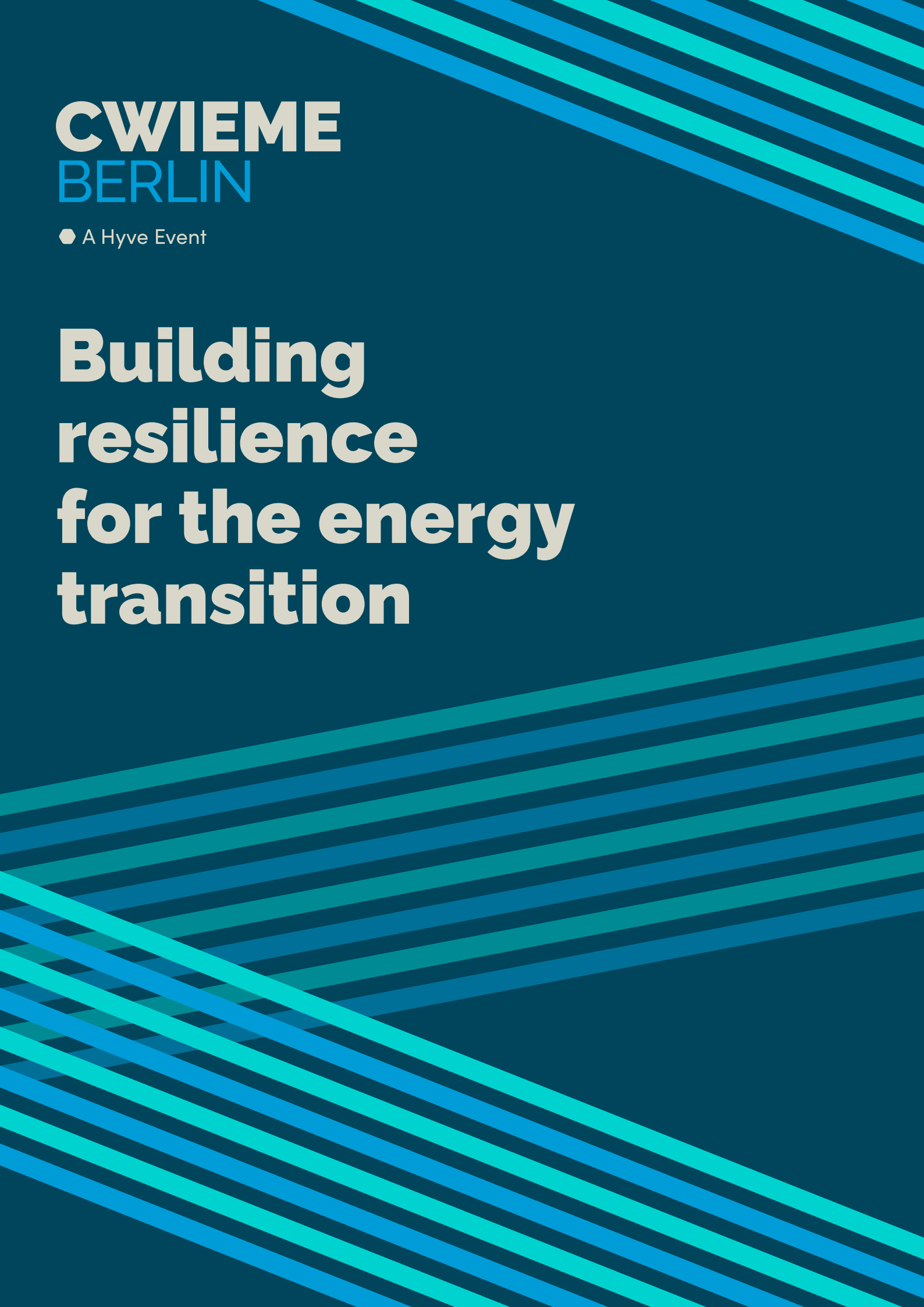




CWIEME
BERLIN

● A Hyve Event

**Building
resilience
for the energy
transition**



Editor's note

The energy industry stands at a pivotal moment. As electrification accelerates and demand for reliable, affordable and sustainable power continues to grow, the infrastructure, expertise and supply chains that support our energy systems are facing a huge amount of pressure.

