

NATIONAL BULLETIN

Bulletin 4 | 2023

CIREN AND EESA

by Terry Lampard, National President of the Electric Energy Society of Australia

CIREN was created in 1971 and is the International Conference on Electricity Distribution. While we in Australia often use the terms “conference” to mean an event where presentations are made to an audience, in this sense the “conference” is also an ongoing international Technical Society.

CIREN is based in Europe and covers:

- the whole field of Electricity Distribution Systems and associated services, including dispersed and embedded generation issues
- the technical aspects of Electricity Supply
- related aspects such as cost reduction, environment, organisation and skills



Terry Lampard, National President of the Electric Energy Society of Australia

CIREN holds a formal conference and a workshop in Europe on alternating years. You may have noticed that a paper from one of these events is usually included in these Bulletins. EESA coordinates an annual call for papers from Australian engineers and researchers and makes preliminary recommendations to CIREN for inclusion of papers for inclusion in the CIREN event program. I am pleased to advise that seven papers from Australia have been accepted into the 2023 CIREN conference, which is an outstanding result.

CIREN also sets up committees and working groups to examine topics of interest with the purpose of preparing technical reports based on international collaboration between experts. Generally, the details of new working groups are circulated to EESA's State Chapter Committees, who call for expressions of interest from potential contributors. CV's are usually submitted for assessment by the working group convenor prior to approval of membership. Membership of these groups allows Australians to participate in an international community of experts. Many energy organisations around the world face similar problems and issues, but there are vast differences in the operating environments of systems between the northern and southern hemispheres. This makes Australian participation in CIREN activities very valuable because environmental contrasts greatly enrich the global knowledge base in the energy sector.

Affiliations





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EESA (and previously ESEA) has been an Associate Member of CIRED since its creation. The late Frank Evans served as the contact point for CIRED for many years, and Dr David Sweeting AM followed on from Frank. David has now stepped down from this role and I now have the privilege to be Australian contact point. My sincere thanks go to David for his decades of diligent service in this role.

One of the obligations of an Associate Member Country is to encourage and promote participation in CIRED Conferences. The full details of the next CIRED event on 12-15 June in Rome can be found towards the end of this Bulletin (although Early Bird Registration expired on 24 Apr). EESA usually runs an annual competition for Young Power Engineers and fully paid attendance at a CIRED event has been offered as part of the prize. This year's competition will be announced in the very near future.

Further information on CIRED can be found at <http://www.cired.net/>. Access to a full set of CIRED Publications is also available on this website at a modest cost.

Affiliations





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TRANSGRID BUNDLES PROCUREMENT FOR LARGE PROJECTS TO COMPETE IN GLOBAL MARKET SHORTAGES

By Jemma Townsend | 13 April 2023 | Source: [Energy Insider](#)



In the past three years, Australians and the rest of the world have had a crash course in supply chains.

Remember the Covid-induced global rush on toilet paper? That was all due to the huge uptick in (panic) purchasing at a time when there were already supply chain disruptions.

As the world recovers from the pandemic, there are still lingering flow on effects on supply chains – with huge backlogs occurring across the world. Add to that a war in Europe, soaring gas and fuel prices and slower than usual turnaround times for freight and industries across all parts of the economy are needing to plan ahead more than ever.

Transmission businesses are no different. Australia's long term emission reduction plan seeks to achieve net zero emissions by 2050. Fortunately for the environment, and unfortunately for our capacity to get it done – the rest of the world has the same target.

This means a huge amount of pressure is being placed on supply chains that are working overtime to deliver the essential components – reactors, transformers, line conductors and steel – needed to build large scale transmission infrastructure.

There's no transition without transmission.

This is a phrase we like to use a lot at ENA. It's catchy and it's true. Australia is working towards net zero but is hampered by a lack of transmission infrastructure. This is essential to connect new renewable generation to the grid and deliver it to homes and businesses. More connectivity also is critical to put downward pressure on wholesale prices.

In the past 12 months we have seen state and federal governments sending significant signals to the market to encourage this infrastructure build, including updating the regulatory framework to allow for landholder and community benefit payments and the creation of the \$20 billion Rewiring the Nation fund.

These are welcome measures – but they can't deliver the infrastructure without the materials and labour to build it.



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Economies of scale

Most of us are familiar with the microeconomics theory economies of scale. We see it all the time. Large chain stores can buy in bulk at a negotiated lower rate which enables them to pass those savings onto the customer. NSW transmission network service provider Transgrid has done just that with its transmission infrastructure buys.

Transgrid is bundling procurement for key transmission projects such as VNI West, HumeLink and Energy Connect allowing it to compete globally for highly-sought-after equipment and deliver it faster and cheaper for consumers.

The Powering Tomorrow Together program seeks to de-risk a highly competitive supply chain as energy companies race to secure critical, large-scale equipment, materials and skilled people to deliver the projects which will reshape the nation's grid.

"By rolling EnergyConnect, HumeLink and VNI West into one procurement program we're able to purchase materials, like steel and substation equipment earlier and at a lower cost, enabling limited construction resources to be secured and used across all three projects" – Transgrid CEO Brett Redman.



Transgrid CEO Brett Redman and Hyosung CEO and President Takeshi Yokota sign the contract for single phase transformers.

So far Transgrid executives including CEO Brett Redman have visited South Korea and Japan with a 'shopping list' which includes \$385 million in equipment, transformers, steel and cables.

By bundling procurement for the three projects into a single program of work, Transgrid is expected to save up to \$500 million, savings that can be passed on to customers.

The energy sector has been doing a lot of the heavy lifting in the shift to net zero. Networks like Transgrid understand the importance of being ahead of the closure of coal generation and the need to build large scale renewable generation. But the sector can't bring on new renewables until we have the transmission in place.

This is why the entire sector must work together to accelerate the timeline of this program of work to allow fully for the transition to net zero.

