He is a member of IEEE, NFPA and is a standing member on the technical committee CSA Z463 guidelines on maintenance of electrical systems.

Do We Really Need Another Show in the World of Power Transmission and Distribution? Simply Put… The Answer is Yes! and Here's Why

Globally there is a lot of activity in the Power Transmission and Distribution sector by way of conferences and big energy industry events, but very little that's focused specifically on the design, architecture, and technology for developing the next generation grids and electricity distribution networks. Long-standing events innovator and leading exhibitions industry figure, Tony Robinson, is busy with the launch of a new show in Europe that will set things straight. As he says 'there are plenty of conferences in this sector and they have had considerable relevance for strategic discussions relating to the need for investment in new infrastructure to meet the next generation demands on electricity. The strategy is now clear, the investment by governments and private/public partnerships is a given and the requirement to meet a net zero future in the face of huge capacity growth is well defined. So now it's time to design, build, specify and procure. It is simply put, the biggest Bonanza moment in decades for specifiers, buyers and sellers of technology in the power industry to come together and make it happen'.

There are plenty of conferences in this sector and they have had considerable relevance for strategic discussions relating to the need for investment in new infrastructure to meet the next generation demands on electricity.

What we are in the process of doing is giving the Power Transmission and Distribution industry its own 100% focused technology showcase exhibition. This is really essential because there is just nothing like a show where professionals can go and see 100% of what's exhibited that is entirely relevant to them. Think of it like being in the world's best sweet shop where every booth is relevant to everybody there. From cables and sub-station equipment through to transformers, from smart metering, power management optimisation systems, weather and load forecasting and damage mitigation and advanced warning systems, everything will be on show for the engineering and technical people charged with building the next phase of power distribution networks. 'Our visitors will represent the full value chain all the way from the point of generation, all through the distribution network to the point of consumption be that in the factory, data centre or household'.

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Tony has done this sort of thing for years and has transformed the way numerous industries now come together in sectors as diverse as tire design and manufacturing, aircraft interior design, and even in the weather forecasting world where previously such specific sectors were often caught up in generalist shows for rubber and plastic, aviation and the like. Now what he's doing is delivering us a truly focused exhibition for our industry. And he says there's not a conference session in sight. On the other hand, Open Technology Stages will be running within the show layout to enable exhibitors to explain and demo how their technologies can offer advantages. Expect around 3,000 to 4,000 visitors mostly from Europe, Middle East and North Africa and 200 exhibitors in a 3-day event spanning 220,000 sq ft (22,000 sq m of space). It's running in Cologne in Germany which is in the most densely populated part of Germany and located in the busiest manufacturing corridor. The Messe there is in the top 10 largest in Europe.

Tony Robinson describes how big a launch show can be... at the 2024 AEO Conference (Association of Exhibition Organisers)

Author:
Tony Robinson
CEO, Power Transmission and Distribution Technology Expo (Next Events & Conferences Ltd)

Tony Robinson has a lifetime of experience launching specialist industry magazines and exhibitions and indeed companies. In the 1980's he trailblazed the London scene launching around 55 international B2B publications and in 1991 founded his own company UKI Media & Events which became synonymous with the creation and running of global specialist industry magazines and exhibitions. He was listed in the 'Europe 500' of fast growth companies and in the Sunday Times 100 Fastest listed at #33. The shows are now mainstays of major industries covering sectors as diverse as tire manufacturing, aircraft interiors, airport design, automotive design and transportation and the list goes on. He's run events in China, India, South Korea and America and became the biggest non-German 'guest' events company running shows in Germany in the period 2000-2007. He created another company in 2010, Smarter Shows, launching events in America and Europe including The Battery Show and Electric & Hybrid Vehicle Technology Expo. In 2017, still while being involved in both companies, Tony helped his son launch TransGlobal Events which now runs the world's largest Hydrogen Technology Show with over 800 exhibitors. This Expo on Power Transmission and Distribution Technology is under the banner of Next Events & Conferences Ltd. He recently spoke at a leading exhibition industry event run by the Association of Exhibition Organisers on the subject of launching shows.

The Definitive Guide to Cable Troughing

What is Cable Troughing?

Cable Troughing, which is often called Cable Raceway, Cable Routing System, Cable Management Trough, Electrical or Industrial Cable Routing, is a specialised system designed to protect, organise and route electrical cables within a defined pathway. Essentially, it provides a secure and accessible channel for cables, wires and ducts, preventing damage and ensuring efficient cable route management.

Paul Forester is Operations Director at E-Tech Components, leading specialist distributor of Power Cable Accessories & Electrical Components. His professional journey began at the original BICC Components offices in Prescot, now Prysmian, where he was introduced to the electrical industry and gained valuable experience in Crimping Systems, Electrical Machines and Transformers. In 2004, he joined E-Tech Components and got involved with many aspects of the business. From warehouse and sales to operations and boardroom, Paul and E-Tech have grown and evolved massively since then. Step-by-step, "connection-by-connection", and with continuous support of E-Tech's partners, Paul became one of the most influential Crimping Systems & Cable Components' Experts in the UK.

Glassfibre Reinforced Concrete (GRC Cable Troughs)

Cable troughs are typically made from durable materials. One of the most common are Glass Reinforced Plastic (GRP Cable Troughs). Lightweight, strong and corrosion-resistant, these cable troughs are easy to handle and install. They're ideal for harsh environments due to their chemical and UV resistance, and they're also fire and non-conductive for safety. With low maintenance needs, a long lifespan and recyclability, GRP cable troughs are cost-effective and environmentally friendly cable routing solutions.

GRPs are significantly lighter than traditional concrete options. This makes transportation and installation much easier and quicker. Strong and resistant to breakage, they can be easily worked with using standard hand tools. Resistant to rust and rot, they also boast excellent fire resistance, making them suitable for demanding environments.

Concrete Cable Troughs

Renowned for their durability, fire resistance and load-bearing capacity, these cable troughs are a robust and secure choice for cable protection. However, we believe PVC / plastic cable troughs have several advantages over their concrete counterparts. Carry on reading this article to learn about the limitations of concrete.

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PVC Cable Troughs / Plastic Cable Troughs

Lightweight, corrosion-resistant and cost-effective, make them easy to install and maintain. Their versatility in size and shape allows for adaptability to various cable layouts.

Applications

Coming in various sizes and configurations to accommodate different cable capacities and installation requirements, they are widely used in a range of different environments, including Construction Projects, Utilities & Telecommunications, Highways, Rail / Traction, Renewable Energy, Power Plants, Stadiums, Airports, Data Centres, and more.