This year's CWIEME Berlin report brings together insights from industry leaders, innovators and subject matter experts to explore the opportunities and challenges shaping the future of energy transmission and distribution. From reimagining grid infrastructure for a renewable-powered world to addressing workforce shortages, geopolitical uncertainty and raw material volatility, the perspectives featured in this report highlight the interconnected forces transforming our industry.

Across these discussions, there's a common theme: resilience. Whether strengthening transformer supply chains, developing the next generation of talent, harnessing artificial intelligence to improve decision-making or accelerating investment in clean energy infrastructure, organisations are being challenged to adapt faster than ever before.

The energy transition requires collaboration across manufacturers, utilities, suppliers, policymakers and technology providers. Success will depend not only on innovation, but also on our collective ability to build systems that are flexible, secure and prepared for long-term growth.

CWIEME Berlin continues to serve as a global platform where these critical conversations take place. By bringing together experts from across the electrical engineering, transformer and energy ecosystems, we aim to foster the knowledge-sharing, partnerships and innovation needed to support a more resilient energy future.

We hope the insights within this report inform your thinking, spark new ideas and contribute to the conversations that will shape the next chapter of the energy transition.

Melissa Magestro, CWIEME Berlin Portfolio Director

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Advancing Resilient, Affordable, and Clean Energy Through Transmission and Distribution Innovation



Prof. Henrik Stiesdal
Wind Power Pioneer



Summary

Not every conversation at CWIEME Berlin could be explored in a full feature. The following summary captures the key themes, insights and discussion points from this session, highlighting the ideas most relevant to the industry's ongoing transformation. Here Henrik Stiesdal captures the key themes and strategic implications for the future of energy systems.

The session explored the challenges and opportunities in transitioning to resilient, affordable, and clean energy systems, with a focus on transmission and distribution infrastructure. The speaker highlighted the importance of moving beyond reliance on fossil fuels, noting that Europe imports nearly all of its oil, gas, and nuclear fuel but produces renewable energy domestically. Investing €200 billion annually in renewable energy over 15 years was deemed a more sustainable path than current fossil fuel expenditures. The urgency of addressing climate change, as evidenced by rising global temperatures, underscored the need to accelerate this transition.

Renewable energy sources like wind and solar were identified as the most reliable and scalable options for decarbonisation. The speaker advocated for prioritising electrification wherever possible, using hydrogen as a secondary option for energy storage and transport when direct electrification is unfeasible. They emphasised that existing technologies are sufficient to meet modern energy

demands, dismissing the notion that reliance on fossil fuels is irreplaceable. Examples such as Australia's potential to power global electricity needs with solar energy on just 2% of its land demonstrated the scalability of renewables.

Significant emphasis was placed on the inadequacies of current grid infrastructure, which was designed for centralised fossil fuel plants, not the fluctuating nature of renewable energy. The speaker argued for more flexible and responsive grids that could adapt to variable production and consumption patterns. Solutions included prioritising grid-friendly projects, leveraging AI for smart grid management, and incentivising storage and flexible demand. Examples of successful models included Denmark's high renewable integration with minimal outages and the potential for electric vehicles and hydrogen plants to stabilise the grid.

The speaker criticised prolonged permitting processes and insufficient grid expansion as major bottlenecks to renewable deployment. They

described how Europe has 1,700 GW of renewable projects stuck in connection queues, with many projects lacking viability or grid-friendliness. Recommendations included revising permitting practices, ensuring projects meet grid-friendly criteria, and implementing flexible connection agreements. The speaker stressed that overbuilding grids was neither feasible nor timely, necessitating smarter utilisation of existing infrastructure.

Energy storage technologies were described as critical to bridging production and consumption gaps. The declining costs of battery storage, driven by mass production, were highlighted as transformative. The speaker proposed integrating storage as an active part of grid planning, not merely as a market-driven commodity. Examples from Australia demonstrated how battery storage had already mitigated peak demand issues, underscoring its value. The speaker also called for dynamic and location-sensitive tariffs to encourage grid-friendly behaviours and optimise resource allocation.