LOCAL NEWS

FUTURE GAS SUPPLIES AND THE NEW SAFEGUARD MECHANISM

By Dennis Van Puyvelde | 30 March 2023 | Source: [Energy Insider](#)



Australia's Safeguard Mechanism reforms will require new gas developments to offset their emissions, possibly putting more pressure on gas prices. This is at a time when customers are concerned about the cost of living and there is a critical need for more gas supply to prevent shortages and support the energy transition. The Australian Energy Market Operator's (AEMO's) recently released 2023 Gas Statement of Opportunities highlights supply issues, however it did not consider the impact of the Safeguard Mechanism on these.

AEMO produces annual reports, usually at the end of March, to forecast the adequacy of gas supplies. For Australia's east coast, this is the Gas Statement of Opportunities[1] and for the west, it is the WA Gas Statement of Opportunities[2]. These reports are based on information from gas industry participants and forecast changing customer gas needs for the next 20 years.

This year, the GSOO was released earlier than expected and made a big media impact with its warnings of potential shortages in coming years and for highlighting the need for more gas supply. However the Commonwealth's Safeguard Mechanism, which is welcomed for providing certainty and supporting emissions reduction, has a possible unintended consequence of increasing the costs of new gas supply. The reforms are expected to pass through the Senate this week.



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Gas shortages have been forecast by AEMO since the first GSOO in 2016[3], which showed a potential shortfall under a medium scenario from 2019. As noted in the executive summary:

As proved and probable reserves are projected to decline from 2019, currently undeveloped gas reserves and contingent and prospective resources will be required to meet forecast demand (AEMO, 2016 GSOO, pg 2).

Figure 31 Assumed biomethane supply by state in the Green Energy Export (1.5°C) scenario, 2023-42 (PJ)

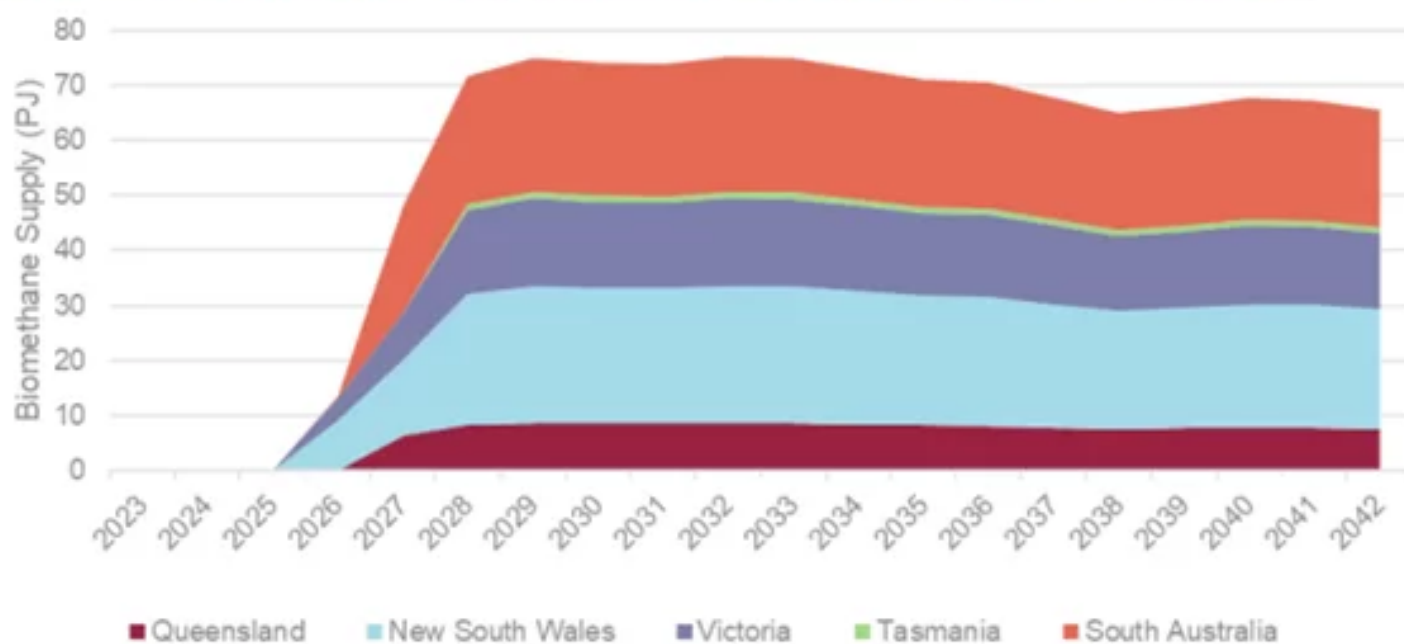


Figure 1: Projected shortfalls in 2019 from the 2016 GSOO (Source: AEMO)

Of course, the 2019 shortfall did not occur as the gas businesses mobilised to produce adequate gas supply to meet demand.

Solving the near-term shortfall

The near-term shortfall forecast in the most recent report is predicted to occur in winter this year.

In particular, the risk of peak day shortfalls continues to be forecast under very high demand conditions in the southern states from winter 2023 (AEMO, 2023 GSOO, pg 4).

The annual physical gas supply is expected to be adequate until 2027 when additional investments will be needed to secure additional supply. Calling out a gas shortage three to four years from the publication date is common in the GSOO series of documents.

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The shortfall predicted during very high demand conditions is a real risk. This can occur when several events happen at the same time, for example:

- Extreme cold weather across the southern regions.
- The unavailability or inadequacy of deep gas storage.
- The reliance of gas use for electricity generation at the same time.
- Gas transmission constraints from infrastructure developments not proceeding as planned.
- Whether spot cargoes in excess of LNG export contracts are made available to the southern market.
-

When all these factors combine, the impact is shown in the figure below in the red circle. This is based on 2019 when there was a high level of coincidence of the above events. A key driver to that potential shortfall is the reduced gas production in the southern states. Using an alternate reference year of 2017 provides the results in the bottom of the chart, i.e., no near-term supply shortage.

In the report, AEMO outlines a range of potential actions to ensure the gas system has maximum resilience and production capability. These actions may be required to address the potential shortfall. There are three broad actions related to infrastructure:

- Ensuring all planned gas infrastructure projects are completed on schedule.
- Develop new (committed but not yet developed) gas supply projects on time.
- Ensuring southern gas storage is at full capacity before the start of winter.