Key Components of a Cable Troughing System

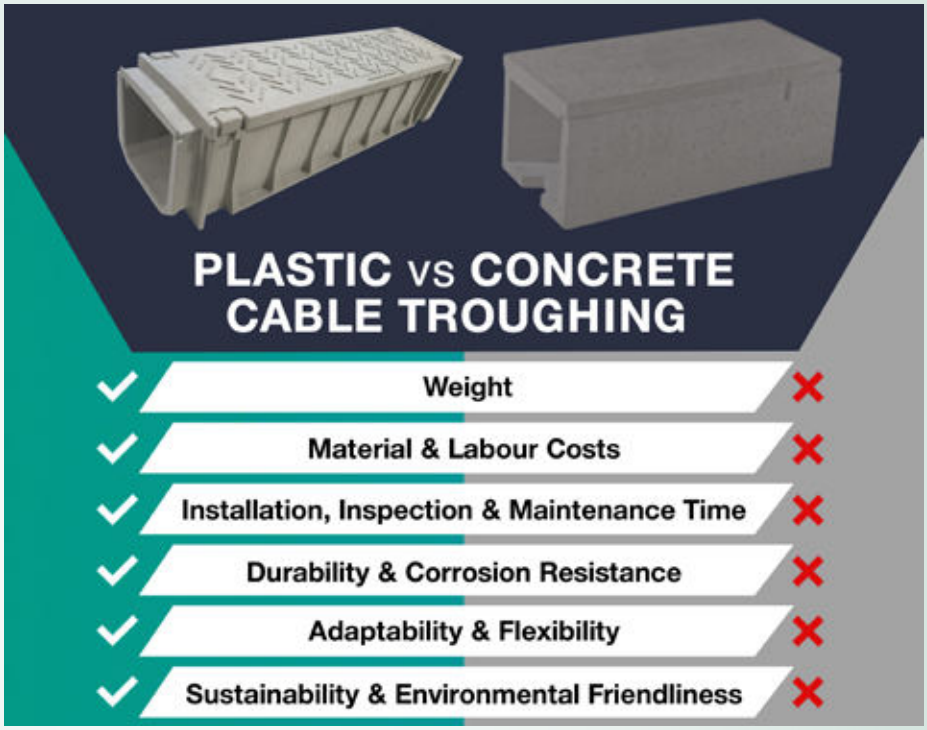
These include the base, which provides a stable foundation, and the cover, which protects cables from physical damage and environmental factors. Dividers are optional components that can be used to separate different cable groups within the trough. Bends, gradients and elevated systems are suitable for navigating obstacles, allowing the route to go around or over them. Additionally, accessories such as junctions, reducers/adaptors and end caps ensure complete system assembly.

Why Use Cable Troughs?

Providing a defined pathway for cables, cable raceways prevent them from being carelessly routed. The result is a professional and visually appealing installation. Improving the overall aesthetics of a project, cable raceways ultimately make it easier to identify and trace cables. Because cables are contained within the trough, this makes them ***readily visible and accessible for inspection, maintenance or modifications***. In turn, this reduces downtime because technicians can quickly locate and address any issues without disrupting other components.

In addition to enhancing aesthetics, cable troughing serves as a protective barrier, ***shielding cables from damage due to impacts, crushing, abrasion or adverse environmental conditions***. This protection is especially crucial in environments with heavy machinery or significant foot traffic. For example, railway cable troughs are essential where linemen or rail professionals frequently access the tracks, often at night, for maintenance and repairs. Additionally, the enclosed structure of a cable trough system shields cables from moisture, dust and other non-environmental contaminants that can degrade their performance and lifespan. This is crucial in harsh or corrosive environments.

Improving the overall aesthetics of a project, cable raceways ultimately make it easier to identify and trace cables. In addition to enhancing aesthetics, cable troughing serves as a protective barrier, shielding cables from damage due to impacts, *crushing, abrasion or adverse environmental conditions*.



By containing cables in a non-combustible cable trough, ***the risk of fire spreading is minimised***. In the event of a short circuit or overheating, the trough can help to prevent the fire from reaching other combustible materials. Moreover, cable management raceways help prevent accidental contact with exposed live wires, reducing the risk of electric shocks for both workers and the public.

Lastly, cable routing systems are modular and customisable, ***enabling quick and easy installation to meet bespoke project requirements***. This design reduces labour costs and project timelines while providing flexibility during both the design and installation processes. Essentially, project managers can add or remove sections as needed. Sure, there is an initial investment in cable raceways. However, it can lead to long-term cost savings by preventing damage to cables, reducing downtime and improving safety. This can result in lower maintenance costs and increased productivity.

Plastic Cable Troughs vs. Concrete: Why Plastic is the Preferred Choice

Plastic cable troughs / PVC cable troughs offer a multitude of advantages over concrete cable troughs. Their significantly reduced weight makes them exceptionally easy to handle, transport and install, often requiring less personnel and equipment. Ultimately, installations can be expedited with reduced labour costs too.

Compared to their concrete counter-parts, plastic cable troughs are

highly adaptable, allowing for easy modifications in cable routing or quantities, and providing flexibility throughout a particular project's lifecycle. Their corrosion resistance and low maintenance ensure long-term durability and performance in various environmental conditions. Using PVC cable troughs is an excellent way to ensure compliance while providing easy access for inspection, repairs and maintenance. These troughs are approved by major railway authorities, including Network Rail, New South Wales, Banedanmark, and Japan Railways.

Compared to their concrete counterparts, plastic cable troughs are highly adaptable, allowing for easy modifications in cable routing or quantities, and providing flexibility throughout a particular project's lifecycle.

From a financial perspective, PVC or plastic cable troughs are generally more cost-effective than concrete, both in terms of material and installation expenses. Additionally, the recyclability of plastic makes it a more environmentally friendly option compared to concrete. In the age of sustainable construction practices, it's no wonder that solutions like Green Trough are gaining popularity.

Installation of Cable Troughs

Installing cable troughing might seem complex, but with the right approach, it can be a straightforward process.

First, determine the cable routing path and required trough size, ensuring the installation area is free from obstructions and that all necessary tools and equipment are gathered. Next, securely fix the base of the cable trough to the desired surface using appropriate fasteners, making sure the base is level for proper alignment and stability. Once the base is in place, carefully route the cables through the trough, organising and securing them with cable ties, bundles or other methods.

Afterwards, align the cover with the base and secure it with the provided fasteners, ensuring a tight fit to protect the cables from external elements. If needed, install bends, junctions or other accessories to accommodate changes in cable routing. Finally, verify that all cables are properly routed and secured within the trough, checking for any gaps or damage to the trough and its components. Keep in mind that each manufacturer may have additional steps or unique features in the process based on their specific solutions.

Laws & Regulations

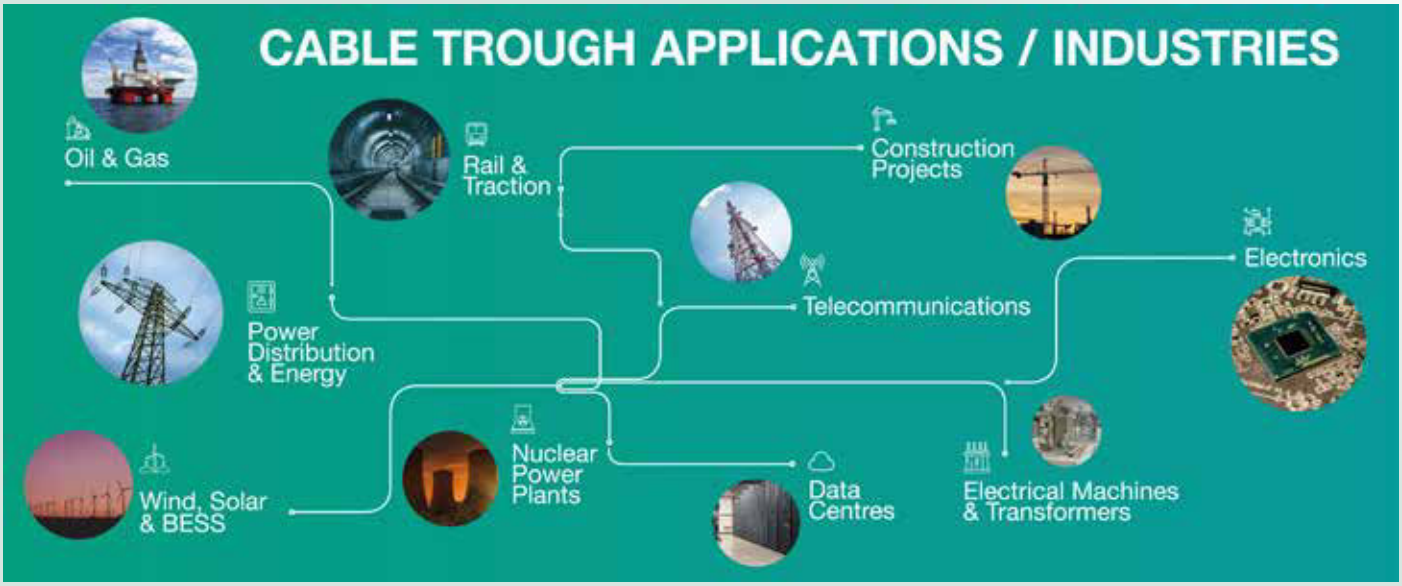
Adhering to relevant laws and regulations is crucial for ensuring the safety and compliance of your electrical installation.