Finally, the session called for a cultural shift in energy planning, advocating for greater coordination between transmission and distribution operators. This included integrated planning, shared scenarios, and recognising the interconnected nature of energy systems. Large-scale projects like the Baltic Energy Island were cited as examples of cross-border collaboration. The speaker concluded by stressing that while challenges remain, the transition to a sustainable energy future is achievable through innovation, collaboration, and smarter grid management.

Takeaways

Flexibility in Energy Systems Is Crucial for the Transition to Renewable Energy

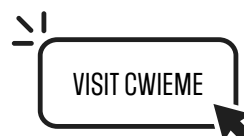
The session stressed the importance of adopting flexible energy systems to accommodate the variability of renewable energy sources like wind and solar. By encouraging grid-friendly behaviour, such as flexible demand, smart storage solutions, and dynamic tariffs, the transition to a resilient, affordable, and clean energy future becomes both feasible and efficient.

Grid Infrastructure and Permitting Are Critical Bottlenecks

The discussion highlighted significant delays in permitting and insufficient grid infrastructure as major barriers to renewable energy deployment. Simplifying permitting processes, enhancing grid capacity, and prioritising grid-friendly projects were proposed as key strategies to overcome these challenges.

Renewables Are Outpacing Fossil Fuels in Growth

The session underscored the rapid expansion of renewable energy, which now grows faster than global electricity demand, with solar and wind leading the way. This trend demonstrates the feasibility of achieving a sustainable energy transition, although challenges in balancing supply and demand remain.



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The impending talent crisis behind the transformer boom



Adam Middleton

Director
EnergetIQ Advisory



The hidden workforce issues threatening to impact the future of transformer supply

In recent years, the rise in demand for power transformers has been covered across the media landscape. However, while most industry conversations focus on materials, manufacturing capacity and logistics, a more fundamental constraint is emerging beneath the surface: people. Here, Adam Middleton, director of EnergetIQ Advisory and [a CWIEME Berlin speaker](#), explores the growing talent crisis impacting the transformer industry, the effect of changes in workforce demographics and the rise of AI.

The surge in transformer demand didn't come from a single source. It's the result of multiple forces converging at once. There was the post-COVID rebound, of course. But there are many other factors layered on top of that, including the broader shift towards electrification, with everything from transport to heating being reimagined around electricity.

Then there's the energy transition itself. Renewable generation is inherently more distributed than traditional fossil fuel systems, which means grids need to be rebuilt, reinforced and reconfigured. Add to that ageing infrastructure, with much of it now reaching

end-of-life, and the need to increase base capacity, and the scale of the challenge becomes clearer.

Finally, and perhaps most strikingly, there's the rise of data centres. In the UK alone, peak demand from data centres has reached around 9GW – that's roughly equivalent to London's peak demand.

Put simply, demand is rising, being impacted from every direction, all at once.

The constraint no one wants to talk about

While supply chains are working hard to keep up, there's a growing recognition that the biggest constraint may not be steel, copper or components – it's talent. Demographic change is impacting the workforce in ways many organisations are still struggling to grasp.

A significant proportion of the industry's most experienced engineers are approaching retirement. In some cases, companies in the energy sector could lose up to half of their most experienced workforce within the next decade.

Despite the scale of the issue, many leadership teams remain focused on short-term profitability. Workforce strategy and recruitment are still often seen as an HR concern rather than a core business risk. In some cases, business leaders simply do not have the data to confirm the situation.

The value of experience

While these demographics shift, AI is continuing to transform the industry.

There's a common narrative that AI will replace jobs. And to some extent, that's true - certain roles will disappear. But that's only part of the story. In reality, AI is increasing the value of experience.

AI tools are only as effective as the context they're given. Without deep domain knowledge, they risk producing outputs that are technically plausible but practically flawed. This means that businesses can't rely solely on AI. They need the technology plus the expertise.