However, flexible operation of gas consumption is also available to manage supply risks. These actions can include:

- Reducing gas generation at times of peak gas demand, with greater potential use of secondary liquid fuels (if available), or the use of alternative electricity generation (such as batteries or pumped hydro).
- Reducing electricity demand by deploying demand response measures in the electricity market to reduce electricity demand, thereby lowering the need for gas generation.
- Voluntary reductions in consumption from gas consumers during extreme peak day events may also be available, however incentives and processes to deliver these are less mature in the gas market than in the National Electricity Market.

Figure 34 Actual and forecast daily southern gas demand showing seasonality, peakiness, southern production, and total system capacity available to meet southern demand using existing and committed projects, Orchestrated Step Change (1.8°C), under average and extreme weather conditions (17)

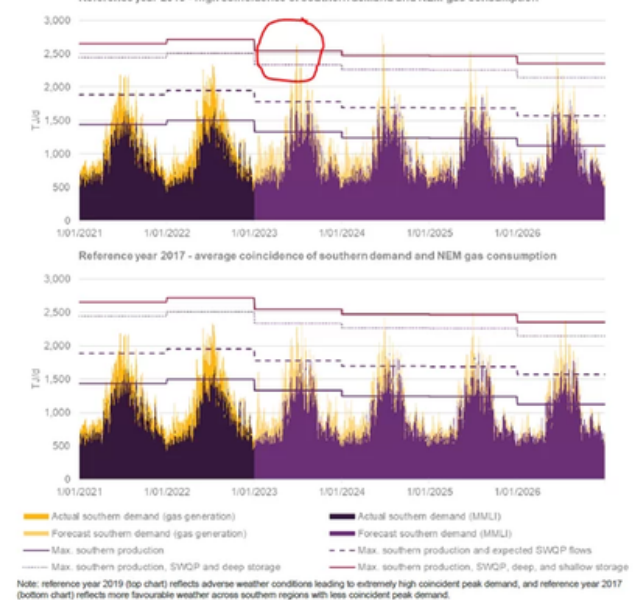


Figure 2: The impact of different reference year weather conditions on potential short term supply shortages (AEMO, 2023 GSOO, pg 71)

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Flexible operation of the gas and electricity system combined provides AEMO with several tools to manage projected near-term gas supply shortages. This demonstrates the value of being able to have a variety of fuels and storage options that can be used to meet changing demand and varying external conditions.

Renewable gas for long term shortages

Projected gas shortage in the longer term will require new gas supplies. AEMO expects gas shortages from 2026/ 2027.

These shortages can be met with additional supply including increased drilling in Queensland, potential gas imports and renewable gases, such as hydrogen and biomethane.

AEMO assumes that more than 70 PJ of biomethane could be available by 2027 to help address the projected gas shortage.

Figure 2 Eastern and south-eastern Australia domestic gas markets (excluding LNG), 2016–35

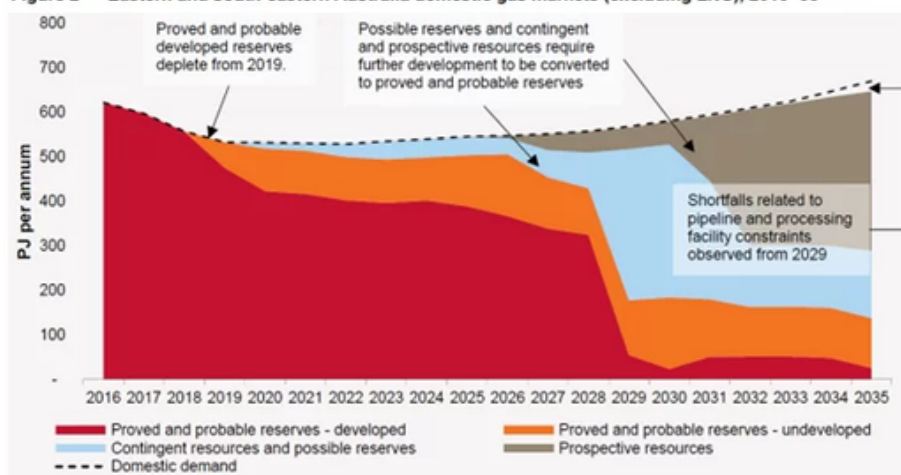


Figure 3: Assumed biomethane supply for Australia's east coast (Source: AEMO, 2023 GSOO).

Renewable gas is not currently considered as an alternative gas supply in the GSOO. It could help plug the gap from declining production of natural gas from the southern states and the increased pressure on new gas projects from the safeguard reforms. Biomethane and hydrogen projects are well underway across Australia and are already providing renewable gas blends to customers. A supportive policy environment would accelerate these projects and help decarbonise gas networks at the same time.

Summary

Gas is used by many millions of homes and businesses and is a critical fuel source for industry and on-demand power generation. Forecasting its demand needs to consider potential extreme weather conditions and coincident need for gas for heating and power generation.

While the focus has been on gas shortages, the GSOO also documents practical actions that can be undertaken to minimise the impact of potential near-term or longer-term shortages. An important addition to these is the development of renewable gas like green hydrogen and biomethane. This will help us meet our emissions objectives and deliver a reliable, secure energy transition.

LOCAL NEWS

AUSTRALIA'S HYDROGEN "SUPERPOWER" DREAM COULD BE "MASSIVE WASTE OF MONEY"- SAUL GRIFFITH

By Sophie Vorrath | 6 April 2023 | Source: [Renew Economy](#)



Rewiring Australia Founder Saul Griffith at an Electrify Parliament event in March (AAP Image/Mick Tsikas)

The well-funded push to make Australia a green hydrogen superpower is shaping up to be a costly economic mistake and a waste of the nation's abundant renewable energy resources, Rewiring Australia co-founder Saul Griffith has warned.

Speaking at a parliamentary inquiry on Thursday, Griffith said Australia – with its huge land mass and unparalleled solar and wind resources – has the “easiest shot on goal” of almost any country in the world to become a renewable superpower, but not through hydrogen.