Cable troughing, as a critical component of cable route management, is subject to specific standards and guidelines.

From a financial perspective, PVC or plastic cable troughs are generally more cost-effective than concrete, both in terms of material and installation expenses.

BS EN 50086 provides requirements for cable trays and trunking systems, including cable troughing, covering design, materials, testing and installation aspects. Local building regulations may outline specific requirements to ensure fire safety and structural integrity too. Additionally, adherence to electrical safety regulations, such as those issued by the relevant national authority (e.g., *IET Wiring Regulations in the UK*), is essential for preventing electrical hazards.

Cable troughs must be selected and installed to meet fire resistance requirements, preventing the spread of flames and smoke. They must also be capable of supporting the weight of the installed cables and any additional loads, such as personnel or equipment. Additionally, cable troughs should be resistant to the environmental conditions of the installation area, such as humidity, temperature extremes and corrosive substances. Furthermore, cables within the trough must be easily accessible for inspection, maintenance and modification. By understanding and complying with these regulations, you can ensure that your cable routing system meets the highest safety and performance standards.



Santiago Barcón

Chief Executive Officer
at PQBarcon

Interview with **Santiago Barcón Palomar**

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It takes 200 years to build a gothic cathedral.

The renewable world is not going to be in the next 30 years or 40 years. It will take longer than that. I think that's a good analogy.

Photo: PQ BARCON

Alan Ross: Hi, I'm Alan Ross. I'm the Managing Editor of APC Media's publications, Transformer Technology, Power Systems Technology, and Women in Power Systems. We're here at the IEEE PES T&D conference in Anaheim in 2024, the 60th anniversary. My next guest is Santiago Barcón Palomar, the CEO of PQBarcon, in Mexico City, MX. Santiago, I enjoy interviewing you because you are such a unique individual. First, you've got your hand in a lot of different things: publishing, manufacturing, you're an author, and future author. You have a lot going on. Tell me a little bit about your life.

Santiago Barcón: Well, I have been in the power industry for almost four decades, and I really enjoy what I do. We always say in Mexico that artists and bullfighters do not retire, so I don't have any retirement plans whatsoever. I'm working as much as when I was 20, 30, 40 years old, and I enjoy it every day.

As you mentioned, we have Energia Hoy, that is a leading magazine in Mexico on the energy sector. We cover the full scope of the energy industry, but since I am an electrical engineer, we lean more toward the electrical industry.

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Also we have a media site and magazine with a green technoloy focus, , called Greentology into what I will call ESG, renewable energy, and everything that is friendly with the environment. Besides that, we are a manufacturer of capacitor banks and harmonic filters, both in low, medium, and high voltage.

We just recently got an order for three big banks at 230 KV for USA. That is the holy grail in the power industry. We are very happy with what we are doing in the manufacturing sector.

Last, but not least, my next book is already in the print press. The first one was very technical, power quality, harmonics, and power factor correction. This one is more focused on the youngsters, and not so young, who have not followed what I consider the best path in engineering. It's called "How to be a Good Engineer, 10 Commandments, and 100 Tips to Achieve It".

It is a short book, about 180 pages, because as I mentioned, it is focused on younger engineers who I believe don't read that much.

It offers small bits of advice, for example, "when you leave college, go to a place where you are going to learn, not because they will pay you 5% more". If your boss is not intelligent, resign. You are not going to change him, and he might make you stupid and lazy, or both. That will be worse. We have already sold several books, so I'm quite happy with it. People are ordering it to give to younger people in their company.

AR Is it digital and print?

SB Digital and print.

AR I'm going to get a print copy.

SB And besides that, once that is finished, we will translate it to English.

AR Excellent. Since my Spanish is rudimentary at best, I'll wait for the English version.

SB I think that there's nothing like that. Before I started to discover the lukewarm water, I looked for it on Google, Amazon, Barnes & Noble, everything. I couldn't find it. There's a lot of books on how to study engineering, but not practical advice for ones that are out of college.

AR Primarily electrical or any engineering discipline?

SB I mentioned in the prologue that, because I am an electrical engineer, we have a focus on electrical issues, but I try to cover all the areas of engineering. But what is nice is that it is also focused on women in the power sector. In chemical engineering and environmental engineering there are even more women graduates than men in Mexico.

AR We'll have to get you involved in our Women in Power Systems community and magazine. One of the reasons why I like interviewing you is because you have your hands in so many things, publishing, manufacturing and I know you are also a passionate wine aficionado. But for now, let's stay focused on the power industry.

SB I'm going to give you some figures from the Electric Power Research Institute (EPRI). Bad power quality costs the US economy $188 billion per year. The total invoicing for the consumption of electricity is around $600 billion. Of course, this is not just the energy that is not supply. It's when you have a sag and the equipment stops. More importantly, 80% of the problems are inside of the consumer. It's not in the grid.

Bad power quality costs the US economy $188 billion per year. The total invoicing for the consumption of electricity is around $600 billion. Of course, this is not just the energy that is not supply. It's when you have a sag and the equipment stops. More importantly, 80% of the problems are inside of the consumer. It's not in the grid.

Leonardo Energy, the European equivalent of the EPRI, finds about the same figures, €160 billion is the cost to the European economy an 80% of that is inside the customer's system.

AR The more robotics that we place into manufacturing 4.0, the more

susceptible we are to power quality issues. Because the robots weld the cars, and if one robot, which also has a transformer doesn't do the task, the weld is affected and the car leaks. I know that oversimplifies the issue, but in many cases, the power quality issue become product quality issues and more likely productivity issues.

SB I can attest to that as a big US manufacturer in one of their plants in Mexico has had a lot of power quality issues. It was about 15-20 years ago that they installed their first robot. Because of power for quality, it committed hara-kiri because it did not run the program properly. Of course, they did not laugh, but I think that it was great illustration of what can go wrong.

AR That's why you're not saying the name of the company.

SB Yes, that's why I'm not saying the name of the company.

AR Robot committed hari-kari, that is a great illustration of what can and does go wrong. I know that you produce products that alleviate these types of issues, right?

SB Yes, and the problem is going to keep on growing, with all these renewable entrants, everything is becoming electrical-driven. There are more harmonics because there are more inverters, even air conditioning,

Photo: Shutterstock

mini-splits, and refrigerators. They are invertor-based to save energy. And of course, the byproduct is harmonics, so we will be there to help.