The people who understand systems, have seen failures and know how to interpret nuances are the individuals who can truly harness the power of AI. They are also the ones best placed to capture and codify knowledge before it disappears.

A widening gap

Companies are already investing heavily in early-career talent. That's understandable, as new entrants are essential for the industry's long-term future. However, younger employees are generally more mobile. Many leave a business within a couple of years, taking their acquired knowledge with them.

On the other hand, mid- and late-career development often receives far less attention. At the same time, outdated assumptions about older workers still exist despite clear evidence that experienced employees are highly productive and more likely to stay.

The result is a widening gap: increasing demand for expertise, coupled with a shrinking and underutilised pool of experienced talent.

Losing experienced staff means losing knowledge that can't easily be replaced. It increases project risk, affects delivery timelines and ultimately impacts client trust. Oh, and don't overlook the fact that there's also a direct impact on margins. Retaining and effectively deploying experienced workers can significantly improve productivity and reduce costly errors or delays. In other words, getting this right isn't just about avoiding risk. It's about creating competitive advantage.

Many colleagues in the final phase of their career share the views that they want to continue to do "something valuable", to contribute and to "give something back to the next generation". As health and life expectancy continues to improve, the duration of retirement only increases. In the energy sector, with the huge growth forecast over the next 20+ years, we need all the help that we can muster. It might however be in a different format.

The risk of standing still

Unfortunately, there's still a gap between recognising the issue and truly comprehending its scale. Unless this gap can be bridged, meaningful policy or organisational change will be difficult. And time is not on the industry's side.

If action isn't taken, the consequences could be profound. In the starkest terms, there's a risk that transformer markets, and potentially wider supply chains, will become dominated by those who are better able to mobilise both capacity and talent.



What needs to change

First, organisations must understand their own demographics. Not in broad terms, but in detail. This includes who is likely to retire, when and what knowledge they hold. Second, there needs to be a greater focus on keeping employees engaged for longer careers. As working lives extend, support structures must evolve with them. Simply, work like never before to keep your employees fit and well.

Third, training must become continuous and inclusive. AI is no longer a niche technical field that businesses can only recruit specialists for. It's now a core part of everyone's role. Therefore, everyone, regardless of age or role, must feel comfortable using it. This is and will be a continuous process.

Fourth, companies must get serious about capturing knowledge. AI tools can be a huge help here, allowing organisations to actively record and structure expertise for the wider workforce. Embrace knowledge, especially the elements that are not written down, before it walks out of your door.

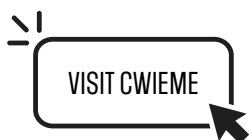
Finally, there needs to be a more open and flexible approach to later careers. Many experienced professionals don't want to stop working. They just want to work differently. Creating pathways for reduced hours, mentoring roles or phased transitions can bring significant value.

A defining challenge for the energy transition

The energy transition is often framed as a technological challenge. And it is, to a degree.

However, it's becoming clear that the bigger bottleneck may be human. The demand for transformers, and the infrastructure they enable, is only going to grow. Meeting that demand will, of course, require investment and innovation, but it also means a rethink of how the industry values, develops and retains its people.

Without the right expertise in place, even the most ambitious plans risk falling short, and that's a challenge the industry can't afford to ignore.



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Navigating Geo-Political Risks & Global Competition in the Transformer Industry: OE