“The idea that hydrogen will play a large role in the energy future does not make economic or thermodynamic sense,” Griffith says in Rewiring Australia's written submission to the Joint Standing Committee's inquiry into Australia's transition to a green energy superpower.

“It will play a small role, but attempting to carve out a large role for it represents a wasteful way to achieve clean energy goals.”

Griffith is not the first or only energy expert to question the green hydrogen super-hype. The common theme among these critics, including Bloomberg's Michael Liebreich, is that green hydrogen will play an important role, but only in certain hard-to-abate sectors. For the rest, wind and solar and storage will do the job.

And yet, this is far from the message we are getting from Australia's governments, and even energy market arbiters.



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The Australian Energy Market Operator's draft Integrated System Plan for the national grid now includes a "hydrogen superpower" scenario that models the end of all coal generation by 2032, and is the only scenario consistent with 1.5°C. (Although it has indicated it may dial down the hydrogen equation in the next version).

All federal and state governments have ambitious hydrogen strategies – including a federal stretch target of producing green hydrogen for \$2/kg – and are pouring hundreds of millions into research and development and project proposals.

On the private side of the ledger, according to this tally in December of last year, more than 90 projects representing \$A250 billion in investment are planned around the country – a figure that's bound to have increased substantially in the past few months.

Griffith, who's main focus through Rewiring Australia is to lobby for rapid and broad electrification – starting with Australian households and cars – says these billions could be much better spent.

"It gives me pause for concern," he told the committee, which noted in comments during the session that the seemingly infinite promise of renewable hydrogen had been the hottest topic of the inquiry.

"When I look at the... graphs – and I do it diligently and I do it from first principle physics, I struggle to believe that hydrogen will be the contributor that is being lobbied for in this country," he told the inquiry.

Griffith argues that certain parties with their own vested interests have had a "heavy hand on the tiller of the hydrogen conversation," including Australia's regional neighbour Japan, which sees hydrogen as the answer to its very particular set of energy security problems.

The International Energy Agency, too, has come in strongly behind hydrogen, predicting, as a Griffith notes, that by 2050, 50% of the world's electricity will be used to make the zero emissions fuel.

"The International Energy Agency is not a nonpartisan group – it was actually initially founded as as a sort of trading bloc of fossil fuel producing countries for oil and gas. So it really is the mouthpiece for the oil and gas industry," Griffith said.

"They are famously wrong on all their projections of the energy transition... but nevertheless, governments look to the International Energy Agency for advice.

"The people I respect doing the modeling of this, [they say] you know 90-95% of the economy will be all-electric, with 5%, maybe, hydrogen, on the high side.

"If [the IEA's prediction on hydrogen] is true, there's no way we will hit our climate targets because you need all that electricity to be running the economy. That's a very expensive way to do things."

Expensive because, as Rewiring Australia explains in its written submission, it takes three times as much electricity to produce the hydrogen that eventually powers a machine that could have been powered with just one third of the starting electricity if it was stored in a battery not a hydrogen cell.



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"Over-investment in hydrogen is likely to leave Australian homes and Australian businesses with less economic savings and fewer emissions reduction," the submission says.

"With so few people per square kilometre, and so much land, we have the opportunity to produce more renewable energy than we do currently and more than we need domestically, and we can do it cheaper than other nations.

"The question is what to do with that extra energy capacity."

Griffith says the answer to that question is to become a world leader in electrifying the primary production of materials from ores, and doing so with renewables.

"We have a superpower opportunity well suited to Australia's natural resource advantages – metal ores and low cost energy.

"Steel sells for roughly 10 times the price of iron ore. As a simple example, today we earn around \$78 billion in revenue from iron ore exports. If we refined that and exported it as steel, it could make up to \$707 billion in revenue," the submission says.

"This version of an Australian bauxite industry would be earning \$48 billion in exports, three times as much as today's \$16 billion," Griffith says, although he adds that to do this will require an enormous amount of renewable electricity.

"This highlights the importance of boosting our renewable energy production to assume the status of a world superpower," he says.

"That's really the fundamental argument ...up-processing these things in Australia to, maybe not finished stainless steel but at least into pig iron, or into a highly concentrated lithium brine, is absolutely how we should export our energy.

"So use the renewables here to do that. We may not make the cars for America but we will make the steel and aluminium and lithium," Griffith told the Committee.



LOCAL NEWS

SOLAR POWER PUSHING FOSSIL FUELS TO OBLIVION- ANU PROFESSOR ANDREW BLAKERS

By Nick Smith | 12 April 2023 | Source: [Engineering and Technology Magazine](#)



Professor of Engineering at the Australian National University, Andrew Blakers has just been awarded the 2023 Queen Elizabeth Prize for Engineering for his research into solar cell technology that is spearheading a transformation of the global energy mix.

Solar electricity is now “the cheapest energy in history. Cheaper than coal, oil or gas energy. This is the remarkable change that’s happened in the past five years,” says Andrew Blakers, one of a small team of research engineers that has been instrumental in bringing about this transformation. In recognition of his work in developing the PERC (passivated emitter and rear cell) solar photovoltaic energy cell, he and three of his colleagues at the Australian National University (ANU) have been awarded the 2023 Queen Elizabeth Prize for Engineering. As one of the judges on this year’s QEPrize said of the victorious PERC technology: “The winners this year stood out because of the importance of proving that we can produce solar voltaic cells that can meet the energy demands of the future. They showed it can be done.”

Awarded for ground-breaking innovations that have been of ‘global benefit to humanity’, the Queen Elizabeth Prize for Engineering is arguably the most prestigious international honour in the sector. Its aim, says its most recent laureate Blakers, is to inspire “a new generation of engineers to create solutions that can help us tackle the biggest challenges faced by humanity, such as climate change”. Chairman of the Queen Elizabeth Prize for Engineering Foundation Lord Browne of Madingley says the “QEPrize celebrates the engineers who time and time again solve the impossible and transform our world for the better. PERC solar technology is one of those innovations.”