AR And green energy is the invertor-based system. The more we grow green, the more problems we create.

SB That is why some inverters are what they call grid-forming. People worry about it, but we will find a solution. We will find a solution.

AR The United States Marines runs ads that say, "We run to the trouble". I'm a mechanical engineer and I find that engineers run to the problem because we solve problems; we don't run from problems.

SB In the book, I mentioned that we need to control that urge because that creates a bad economic situation for most of the engineers. We give too much free advice because we like to solve things. And doctors and lawyers, they just keep it to themselves. We need to learn from these guys. (Laughing)

AR Let's move from manufacturing back into publishing. Talk about your publishing, particularly Energia Hoy. As soon as we get this done, we'll do an MOU where once an issue, we will publish one of your articles, we'll transcribe and publish, and then we will provide one to you to transcribe and publish. Talk about how you got into that. Did you just wake up and decide you were bored?

SB I went into the Office of the Energy Savings Government Bureau, and I saw Energia Hoy, issue 2. I found the publisher. I always liked to write, and the publisher was happy to give me my column, so I started to write. Initially, Energia Hoy was a small part within these company. The editor had another one that was the largest circulation magazine. It was a Sunday magazine of three newspapers.

I became a good friend of the president of the company, and eventually, he invited me to write about wine in this very important magazine. My life expanded because I went everywhere, and I got free entrance and the best wines. Eventually, one of the partners decided to start his own Sunday magazine on the back of his partner. I sat down with the President of the company, who was a minority partner, and he told me the history and over lunch and he told me, *"If you don't buy it today, I'm going to close it down"*, so I bought Energia Hoy.

I didn't know anything about the publishing business, but I liked the magazine, so I bought it. And although the price was quite low, I knew that I was going to lose money. But either way, it's a way to contribute to the sector, to the energy sector in Mexico. Since that day, we have been very, very open. We have people from left wing, right wing, people that are for renewables, people that do not believe in renewables. And I think that creates a good environment of exchange of ideas.

AR This book that you're doing for young engineers is something new again and since we need to attract a lot of young people because to the industry. I imagine it will help in your own production facilities, getting good quality engineers and keeping them, which is important, right?

SB Yes, and it's becoming a greater challenge because of the pandemic it was a problem, especially for students. They did not work in any labs, and they did not get out to see substations or machines working. They will need a lot of help to recover, to become good engineers.

AR The biggest issue that we're dealing with right now in the power industry, obviously, is change. In the United States, a lot of government money is supporting the growth of renewables, but we have an election this year and the next government may not be green energy based. When the government funds something and then it pulls back, it creates chaos in the industry because people invest billions of dollars in the future. Without consistent policies, companies have a hard time planning. Is it the same in Mexico?

SB It's the same in Mexico. But I think that the problem is polarization. It's not that you can live without oil. We still need oil, but you need more renewables. But if you take these positions that oil is killing us, when everyone is driving a car and flying on an airplane, I think that doesn't create a long-term planning scenario. You have these swings that you are mentioning, depending on who's the president, on who sets the policy. I read a nice article about gothic cathedrals. It takes 200 years to build one. The renewable world is not going to be in the next 30 years or 40 years. It will take longer than that. I think that's a good analogy.

AR The one in Barcelona started in the 1600s, and I believe it is supposed to be finished next year. That's a great way of looking at it. That's generational thinking.

SB Yes, that's why we need to change the whole matrix of energy.

AR Tell me about “Greentology”.

SB Most of the group in publishing are youngsters, so they are very much into these ideas of a green and renewable grid. Because they basically manage on their own, even though we give them ideas of course, they are excited about the subject matter.

AR What you just said about oil and renewable, that they must work together, how do you teach those young people to take a long-term approach to this?

SB What I tell them is that, unfortunately, they're not going to see the final outcome in their lifetimes. I give them examples like, one kilogram of gasoline has as much energy as 140 kilograms of lithium batteries. So how is an airplane going to fly based on lithium batteries.

If you are just doing that for money, it's a complete waste of your life. If you belong, then you learn, you listen, you find new technologies. I was chatting with one of the customers I consulted with about the book, and he said: “So you believe that when engineers get out of college they don't study anymore?” I said, sadly you are correct, for the most part.

He is a financial expert, so I said, “you continue to study because every year the government changes the tax rules and you need to study again, right?” But the electrical rules will not change. We were visiting the factory where they have a large number of motors that are 40, 45 years old. I told him respectfully that he should consider energy efficiency motors that will probably save a lot of money.

He said, “No, we tried that, and they do not work well”. I said, “When?” He said, “Well, back

Green hydrogen, a potential solution, is still a long way to go. We remember what happened to Zeppelin. That forces them to think of alternatives because I don't believe that it's going to happen overnight.

AR Let’s talk about IEEE. I think I met you the for the first time at an IEEE event, wasn't it?

SB In New Orleans, yes.

AR Talk to me about the value of IEEE and CIGRE.

SB You must belong to IEEE and CIGRE. The first commandment in my book is for you to love your profession more than anything else in your working life. Because if you don't love your profession, you are unfortunately never going

Photo: Shutterstock

in 1994" That gives you an idea of the problem. If you don't read magazines or periodicals that talk about how the efficiency of the motors is going up, you will live with this conclusion. But motors today are a lot more efficient. If you don't keep studying and getting new inputs about what is changing you do not change.

AR Lifelong learning is the key to a successful engineering career. Santiago, you are a manufacturer, a publisher, an author and a wine expert. What's next?

SB We also have a company called Instituto EH., where we train people in energy, mostly in electricity. Of course, I love teaching, and I think that's a good way for retirement, to keep on teaching and being close to people so you can pass all this knowledge that we have accumulated over the years. I don't see myself retired, but I don't see working at 88 from 8:00 to 6:00. I will be more than happy to be teaching and sharing knowledge and experience with the people.

AR Have you done a good job with succession in each of your businesses?

SB Yes, with my son. There is a saying in Spanish "El pan ajeno hace al hijo bueno". That means, "the bread off of the other table makes your son good". He has his own business, but now he's helping me out, and we're planning the succession. But I think that is very important, that it's not always in parent's company.

AR Santiago, I always love interviewing you. You're my renaissance man of the power industry. Thank you so much.

SB Thank you, Alan.

The first commandment in my book is for you to love your profession more than anything else in your working life. Because if you don't love your profession, you are unfortunately never going to be happy. If you are just doing that for money, it's a complete waste of your life. If you belong, then you learn, you listen, you find new technologies.

POWER PANEL DISCUSSIONS

Marcel Hilgers
Vice President of Customers, Markets, and Technology, thyssenkrupp

Ron Harper
CEO, JFE Shoji, Canada

Changing Dynamics of Electrical Steel

The following are excerpts from the Power Panel on Changing Dynamics of Electrical Steel with our guest experts Marcel Hilgers from thyssenkrupp Electrical Steel and Ron Harper from JFE Shoji Canada that was conducted live in November 2024.

Alan M Ross
Managing Editor, APC Media

> The whole industry has to decarbonize. I think we all agree in the long term on this question. But the question is, when do we commit and how do we then bring it about?
>
> **Marcel Hilgers**

Alan Ross: Welcome Marcel Hilgers. You are the Vice President of Customers, Markets, and Technology, at thyssenkrupp?

Marcel Hilgers: That is right, Alan, at thyssenkrupp Electrical Steel.