Merve Maden Avci

Global Product Line Marketing Leader
Medium Voltage Assemblies



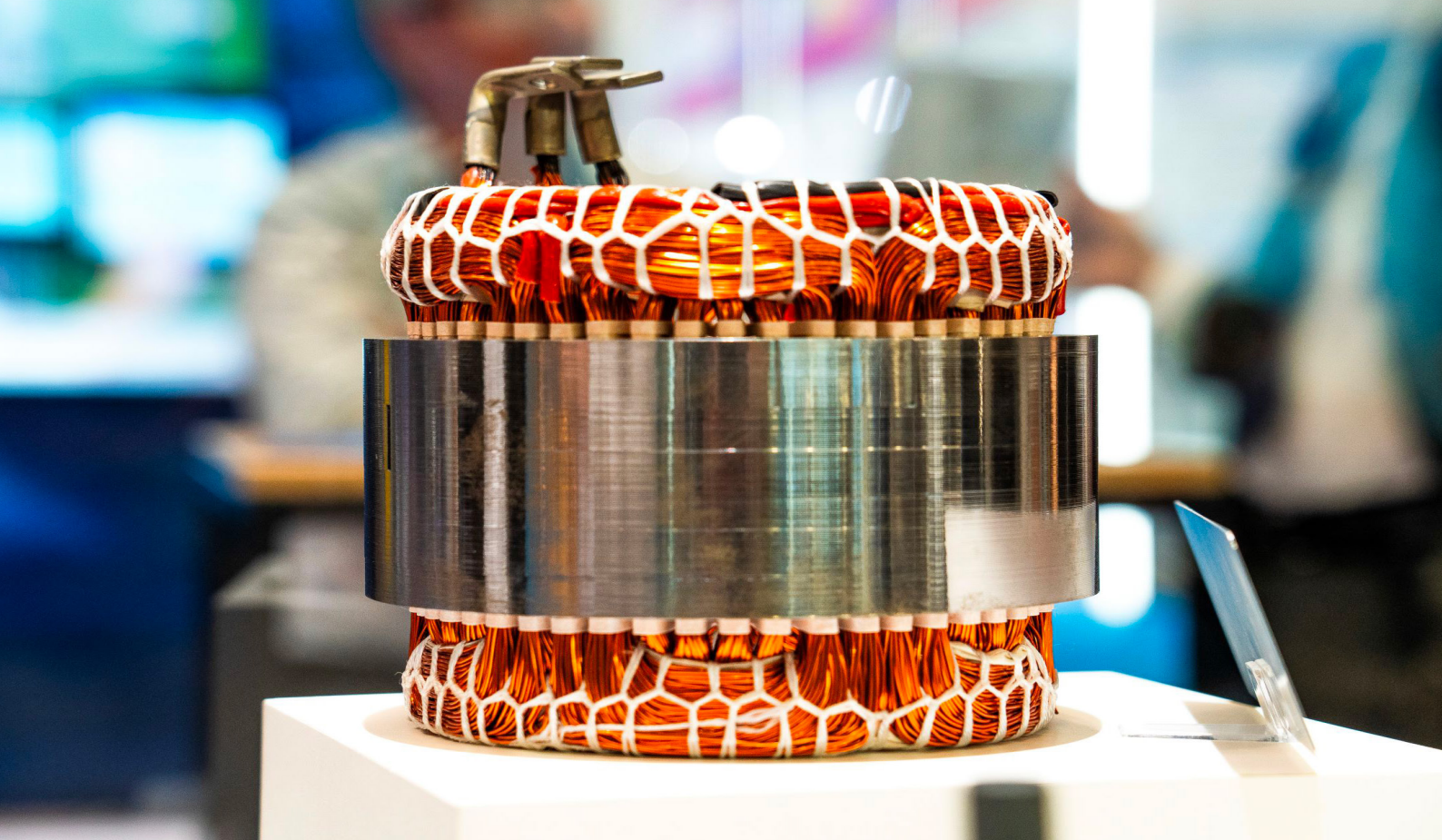
Adam Middleton

Director
EnergetIQ Advisory



Erhard Eder

Senior Vice President
Grid Technologies Transformers



Summary

Alongside the feature articles in this report, CWIEME Berlin hosted a series of expert panel discussions addressing some of the industry's most pressing challenges. The following overview distils the key themes, perspectives and recommendations that emerged from this conversation.

The panel explored how geopolitical conflicts, particularly in Europe and the Middle East, have disrupted the transformer industry, highlighting strained relationships, supply chain disruptions, and increased demand for electricity. A panellist noted that this “energy war” involves leveraging energy supply and infrastructure for geopolitical advantage, with examples like one country’s dominance in transformer lamination and rare earth metals. The panel discussed how Western governments responded with strategic policies like the US Inflation Reduction Act, but underscored the slow, non-kinetic nature of this conflict, fought through supply chains rather than traditional warfare.