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Blakers, who is Professor of Engineering at ANU, says that PERC “is now the most commercially viable and efficient silicon solar cell technology used in solar panels and large-scale electricity production, and accounts for almost 90 per cent of the global solar cell market”. In combination with other renewable technologies, it is playing a role in “reducing more than three-quarters of present-day global emissions and reaching net-zero carbon emissions by 2050 – as called for in the Paris Agreement. Solar energy provides a solution that is not only clean and sustainable, but accessible and affordable to the wider public.” With worldwide demand for solar growing and global economies increasingly recognising its benefits, the International Energy Agency estimates solar PV capacity will triple over the 2022-2027 period, becoming the largest source of power capacity in the world. Currently, solar is providing about half of new-build electricity generation capacity worldwide.

There’s never been a Nobel prize for engineering – although several notable engineers have scooped the accolade in different fields – which has led to the general consensus that the Queen Elizabeth Prize for Engineering is the nearest thing we have to an equivalent. Blakers agrees, and is understandably aware of the scale of the honour, while taking pains to draw attention to the fact that such high-profile recognition is for sustained scientific collaboration. He’s not just talking about the colleagues he worked alongside – Martin Green, Aihua Wang and Jianhua Zhao – but also the entire solar community that has, in contrast to other research sectors, shared its ideas widely. The PERC team, says Blakers, haven’t patented their work in an attempt to encourage further work in the field.

Blakers maintains that the development of solar photovoltaics has been an incremental “team effort” right from the early days of the technology in the 1960s. “There hasn’t been one of those Theory of Relativity breakthroughs that Einstein had. It’s been a long succession of small steps by many, many people.” He explains it was by collective effort that they first took silicon solar cells into space on satellites, and also out into remote areas. “That was a big thing in Australia because solar panels do a lot better than diesel gensets when you’re 500km from the nearest town.” From these initial applications, solar power has “turned into a global juggernaut that is pushing fossil fuels into oblivion”. It’s been a team effort by electrical, mechanical, materials, design and chemical engineers, as well as physicists “and everybody else in between”. What this widespread co-operation has achieved, says Blakers, is to bring “something that costs thousands of dollars per square centimetre of solar cell down to thousands of square centimetres for a dollar”. That trend is “what’s sweeping fossil fuels out of the energy market”.

The 67-year-old Australian professor has watched or taken part in most of the evolutionary timeline of photovoltaic solar energy, from its early days of being regarded as a fringe technology to the point where harnessing the power of the Sun is underpinning the large-scale production of low-cost electricity. But, says Blakers, “it doesn’t really matter when you come into the industry. Because of its exponential growth, you’re always in on the ground floor. If you came into this a decade ago, then the industry’s now ten times bigger. I came into the area in 1979 and the market is 10,000 times bigger – probably a lot more – than it was. It’s just mind-boggling growth in a small number of years.”



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Looking back over his career, Blakers identifies three phases in the evolution of solar. “At the start there was this idea that solar energy is a joke. Sure, if you’re out in the middle of the Indian Ocean somewhere, solar panels are the way to go. But as for real energy that can run a smelter or an electricity system... you need massive subsidies. It’s just not going to happen.” Here the professor breaks off to imitate the sarcastic laughs of the detractors that were many and vocal at the dawn of the technology. “Then about five years ago, there was this massive change when the gas and coal industries recognised that solar was a real threat.” This was when the tone changed from a be-my-guest attitude to the rhetoric of “hostility, misinformation, outright lying and concerted efforts to slow solar down”. But now, says Blakers, “at least in Australia, there’s pretty much universal acknowledgement that solar and wind have hands-down won the global energy race, and by the end of this decade will constitute 80-90 per cent of the energy mix”.

Blakers sees Australia as a model for how the rest of the world can move towards a renewable future, describing the country as “the global solar pathfinder. It is generating twice as much solar energy per capita than any other country. Australia is way out in front, and it’s all non-subsidised in a completely open market. The reason we are so far ahead is that we have a relatively free electricity market that anybody can hook into with their solar or wind farm as long as they meet a few tech specs. Most other countries don’t have that. It has been a remarkable change. Every state and territory government, and the national government, understands that the faster we get to 100 per cent renewables, the lower will be our electricity prices. The world is going to follow the Australian path very fast because nobody really wants to burn coal, oil and gas anymore.”

At this point, he digresses on the subject of Russia’s aerial attacks on Ukraine’s critical national infrastructure that has concentrated on power generation facilities. Blakers contends that the major supply disruptions caused by the bombardment would have been more manageable in a distributed renewable network. He thinks there are now “a lot of people” waking up to the idea that if you have systems “comprising thousands of wind farms and millions of solar panels spread across the entire continent with a strong network joining them all together, you’ve got to work hard to knock out even a few per cent. But take out one fossil or nuclear power station and you’ve lost 10 per cent of your electricity.” Another advantage, says Blakers, is that territories implementing national renewable strategies will rely less on importing “other people’s energy. You make your own.”

Discussing how PERC has made such a contribution as a game-changer, Blakers explains the problem with designing solar cell for commercial use is the trade-off between “making a really efficient solar cell that no-one can afford to buy, or a really cheap one that you can’t afford to mount on structures because it is so inefficient”. What researchers such as himself have worked towards, he continues, is a “sweet spot”, which is where the PERC cell finds its niche. “In a nutshell, traditional solar cells didn’t worry about what was going on at the back of the silicon wafer. With these old-style cells, all the engineers really worried about was what was going on at the front. PERC allowed optimisation of both surfaces in a cost-effective way, and for the past decade, it has provided affordable-efficiency potential in that sweet spot.” He speculates that in the next decade, it’s likely that another technology will push PERC out of the equation, “but at the moment it is completely dominant”.



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One of the misconceptions Blakers has to deal with is the attitude that Australia is better suited to renewable adoption than other regions due to geophysical factors such as latitude, climate and area, while small northern islands such as the UK enjoy none of these advantages. But he sees no reason why the mix of solar and wind can't be applied as a universal renewable energy solution. "Yes, it can be," he says, reminding me that most Australians live at moderate latitudes – the planet's subtropical and temperate zones lying between the two tropics and the polar circles – a characteristic shared with 80 per cent of the global population. "For these six billion people, the summer-winter ratio of solar is less than two-to-one, meaning that solar works well in winter as well as summer."