AR And welcome Ron Harper, you are the CEO of JFE Shoji, Canada?

Ron Harper: Yes, thank you, Alan,

AR Marcel, could you share a little about your role at thyssenkrupp Electrical Steel and your background.

MH Thank you, Alan. I am dedicated to the steel industry and have been for more than 20 years in steel industry, and I have worked with products like carbon steel and stainless steel. But the dearest product to me is GOES, Grain-Oriented Electrical Steel, which I have been working with for more than 11 years. I am in charge of sales, technical customer service, marketing and public affairs for our company for one product, GOES, which we produce in our three global factories.

AR Excellent. Thank you. Ron, give us a little bit of background and current role?

RH Thanks, Alan. As you said, I am currently with JFE Shoji in Canada. Our business used to be Cogent Power. Many people knew that name for almost 20 years. We were acquired by the large Japanese steel firm, JFE, back in 2019. We have been in the industry of electrical steel and electrical steel products for almost more than 50 years, and always in Canada serving the North American market for our materials and products. This is a very niche product with a handful of producers in the world, so there are a lot of international connections. We have worked with and continue to work with every steel mill that's making GOES in the world. I am happy to be here today.

AR When we first decided on the content and guests for this Power Panel I thought, 'Are these two competitors, or are these two collaborators?' What is the relationship between JFE Shoji and thyssenkrupp Electrical Steel?

RH I'd start by saying we are collaborators. We have worked very closely with thyssenkrupp for many years on supporting the supply chain and the demand for electrical utilities, with our focus in North America, but also thyssenkrupp has a much wider scope around the world. We have worked quite closely in terms of the supply chain using thyssenkrupp for materials we use in the finishing products that we produce for North America. I think collaborator is what I would start with. But also, I think it is important to know that even though our company, JFE Shoji is connected with JFE Steel by common ownership, our business focus is on processing

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electrical steel, not making it. And so, we buy from all material suppliers.

Since our relationship with thyssenkrupp is synergistic and also a customer-supplier relationship, collaborator is how I would describe it.

AR Excellent. Synergistic. Do you have anything else to add to that, Marcel? Is that a good definition of the relationship between the two of you?

MH Yes, absolutely. It is a complex and dynamic world we are living in and while JFE is a competitor of ours, JFE Shoji is a customer.

AR Before we talk about Transformer Steel, you have both been in the industry long enough and you are smart enough to look at the industry as a whole. What do you see going on? Ron, what do you see going on within the power industry, primarily in Europe, UK and North America?

RH What is going on in our industry, or the things that keep CEOs up at night? (Laughs) The first thing that comes to my mind when you talk about the industry in general, especially if you look at Europe, UK, and North America, is that we're in a real significant shift. The supply chain and manufacturing of transformers is in about a 20 to 30 years of slow decline, because most of our electrical grid in both Europe and North America was produced after the Second World War, and it didn't need to be expanded too much. But now, with the advent of artificial intelligence and data centers demanding so much anticipated electrical energy in the future, and with transportation systems, EVs, et cetera, the demand in the regions is growing so significantly and so quickly that our industry has gone from a market that was stable to slow decline to one that's rapid growth overnight.

This change requires a completely different mindset and shift, both in terms of how you run your own business, but how you actually work with your suppliers, partners, and clients through that.

You need to take a much longer term, a much more strategic approach, a lot of investment to grow 20, 30, 40% in terms of what our demand is going to need.

AR Great clear and concise perspective Ron. Marcel, comment on that or any differences you see in Europe.

MH I think you really cannot, in the world of GOES, distinguish between these different markets. GOES is truly a global business. This energy transition is happening everywhere around the globe, not only in Europe and North America, but everywhere.

If you think back, we have been talking

about the energy transition for many years in the 2010s and beyond, but nothing was really happening. It was this slow decline all the time. But for a couple of years now it is really happening. You see it, you see projects implemented, you see the demand for transformers really taking a stable move upwards. I remember in 2006 and 2007 there was a boom in the transformer and electrical steel industry. And I always ask myself and the people around me and experts, is there something different right now compared to back then? Is there something which makes us believe that this growth is more sustainable? And the opinion of everyone I am talking to is really - yes, this is different now. It is the energy transition that is happening. It is not a boom which is going to crash.

RH I think it was the energy transition, but the challenge was that the energy transition was going on in China back then. The Chinese demand was so ferocious with very limited production capacity for electrical steel, for example. That was just supporting the electrical transformation in China, primarily. That is what happened then. Now, this is an electrical transformation supported by changing societal trends on electrical transportation. And it still boggles my mind how much electrical energy is going into the Internet and AI-type technologies. It is just almost unbelievable.

AR Marcel, does thyssenkrupp make only GOES?

MH We focus solely on GOES, Grain-oriented Electrical Steel.

AR What are the issues concerning amorphous steel and GOES, Ron? I am not sure everybody is aware of what they are.

RH Well, I think it first starts with what's driving the conversation, and that is the desire for more electrical grid efficiency. The question then is, how do you actually help make the grid more efficient? One of the ways to do that is to make the electrical transformer more efficient.

The DOE has launched new efficiency legislation to be put into place in 2029, and that efficiency legislation will, at today's technology, drive an increase in the usage of amorphous metal, particularly in some styles of transformers. I think, nominally, most people say that it will be more for distribution transformer market share for amorphous metal up to somewhere between 20 to 25%, depending on how OEMs and utilities work out designs. Just one of the reasons that we are such a large processor of amorphous metal today is because the Canadian market has shifted to that level of efficiency standard and no-load losses a number of years ago. The market share in Canada for distribution for amorphous metal is actually high. The real issues are the availability of amorphous metal to support that standard, the investment that needs to go in by producers to support that standard, and how are those investments and agreements going to be put in place so that we

> “We are not just talking about our business's financial value or thyssenkrupp's financial value. We're talking about creating value through the entire supply chain, to the utilities, to the end users, to our OEMs, and really to the electrical consumer. As long as we stay focused on that as our primary mission, it tends to solve a lot of problems along the way.
>
> **Ron Harper**

can achieve the desired efficiency outcome according to the DOE in 2029.

Having said that, there are efforts underway on most, if not all, advanced GOES producers to continually make the GOES product better so that it comes closer or can meet the DOE standard in the USA. It is really driven by an increasing efficiency standard and the available core materials that are going to support that standard 3 or 4 years from now. The general view is that it is going to be a mix of improved GOES and amorphous metal.