Participants examined the root causes of industry vulnerabilities, citing over-reliance on globalisation and efficiency-oriented supply chains as key factors. It was argued that the pandemic exposed the fragility of long, concentrated logistics chains, while tariffs, labour shortages, and raw material price volatility compounded challenges. Panellists highlighted a shift in focus towards resilience and flexibility alongside efficiency, with some viewing market evolution as an opportunity for supply chain

diversification, while others stressed the need for closer collaboration among stakeholders to mitigate risks and improve demand planning.

The discussion turned to the risks and exposure faced by the sector, including ageing transformer infrastructure, extended lead times, and cyber vulnerabilities. One speaker emphasised that the cost of defending critical infrastructure is high, while the cost of attack remains low. Another panellist pointed to significant investments, such as Siemens Energy’s billion-dollar initiative in the US, as evidence of the strategic importance of addressing these risks. However, concerns about raw material shortages and the need for better alignment between OEMs, suppliers, and customers were also raised.

To address supply chain vulnerabilities, the panel proposed strategies such as “friend-shoring”—collaborating with trusted partners across multiple geographies to ensure flexibility and risk management. Panellists stressed the importance of transparency and long-term planning, suggesting that harmonising supply chain designs could alleviate bottlenecks. However, they



acknowledged that harmonising international standards, such as IEC and IEEE, is a challenging prospect. The conversation also touched on innovation in production processes, including the use of AI and automation to optimise manufacturing and manage demand surges.

Workforce shortages emerged as a critical topic, with panellists identifying the loss of skilled labour due to ageing demographics as a pressing issue. They stressed the importance of mentoring younger professionals and attracting talent by highlighting the industry's critical role in the energy transition. Examples included retraining mid-career professionals for technical roles and leveraging opportunities presented by the energy transition to make the sector more appealing. However, concerns persisted about the loss of tacit knowledge as experienced workers retire.

In conclusion, panellists expressed optimism about the sector's potential despite its challenges. They emphasised the need for innovation, collaboration, and flexibility to navigate current disruptions and leverage opportunities. Strategic investments in local manufacturing, technological advancements, and proactive workforce development were underscored as vital steps. The panel closed by recognising the importance of addressing both immediate supply chain issues and long-term industry transformations to meet escalating global energy demands.

Takeaways

Geopolitical Tensions Demand Strategic Supply Chain Resilience

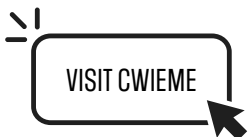
The panel noted that geopolitical events, such as conflicts and trade restrictions, have significantly disrupted supply chains, revealing vulnerabilities in the transformer industry. Strategies like localisation, diversification, and 'friend-shoring' were highlighted as critical to mitigating these risks and ensuring long-term resilience.

Collaboration and Flexibility Are Key to Navigating Market Dynamics

Participants emphasised the need for greater collaboration among manufacturers, suppliers, and customers to address supply chain bottlenecks and unprecedented demand. Flexible operations, harmonisation of design standards, and transparent planning were identified as essential tools for adapting to the evolving energy market.

Workforce and Knowledge Retention Are Critical Challenges

The panel highlighted the ageing workforce and the impending knowledge gap as major concerns for the industry. They stressed the importance of attracting young talent, mid-career retraining programmes, and knowledge-transfer initiatives to ensure the industry's sustainability.



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How AI is rewriting the rules of raw materials



Gustavo Regueira Llansó

Director of strategy and operations
Altrove AI



Moving from sourcing materials to designing them

Engineers have long understood the properties they need from materials, such as magnetic performance, conductivity and thermal resistance. But translating those requirements into real, manufacturable materials has traditionally been hard to achieve. Here, Gustavo Regueira Llansó, director of strategy and operations at Altrove AI, one of CWIEME Berlin's Innovation Zone exhibitors, explains why the materials science community has been experiencing the same problem for decades.