For northern Europe, north-east Asia and North America, "that ratio can be as high as six-to-one, which means that in winter you're not getting much solar. But the fact is that wind energy works much better at high latitudes generally." In the case of the UK and Europe, Blakers elaborates, there is "unlimited offshore wind around Britain and further south you get a lot of sun. The obvious thing to do here is to connect north to south so that the winter wind energy goes south while the summer sun energy goes north. Britain won't go solar in a big way. But it has awesome offshore wind in the Irish Sea and the North Sea. Britain has got energy coming out of its ears – but it's not solar.

"That's the way you make the system work," says Blakers, adding that you also need wide-area transmission to smooth out local weather and the third factor of storage. The important point about the system, he continues, is the technology required to make it work already exists: "The world can readily get rid of 80 per cent of its greenhouse gas emissions using off-the-shelf technology already in production in vast quantities." The solution is staring us in the face, says Blakers. It's just a question of promoting teamwork between the two technologies that convert the plentiful natural resources of sunlight and wind. "Everybody has got solar and/or wind. Which means that everybody can benefit from a cheap energy system based on solar, wind and a modest amount of storage."

Reflecting on why he's never bothered to patent his work on solar cells, Blakers says: "When we published our work, we decided not to because it just seemed that the 20-year life of the patent would expire before the technology hit the commercial big time: so, what was the point?" But perhaps more importantly from the perspective of getting alternative energy into the mix, Blakers felt that "the sooner this technology gets out and gets used the better. There's not many of us," he says of the renewable research and development community, "who are in this for the intellectual challenge. All of us are in this to save the planet."

LOCAL NEWS

AUSTRALIAN DEVELOPER CLAIMS BIG INCREASE IN ENERGY DENSITY FROM SOLID STATE SULFUR BATTERY

By Amalyah Hart | 4 April 2023 | Source: [Renew Economy](#).



Image: Li-S Energy

Australian battery manufacturer Li-S Energy says it has developed a twenty-layer battery cell using its third-generation (GEN3) semi-solid state lithium sulfur technology that packs in more energy density and is safer and more reliable than its previous offering.

Manufactured at the company's Phase 2 facility in Geelong, Victoria, the new cells are built using a low-flammability electrolyte which the company says will make them safer than traditional lithium sulfur and lithium-ion battery cells.

Li-S Energy says its third-generation battery has some major advantages over its previous, second-generation iteration, including a major (45%) increase in volumetric energy density. That increase, according to the company, is thanks to the use of a lower-porosity cathode material.

Using its patented Li-nanomesh technology, the cells incorporate Boron Nitride Nanotubes (BNNTs) into the cell construction to reduce dendrite growth, which improves both safety and the life cycle of the battery.

That's because dendrites, projections of metal that build up on the lithium surface of cells and penetrate into the solid electrolyte, eventually cross from one electrode to the other, shorting the cell.

Dendrites have been a major roadblock to the commercial development of long-lived lithium-sulfur batteries, which have the potential to hold more than double the energy density of the more commonly-used lithium-ion batteries.

Robin Leveson, the chairman of PPG Group, the ASX-listed company that owns a 50.23% share in Li-S Energy, says the announcement is a major step in the development of next generation lithium-based batteries.

"Li-S Energy's development of its twenty-layer battery cell using semi-solid state lithium sulfur technology is a major achievement and highlights the progress made by Li-S over the past 12 months," he said.

"The potential to significantly reduce the physical size of the battery packs through the 45% increase in volumetric energy will undoubtedly be of significant commercial interest to high value partners in sectors such as drones and eAviation.



LOCAL NEWS

"These pivotal results are a testament to the Li-S team and further validate the patent protected Li-nanomesh technology and benefits of incorporating Boron Nitride Nanotubes (BNNTs) into the cell construction."

Levison said the batteries were proving themselves in lab conditions.

"The new GEN3 cells are currently demonstrating a gravimetric energy density in our laboratories of over 400 Wh/kg, and a volumetric energy density of 540 Wh/l," he said.

"Compared to current Lithium ion cells this is nearly double the gravimetric energy density and comparable for volumetric energy density. In practical terms this means that our cells are now the same physical size as existing Lithium ion batteries but half the weight.

"Our development team is currently working to develop the cell cycle testing and characterisation results to produce an industry standard datasheet on the new twenty-layer cells."

"The development of these new battery cells is another validation of the strength of our scientific and technical teams, and our collaboration with Deakin University and other Australian and international institutions," said Li-S Energy CEO Lee Finniear.

"This outcome demonstrates the strength of our progress over the last year. In the coming months we look forward to commencing the production of commercial samples for our partners."

EV NEWS

“DRIVER OPTIONAL” ELECTRIC TRACTORS ROLL OF PRODUCTION LINE IN US

By Daniel Bleakley | 6 April 2023 | Source: [The Driven](#)



MONARCH ELECTRIC TRACTOR

Taiwanese manufacturing giant Hon Hai Technology Group (better known as Foxconn) has announced the start of production of the all-electric Monarch MK-V tractor on behalf of the California start up.

The two companies say the MK-V is the first fully electric, “driver-optional” smart tractor. The first five tractors rolled off the production line this week and will be delivered to customers.

“We’re sold out for the majority of this year, and we’re scaling up here, pretty, pretty significantly over the next couple of months” said Mark Schwager, the co-founder of Monarch Tractors.

Fellow co-founder Carlo Mondavi said: “We’re independent. We’re able to help get into the energy business and we’re able to help protect our planet while we migrate away from fossil fuels.”



EV NEWS

In June 2022, Foxconn signed a contract manufacturing agreement (CMA) with Zimeno Inc. D/B/A Monarch Tractor ("Monarch Tractor") to build Monarch Tractor's next-generation agricultural equipment and battery packs at the Foxconn Ohio facility.

"We're very pleased with the product quality ahead of full-rate production," said Foxconn Technology Group in a statement.