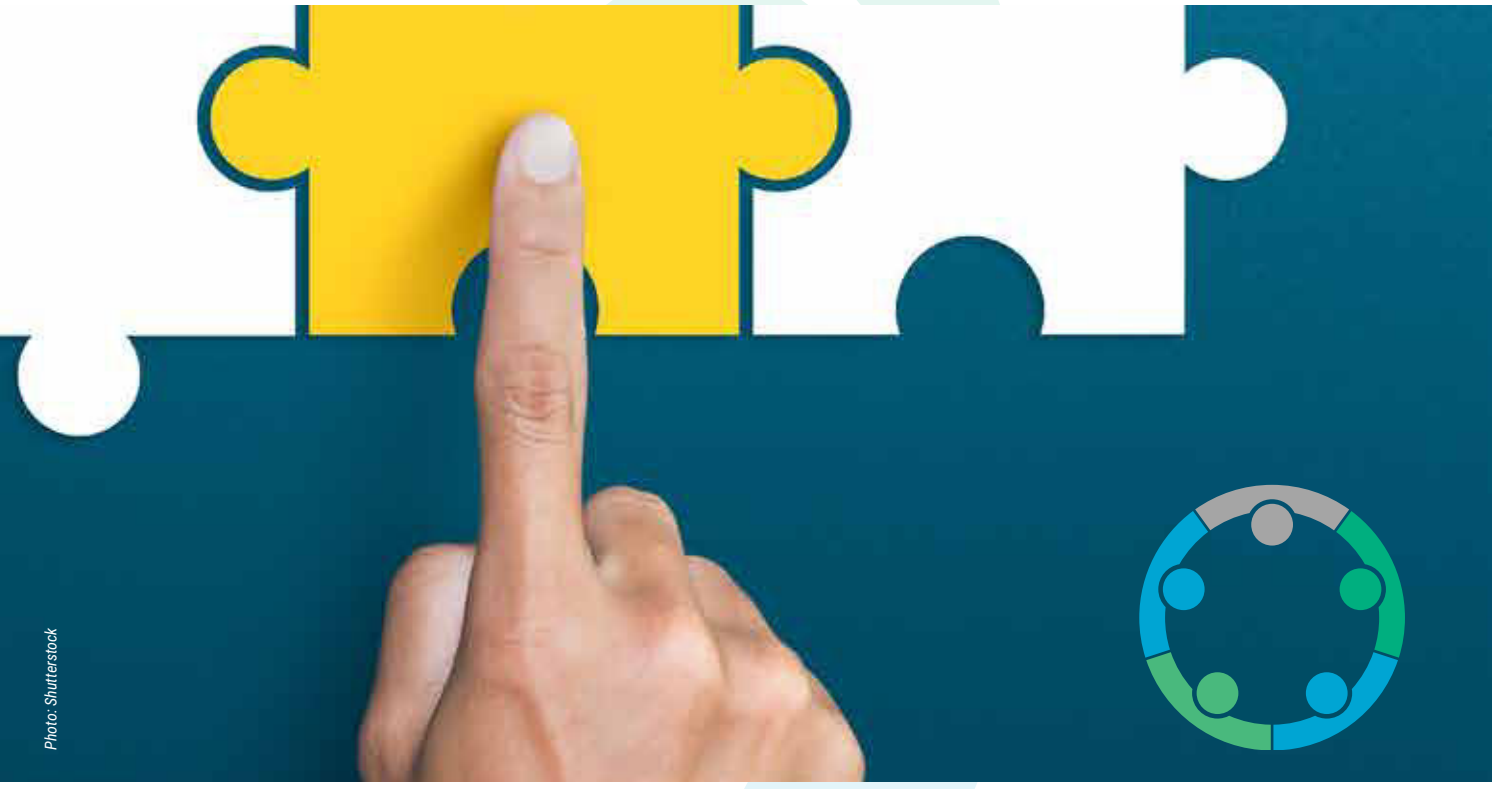
But the question still surfaces then, how is that available? You are pushing the most efficient, green-oriented electrical steel. How much of that is available to the market, and how much amorphous metal is available to the market? Because both of those are pushing the efficiency curve or the performance curve of the material very hard in an environment that is in very, very high demand. So there needs to be investments, whether you're producing better GOES or producing amorphous metal to be able to support that demand for higher efficient transformers.

AR Marcel, Ron just said something that was interesting: more efficient GOES. Is thyssenkrupp working on that? Are you becoming more focused as a company on providing that?

MH Yes, absolutely, Alan. We, as a GOES manufacturer, have predominantly three jobs to do. The first thing is that we have to make a better product. This means lower loss material with better magnetic performance and noise performance, as bigger transformers are getting closer to where people live. The second point is that we have to accompany the growth of our customers because everyone is working at full capacity, and everyone has growth plans. And the third thing we have to do is decarbonize the production, or we have to change our production methodology into a sustainable way. These three things are on our agenda.

In Europe we also have what is called the Eco-design Regulation of the European Commission. There is currently discussion about Tier 3, so the third revision of it. We are also participating in the meetings and the hearings to give the regulators our view on what is realistically possible from a manufacturer of GOES perspective.

We are providing market data as much as we can from public sources to demystify what is available and bringing in some realism about what can be achieved. In Europe, the consensus seems to be that for small distribution transformers, efficiency regulations are unlikely to tighten further since they already require very high-quality GOES. Amorphous is not a topic in the discussions. It is discussed, but people see here that it doesn't make a big difference here. The reason is there's a different landscape of transformers used here, and also a different distribution system. We assume that the focus here will be more on top grades of GOES.



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> I think the first thing that disables collaboration is self-interest... the second one, equally important, is if you play one supplier against another in that supply chain.
>
> **Ron Harper**

We call these low loss GOES grades. This is happening in many markets, especially in China. We are expecting next year a new, Eco-design regulation coming up, which will consume probably a lot of top grades in China again.

AR Do you think the industry today is considering that, as everybody is adding production and growing, the next possible marketplace disruption is going to affect what you're doing? Will something like the 2008 Financial Crisis and Covid affect markets? Are people cautious about that or is it full bore ahead, whatever happened then is not going to happen again?

MH What we are seeing is that the consumption of GOES, the CAGR is somehow disconnecting from the gross domestic product development or other indicators. This is because of the energy transition, actually. We have to transform the system no matter what the economy is doing. We have not seen a slowdown, for example, over COVID; not really in our industry.

But to come to your point, are we prepared for disruption? One keyword is coming up more and more in my discussions with our customers and their customers, with transmission system operators, utilities, and that is resilience. Are we repared in our supply chains from raw material or core and lamination manufacturers to transformer makers for global disruptions? I see much more trade disruption, global crisis, wars, and so on. This is what is really going on where we should be concerned about.

RH I think I would agree with Marcel that the industry and just the clean electrical energy I think I would agree with Marcel that the industry and just the clean electrical energy transformation we're going through has decoupled us from general economic cycles. I would agree completely that the two main issues that I think most people are wrestling with are firstly building resilience in their supply chain, and secondly figuring how to invest to grow. There are obstacles to investment, especially in the Western markets like Europe and North America.

Some of those obstacles have been high interest rates of late. And the other big thing is we are not talking about small growth here. We are talking about a very large double-digit growth in terms of the whole demand for electrical equipment and transformers. And trying to get the entire supply chain to grow at the same pace is very, very difficult. A power transformer has hundreds of components. If all of those suppliers don't grow at the rate the demand does, then it is a bottleneck to growth. It is a little bit, as you said, full steam ahead, but it's full steam ahead where you have to work closely with your partners to make sure everyone is growing at the same pace and same time and investing at the same pace and same time.

AR And that can be a really big challenge. Marcel, you brought up decarbonization which is a big thing. I know thyssenkrupp has made a significant commitment to decarbonize. I mentioned that in an interview a couple of years ago, and the guest said, "There is no way that a steel company is ever going to think about it." They need too much power to worry about that. Talk a little bit about that commitment from thyssenkrupp and where you are with it now.

MH Yes, it is a commitment, absolutely. But overall, it is do or die anyway. We have to decarbonize, otherwise, nobody wants us to be producing in Europe anymore. The whole industry has to decarbonize. I think we all agree in the long term on this question. But the question is, when do we commit and how do we then bring it about?

What we are doing is that we are currently in the process of building the first direct reduction

plant to make iron, virgin iron, not with coal anymore, but with hydrogen, green hydrogen. The construction site is currently operative. So, we will have this first direct reduction plant in our mother company, steel mill in Duisburg, up and running in the year 2028.