We know what “good” looks like. Engineers understand the properties they need, whether it's magnetic properties, conductivity or thermal resistance. But translating those requirements into real, manufacturable materials has often been slow and expensive. However, that is now changing as AI completely changes how we think about materials.

This change could not come at a more critical moment. Across electrical engineering, demand for key raw materials has surged. Copper, rare earths, graphite and specialised alloys are increasing in demand significantly. The electrification of transport, the expansion of renewable energy and the digitalisation of industry are all driving unprecedented consumption. At the same time, supply chains have become more fragile and more concentrated, exposing manufacturers to risks that were once easy to overlook.

Growing importance

Not long ago, materials could be treated as a procurement issue. Today, they sit at the centre of business strategy.

Manufacturers are increasingly aware that their ability to produce depends on forces far beyond their control. Finding new suppliers or diversifying sourcing regions are still necessary, but they are no longer sufficient. In many cases, the material itself has become the problem.

The impact of AI

This is where AI is having a huge impact. Historically, industries have relied on two main levers to address material challenges: extracting more resources or recycling what already exists. AI is now introducing a third path – possibly the most transformative one – creating entirely new materials tailored to specific needs. Now, instead of asking, “Where can we source this material?”, manufacturers can ask, “Can we design a better one?”

AI enables this by dramatically expanding the range of possibilities. Where scientists once worked with a relatively small set of known material structures, machine learning models can now explore millions of potential configurations. More importantly, they can predict how those materials will behave before they are even synthesised. Properties that once required

months of simulation can now be estimated in a fraction of the time.

A recipe for success

Knowing the properties of a material is only part of the challenge. Like identifying the ingredients of a recipe, the real difficulty lies in defining the precise process needed to produce it at scale. In materials science, this "recipe" is the synthesis process: the precise steps required to turn a theoretical material into something that can be manufactured at scale.

By combining predictive models with experimental feedback, it is now possible to generate and refine production processes far more efficiently. Instead of relying on slow, manual iteration, companies can use AI to propose multiple "recipes," test them rapidly and learn from the results. Even failed attempts become valuable data, feeding back into the system and improving future outcomes.

AI is also changing how innovation itself happens. In the past, new materials were often developed in isolation within research labs or academic institutions and only later matched to industrial use cases. This "push" model frequently led to misalignment between what was created and what the market actually needed.

Today, manufacturers can define their requirements upfront. They can specify the exact properties needed, whether these are driven by performance targets, cost constraints or supply chain considerations. AI systems can then work backwards, identifying and designing materials that meet those criteria.

This "pull" model represents a significant shift in how materials are developed. While the concept itself is not new, AI makes it far more practical by enabling manufacturers to define precise requirements and rapidly explore viable material solutions that meet them.

It also challenges one of the industry's most persistent assumptions: that trade-offs are inevitable.

For years, material selection has been a balancing act between cost, performance and sustainability. Improving one often meant compromising another. But by exploring a vastly larger design space and optimising across multiple variables simultaneously, AI is beginning to break this assumption. It is increasingly possible to

develop materials that are high-performing, cost-effective and more sustainable.

Reducing volatility

This shift has direct implications for supply chains. Volatility in raw material markets is a huge issue for manufacturers. Price fluctuations, geopolitical tensions and supply disruptions can all have immediate operational impacts. By enabling the development of alternative materials, AI applied to materials science introduces flexibility into a system that has long been rigid.

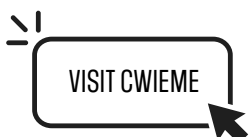
When companies have more options, they are less dependent on any single source. Rather than simply managing dependencies, manufacturers now have the opportunity to move beyond them altogether. By developing alternative materials tailored to their needs, they can reduce reliance on constrained resources and fundamentally change their supply strategies.

Companies that embrace AI-driven material innovation early have the chance to turn a problem into something that gives them a competitive advantage. Developing or adopting novel materials can not only solve immediate supply issues but also help differentiate products in the market. In some cases, it can even redefine entire categories of performance.