MONARCH ELECTRIC TRACTOR

"This milestone is achieved thanks to our employees and the strength of our ongoing partnership with Monarch Tractor. Foxconn prides itself on our partnerships, and we believe the shared goal of promoting sustainability and safety in agriculture is one of the many reasons we have found the right partner in Monarch Tractor."

The company says that the MK-V enables clean, efficient and economically viable solutions for today's farmers and the generations of farmers to come.

The company says the MK-V is a "smart tractor" that combines electrification, automation, and data analysis to help farmers reduce their carbon footprint, improve field safety, streamline farming operations, and increase their bottom lines.

In a press release the company says that new tractor is also safer than traditional tractors. "the MK-V also includes technology that will help prevent farm-related injuries whether the tractor is being driven or performing driverless tasks.

"Each MK-V is produced with collision prevention, human detection, and power take-off (PTO) protection. The tractor will stop moving if it detects a human within six feet of the tractor, and the PTO will automatically shut off if the system detects a person within one foot of the PTO."

EV NEWS

“VEHICLE TO GRID” TECHNOLOGY WILL PROVIDE MASSIVE STORAGE FOR RENEWABLE POWER - EVO ENERGY.

By Giles Parkinson | 29 March 2023 | Source: [Renew Economy](#)



The owner of the electricity network in the Australian Capital Territory, which has already reached “net 100 per cent” renewables, says the growth of electric vehicles and “vehicle to grid” technology will mean that large amounts of wind and solar can be supported with less infrastructure.

EvoEnergy, which owns and operates about 50,000 power poles and more than 5,000 kms of overhead and underground cables in the ACT, has been hosting a landmark trial of V2G technology over the past two years, featuring 51 Nissan Leaf EVs.

The trial is significant because V2G technology is seen as a potential key component of a future grid where wind and solar is providing the bulk, if not all, of the electricity supply, and demand needs are being managed by short and long duration storage. While much of the public debate around storage is focused on stationary batteries, pumped hydro and other forms of long duration storage, many believe that EVs, effectively batteries on wheels, can be a key player because the potential resource is huge.

“You can be in a circumstance where there is a shortfall, and so you’ve got quite a big demand happening at a particular time,” says Peter Billing, the general manager of EvoEnergy.

“If you can draw in, you know, EVs, vehicle to grid vehicles or batteries to tap into to take the edge of that peak, then we don’t need to build as much infrastructure.”

The idea of EVs acting as a grid back-up would have seemed bizarre just a decade ago, and it probably still is for some. But Billing says that network owners are now moving forward, to see how they can embrace the new technologies, including rooftop solar, battery storage, demand management and EVs.

“I think that 10 years ago, networks were kind of thinking ‘what’s happening to our network,’ Billing told RenewEconomy. “Whereas now we just see (these assets) as part of the network. What we are doing is still learning, though.”

Billing says the beauty of bi-directional charging will be its ability to turn EVs into an asset rather than a liability, feeding power back into the grid rather than drawing down at peak times. A lot of this will depend on how tariffs and other incentives are created. For instance, in Canberra in winter the peak demand often happens during daytime hours. And if it has been cloudy, it might make more sense to encourage EV owners to charge their vehicles overnight, when there is often a lot of wind energy.



EV NEWS

"So in winter we might be promoting people to be charging at night when the peak might be lower than it would be during the day," Billing says.

"So with all these technologies evolving over over the next few years, the proliferation of batteries, general storage and vehicle to grid, what does that equation look like. What does the grid need to look like to be able to manage that?"

Billing says it is entirely possible that – as new rooftop solar systems are required to have smart inverters capable of being "orchestrated" by the market operator (i.e, switched off if there is too much rooftop solar output), he says V2G may also become a requirement.

That is many years down the track, considering that V2G is now only possible with older style charging infrastructure known as Chademo, and the V2G standards for CCS charging infrastructure prevalent is yet to be finalised. It will also require EV makers to introduce that technology on their cars, and for the costs of V2G charging hardware to dramatically reduce so there is a clear and obvious return on investment for both the household and the network or market operators.

Todd Eagles, the head of strategic energy deployments at ActewAGL, the local energy utility, says V2G have proved in their trials that can act like a "swiss army knife" for the grid.

"There is functionality to serve the national energy market, to helps support DNSPs (local network owners), all the way down through to the consumer," Eagles said.

"The opportunity really is unlocking what priorities are going to be in place in terms of whether it's a frequency service, a demand response service, or arbitrage from solar in the middle of the day to that evening.

"Doing frequency control is the most difficult thing that we could have selected for this project. But that gives us the ability to send the right signal to the charging market and the vehicle market, and to policy makers across Australia that the capability exists there.

"And because it is like a Swiss Army knife of a Swiss army knife it can be used at every layer across the the energy ecosystem."

ACT energy minister Shane Rattenbury says the Realising Electric Vehicles to Grid Services (REVS) trial – which used 51 Nissan Leafs – with all but one part of the local government fleet – shows that EVs can play a vital tole in supporting our energy grid and in boosting energy security.

"In the future, we hope this can extend to Canberrans' privately owned electric vehicles, providing EV owners with the opportunity to send energy stored in their car's on-board battery back into their own homes or the electricity grid," he said in a statement.

"South Australia has proven it is possible after becoming the first jurisdiction in Australia to approve a network connection of V2G services in a residential setting."

EV NEWS

SWEDES TO BUILD 30 PASSENGER ELECTRIC HYDROFOIL FERRY

By Joshua S Hill | 22 March 2023 | Source: [The Driven](#)

Swedish electric boat maker Candela has secured SEK210 million (around \$A30.4 million) in new funding to accelerate the launch of its P-12 electric hydrofoiling ferry.

Following the launch of its C-7 and C-8 electric leisure cruisers, Candela is edging towards the launch of its much-anticipated P-12 electric hydrofoiling ferry.

When Candela first unveiled the P-12 back in 2021 the ferry was a 12-person boat that the company boasted would be “the very end of sea sickness” due to its quiet, above-the-water running.



The soon-to-launch P-12, however, will be a 30-passenger ferry, designed specifically for coastal, archipelago, or lake-based transport in locations such as Oslo, Stockholm, and New York.