AR Green hydrogen? So, you are using wind and solar, hydrolysis, and then you are making green hydrogen and using it that way. Is that where you're doing?

MH Yes. We're not making the hydrogen ourselves, so we are sourcing it. There is a pipeline network currently constructed, and it's not too far away anymore. We are currently engaging in negotiations with big energy companies, mainly on the hydrogen supply contracts. We are solving this chicken and egg issue, because there is no availability of green hydrogen in the world for a big offtaker. The energy companies would not make any investment if there were not the guarantee to have a big customer. We are working to support this transition to the mandatory use of green hydrogen in the future.

AR Ron, let's switch to North America, what is going on in North America as it relates to green, if anything, or hydrogen for a fuel source?

RH I am not an expert to talk about green hydrogen, but in the energy transformation that we're making it is to clean energy sources, especially on large users like steel manufacturing and other large industrial consumers of energy. Liquid hydrogen is an absolute necessity because you just cannot generate enough material, or you cannot generate enough energy by using electricity alone to do that. In terms of its impact on GOES and electrical steel, producers in North America, Europe, and around the world need to spend trillions of dollars to be able to achieve the clean energy targets they need to. In the end, we are working very closely with our suppliers and partners to make sure that we are advocating for those investments for clean energy for GOES, because without end users investing and providing the means for that, producers are never going to be able to convert to green electrical steel. In the end, that is going to have to be paid for by end users in those investments. And we're working very hard to promote green steel like the product that thyssenkrupp is making available to the market.

AR When I asked earlier, 'what was the relationship between your two companies?', the first word both of you used was collaboration. How can two global companies, two recognized companies in the marketplace; one with a parent who is a competitor of the one who is the supplier, make it work? Marcel, what do you think the most important collaborative principle was?

MH Shared values.

AR Shared values. I like that. The shared value had to be a commitment to something bigger. Ron, your thoughts?

RH That would have been the first one I gave. The second one, I think, needs to be having an open dialog.

MH That is a very good number two. Overall, for a collaborative atmosphere, a collaborative way of working here, it needs to have the same passion for driving value for the end customer in the end, which we have. And collaboration only makes sense if we are creating value for the transformer maker, for the OEM, and their customers in the end.

RH If I can just add to that point, when we talk about value. We are not just talking about our business's financial value or thyssenkrupp's financial value. We're talking about creating value through the entire supply chain, to the utilities, to the end users, to our OEMs, and really to the electrical consumer. As long as we stay focused on that as our primary mission, it tends to solve a lot of problems along the way. Combining that with open communica-tion and a common mission, I think those are really the big recipes. We don't always agree, and we need to be open to work through those issues. I think that is also a part of it, that you must have a commitment to work together to find a resolu-tion to challenges or conflicts that you have.

AR Excellent. Ron, what were some of the barriers and challenges in working together that you saw that you can help others who are trying to collaborate with their suppliers or with their customers in a way that they're trying to bring about something of value?

RH I think there are a couple of things that come to mind that disable collaboration. I think the first thing that disables collaboration is self-interest. If I am more interested or only interested in what I need, or what my business needs, or what my finances are, and I don't care about Marcel and thyssenkrupp's financial health, then that is a big obstacle to collaboration. I think the second

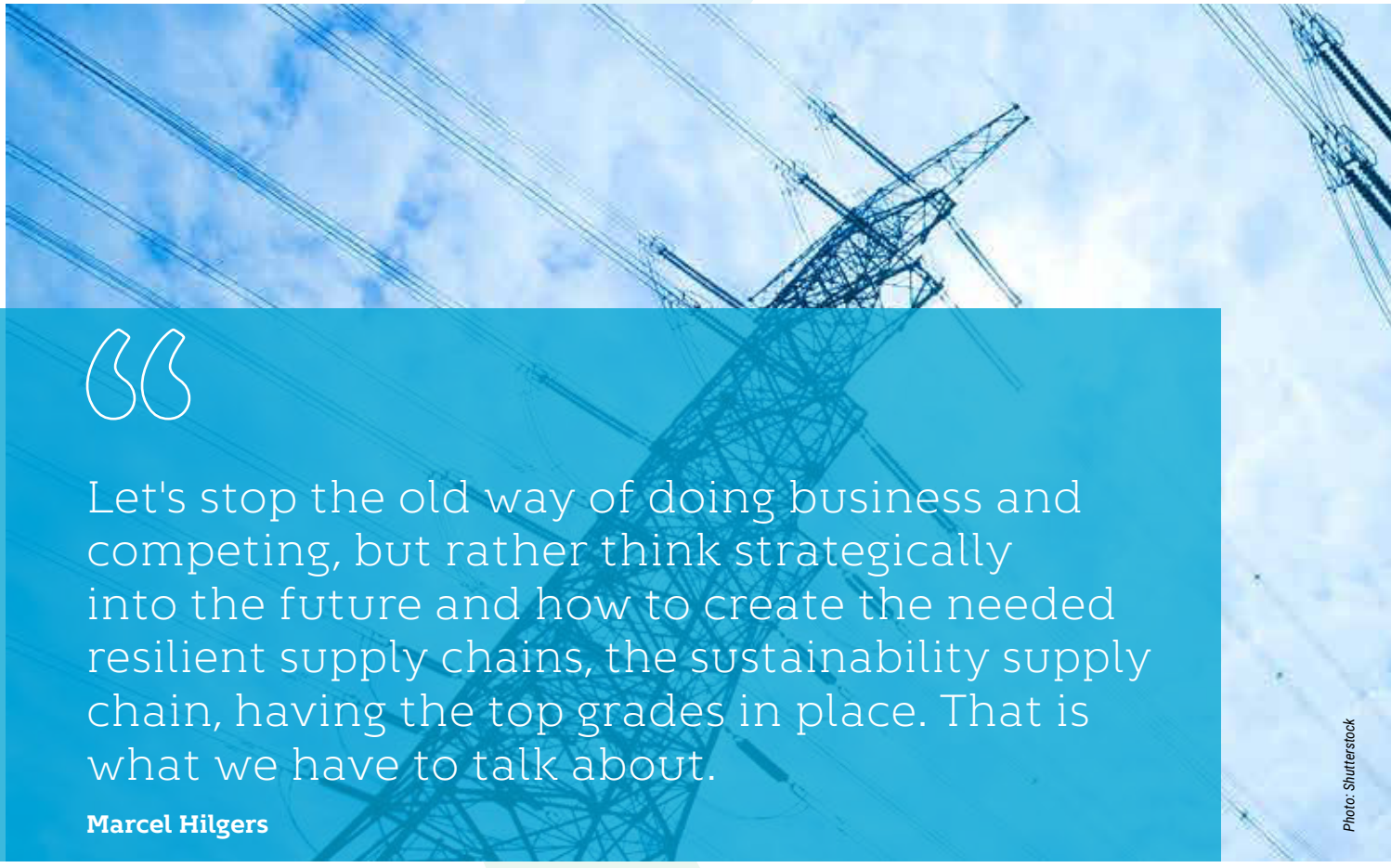
one, equally important, is when you negotiate terms, prices, whatever, if you play one supplier against another in that supply chain; that can also be a disabler to collaboration.

AR Marcel?