As more organisations begin to explore this space, the pace of discovery will accelerate, creating a virtuous cycle of innovation across the industry. Also, with new commercial models emerging, companies can explore AI-driven material innovation with minimal upfront investment, while benefiting from significant upside potential.

This is why the conversation around raw materials is becoming central to events like CWIEME Berlin. What was once a niche technical topic is now a priority for electrical engineering as a whole. The future of the industry will be shaped as much by materials as by design or manufacturing processes.

At Altrove, we see this shift firsthand. The combination of AI and materials science is already transforming how companies approach some of their most critical challenges. And much like that perfect cake, the goal is to finally have the recipe and to make it work, consistently, at scale.



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Transformer Leadership & Sustainability in the Energy Industry



Ana Diaz-Marquina

Global Head of Category
Management Oils, Chemicals,
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Hitachi Energy



Elena Guerrero Nogueira

Sales Manager
Repsol Lubricants



Summary

Leadership plays a critical role in shaping how the transformer industry responds to the demands of the energy transition. The following summary brings together the key themes, perspectives and practical insights shared during this session.

The session explored the challenges, progress, and strategies for incorporating sustainability into the energy industry, with a focus on oils, chemicals, and transformer management. Participants emphasised that sustainability is complex, evolving, and often misunderstood. They highlighted that customers prioritised reducing carbon footprints, securing performance reliability, and ensuring material recyclability, while suppliers faced challenges such as balancing cost, quality, and innovation. Transparency and collaboration across the supply chain were identified as essential enablers for sustainability.

Discussions underscored the importance of transforming supply chain inefficiencies into opportunities for sustainability. Speakers mentioned tangible steps, such as using durable materials, exploring alternatives like bio-based oils, and reducing transportation distances. The importance of aligning customer and supplier goals through co-creation was repeatedly stressed. While geopolitical disruptions and material shortages were viewed

as challenges, they were also seen as catalysts for adopting more sustainable and innovative practices within the industry.

One significant challenge identified was the difficulty in accurately measuring and reporting sustainability metrics. This included inconsistencies in carbon footprint calculations based on geographic and supply chain variables. Participants stressed the need for reliable data and methodologies to support their sustainability claims while maintaining performance standards. They also noted that achieving sustainability goals often required significant investment in production facilities, supply chains, and material innovation.

The session highlighted divergent priorities within sustainability, such as biodegradability versus low-carbon processes. While some saw biodegradability as less critical for transformer oils, others prioritised reducing carbon footprints and ensuring product durability. It was suggested that the

industry should critically evaluate which sustainability attributes are most relevant to specific applications, rather than adopting a one-size-fits-all approach.

Efforts to integrate sustainability included developing low-carbon oils, leveraging existing factory capabilities, and localising production to reduce transportation impacts. These initiatives aimed to balance cost, performance, and sustainability without compromising quality. Participants acknowledged that achieving these goals required long-term commitment, innovation, and continuous investment.

The session concluded with a call for open and transparent dialogue between customers and suppliers. Collaboration was deemed crucial to aligning priorities and addressing unrealistic demands. It was also noted that the energy industry's journey towards sustainability was ongoing, with progress evident in increased corporate commitments and the development of new, innovative solutions. Despite challenges, speakers expressed optimism for future advancements in sustainable practices within the sector.

Takeaways

Sustainability Requires Cross-Disciplinary Collaboration

The session highlighted the complex, multidisciplinary nature of sustainability in the energy industry, requiring expertise in engineering, material science, supply chains, and regulatory frameworks. Transparent collaboration between suppliers and customers was cited as vital for co-creating realistic and impactful solutions.

Sustainability and Performance Must Coexist

Speakers emphasised that sustainability efforts cannot compromise the performance and reliability of energy equipment like transformers. Engineering teams prioritise performance while seeking innovative materials and processes, ensuring that sustainability goals do not undermine operational quality and safety.

Material Innovation and Localisation Are Key Strategies

The discussion revealed that material innovation, such as using bio-based or recycled oils, and reducing transportation distances through localisation, are pivotal for achieving sustainability goals. These efforts not only lower carbon footprints but also enhance supply chain resilience and cost competitiveness.



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