MH I agree with what Ron said. He said something earlier as well. It is this growth we have to accomplish together. We are coming out of a decade and more of having losses in this industry. Transformer OEMs, steel makers or GOES producers, all of us. You could say we are coming out of some tough times. Now it is time to grow together, and we all somehow forgot how to grow and what it means, especially as we are now coming into a time where there is enormous growth ahead. We can already anticipate that there will be supply chain issues along the way. The ones Ron mentioned, if somewhere in the chain there is a missing link, that creates issues for all of us.

On GOES, here is my perspective as a producer, which is based on public data. At this moment, there is a global installed capacity of GOES of around 4 million tons, and nearly all GOES makers are producing at full capacity. Transformer makers are operating at, in many cases, full capacity as well, with the exception of China and some in Southeast Asia. But there are huge investments needed coming up. I do not think that we will have sufficient GOES in the market over a certain period of time. If we look at the projected increase in investments in the grid globally, especially in North America and Europe, then the like-to-like comparison is that by the year 2050, we need more than 9 million tons of GOES in the market. Who is making the needed investments right now? It is very, very slim, and it's a very expensive thing. Also, the know-how needs to be there. Let's stop the old way of doing business and competing, but rather think strategically into the future and how to create the needed resilient supply chains, the sustainability supply chain, having the top grades in place. That is what we have to talk about.

AR Resilient supply chains are one of the things, in North America and especially in the United States, it does not matter who will be President (*At this writing Donald Trump was elected President.*), everybody agrees on this. We needed to "de-china-ise" our supply chains. Covid taught us that. Covid was a real eye opener in terms of getting supplies. Chip makers, everybody is doing that, particularly for transformers. We no longer bring as many transformers in, if any, from China.



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>
> **Marcel Hilgers**

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Marcel, you said we are moving from 4 million tons to 9 million tons. How are we going to do that?

RH If I can start, this is both from mill production of GOES and processing capability. This is where I think collaboration is so important, and I don't think it's just industry collaboration. I think there needs to be leadership from government entities to set the path forward for the transition to clean energy technology. Otherwise, the investments are just going to be too slow. Marcel talked about that just now. We have 4 million tons of GOES produced today. And really, outside of potential Chinese additional investment from existing producers, the only investment that is going on right now is JFE Steel and JSW in India, and that's really mostly intended for the Indian market. So, if you look at that, there isn't really enough that's being considered today for investment in GOES in Europe, North America, et cetera. And why is that not happening? It's not happening because we lack a clear vision five years from now or ten years from now. If I was going to spend a billion dollars to invest in a GOES production facility, the question is if the path clear enough for me to make that investment worthwhile.

I just don't think there is enough leadership to make that long term investment clear.

We are all owned by private companies that our shareholders expect us to make a return on the investments they make, and they don't expect a return sometime in the future, they expect a return when that asset is put into place. And this is the challenge that I think both Marcel and I have been talking about, about industry growth. How do we grow the entire supply chain of electrical steel, other components for transformers, with the capacity to produce power and distribution transformers, and the ability to install those transformers? How do we grow that at the pace that the electrical demand requires and the path that we're on? How do we grow those with sensible investments from all the players in the supply chain so that we satisfy the demand in the future and satisfying our shareholders that we're making good business decisions and investments.

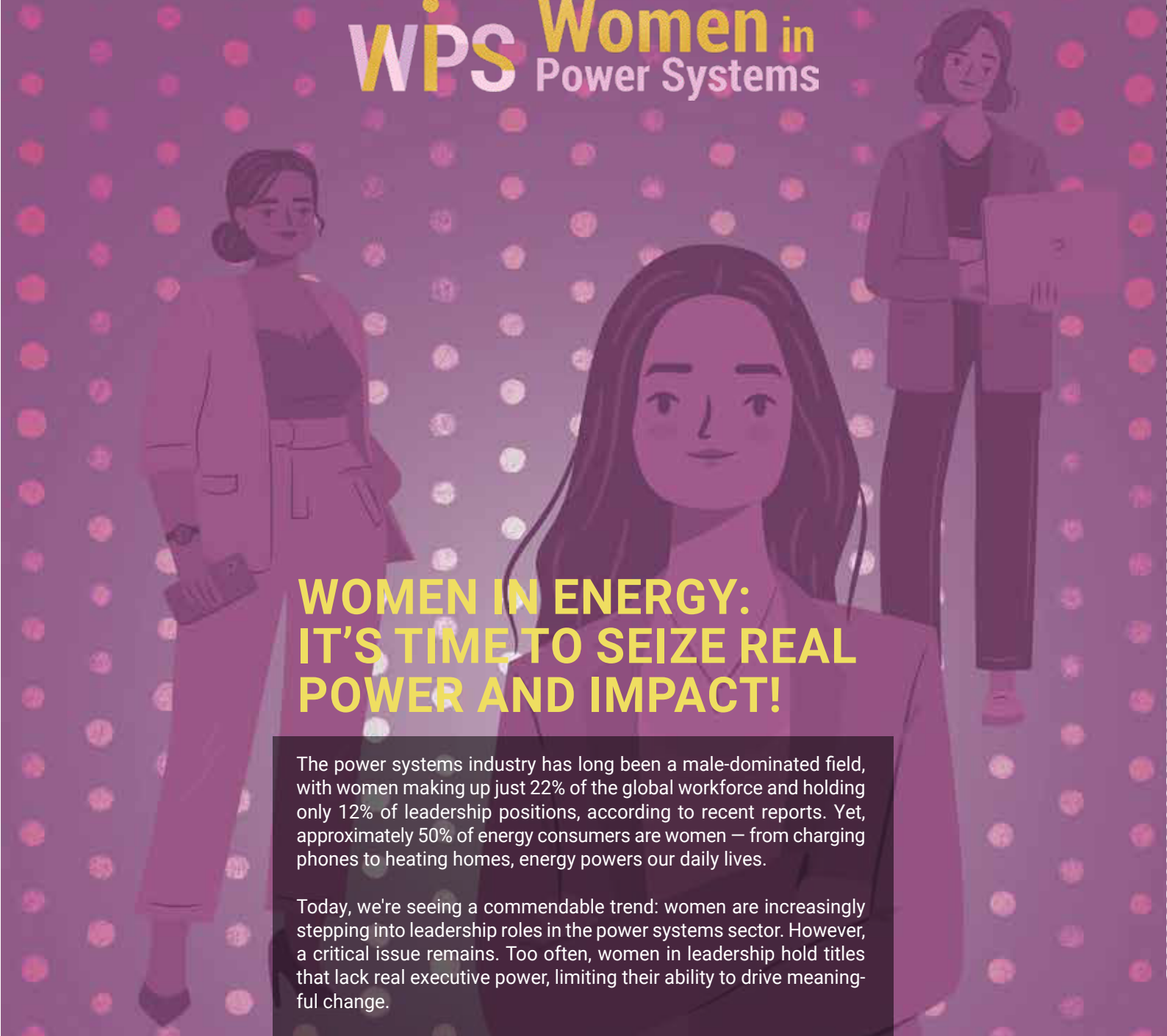
AR Gentlemen, I would consider both of you rock stars of our industry, so thank you very much for your time and insights on this important topic.

MH Thank you, Alan.

RH Yes, thank you, Alan. It has been a pleasure.

Editor's Comment: For more on this topic please go to https://www.powersystems.technology/community-hub-pst/apc-power-panels/power-panel-discussion-changing-dynamics-of-electrical-steel.html to view the complete Power Panel in our You Tube Channel.

WPS Women in Power Systems



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Contact: Managing Editor Tamara Marček tamara.marcek@apc.media

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