The P-12 hydrofoil ferry – which uses a wing-like strut or struts below the water which elevate the boat above the water level when at speed – delivers a range of up to 60 nautical miles (around 110 kilometres) at a cruising speed of 27 knots.

As the ferry is electrically powered and doesn't have to push through the water as a normal boat would, the P-12 uses approximately 80% less energy than a traditional vessel.

“This new investment will unlock the potential of underutilized waterways for climate-friendly, high-speed commuting,” said Gustav Hasselskog, Candela's founder and CEO.

“The P-12 Shuttle will in many cases be faster and cheaper than land transport like bus lines, and it will be profitable for operators from day one.

“We are now heavy into the process of finalizing the development and putting this ferry into production, which we think is going to be kind of a game changer in public transportation.”

Speaking to TechCrunch, Hasselskog also explained the decision behind a 30-passenger ferry over large sizes.



EV NEWS

"It looks the same in Oslo, in Stockholm, in New York and everywhere: most of these boats are typically 300 passengers," said Hasselskog.

"But when you study optimal boat size, especially in Stockholm, Istanbul and in San Francisco, it's concluded that it's not the optimal boat size. Seat utilization is typically super low. In Stockholm, it's 5% over the year.

"When you have only 30 passengers, you don't need more than one staff member on board; otherwise, you need three staff members. If you put that all together, you get a very good cost equation, and that's why we went with this format. Operators save typically around 40% compared to traditional, large, diesel setups."

Hasselskog is also expecting smaller ferries like the P-12 will start to replace larger vessels, and even road travel.

The Swedish capital of Stockholm is also planning to start a nine-month trial of the P-12 this year. Stockholm, an archipelago of 14 islands connected by 57 bridges and an estimated fleet of 756,000 leisure craft, is a perfect use-case for the P-12.

"The first one we're going to put in water is for the city of Stockholm," said Hasselskog this week.

"It's going to run from a suburb outside of town into the centre. If you travel that route today by bus and subway, or by the current boat, it takes 50 minutes. We can do that in 25 minutes, the reason being we don't create any wake so we have permission to go faster. If we can save commuters' journey time, that makes a huge difference."

"The next step for us here is to... take a place like Stockholm, where there are, say, 35 big ferries today," Hasselskog continued.

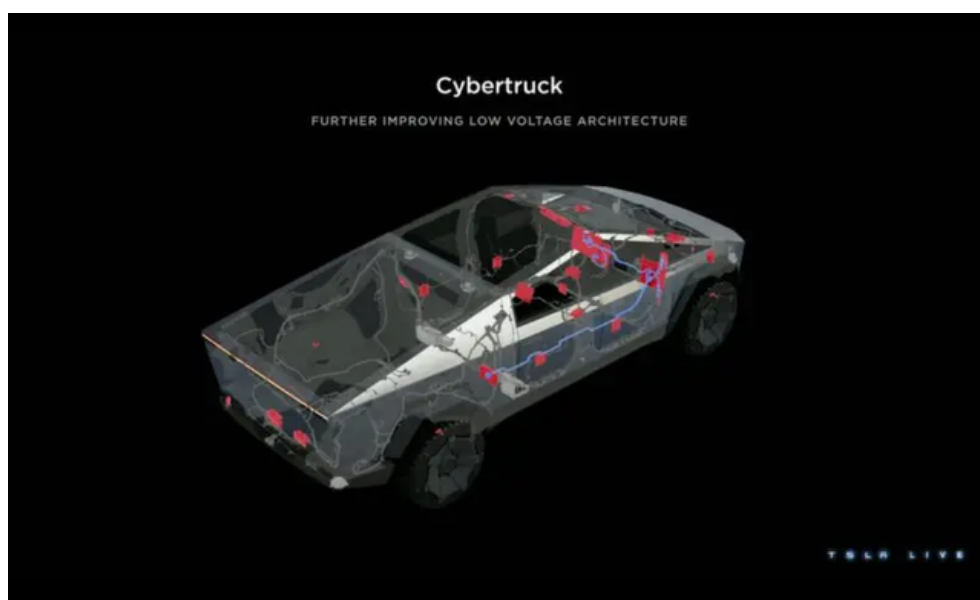
"We will replace them with 120 of ours. It's a global business that we envision and so far, we are in dialogue with hundreds of customers. They are spread from Hong Kong to Sydney. There are a lot in the Gulf region, in Europe, and we have dialogues in Mexico, Belize, San Francisco, New York."

Candela has also partnered with fellow Swedish electric pioneer Polestar, incorporating the company's batteries in the Candela C-8. The two companies announced their partnership back in August 2022 and launched the first C-8 'powered by Polestar' electric watercraft earlier this year.

EV NEWS

TESLA MOVES TO 48 VOLT ELECTRICS - "INDUSTRY GAME CHANGER"

By Tim James | 20 March 2023 | Source: [The Driven](#)



TESLA 48-VOLT CYBERTRUCK

Tesla's CyberTruck has been grabbing attention in the auto industry since its unveiling in 2019. The cold-rolled stainless steel exoskeleton chassis and innovative manufacturing methods have been generating increasing interest, despite multiple delays in its launch date.

The vehicle's fan base is constantly on the lookout for latest information, and recent investor day presentations confirmed a long-discussed innovation: its 48-volt electrical architecture.

While 48v systems have been partially utilised in mild hybrid vehicles for a few years now in high draw componentry, the CyberTruck replacement of the traditional 12v system is a significant step forward for the auto industry. In traditional 12v systems, wiring and components must be larger and heavier to handle high electrical loads.

However, a 48v system can accommodate high loads more efficiently, which reduces the size and weight of wiring especially for low draw componentry. This translates to better vehicle efficiency, better handling and production efficiency.

Legacy automakers have been slow to fully adopt 48-volt technology due to their dependence on third party suppliers, who may not be equipped to manage a rapid transition to a new system voltage. In a recent Autoline Daily interview, Sandy Monroe noted that "Everybody has been talking about doing this for 30 years, but they did it."

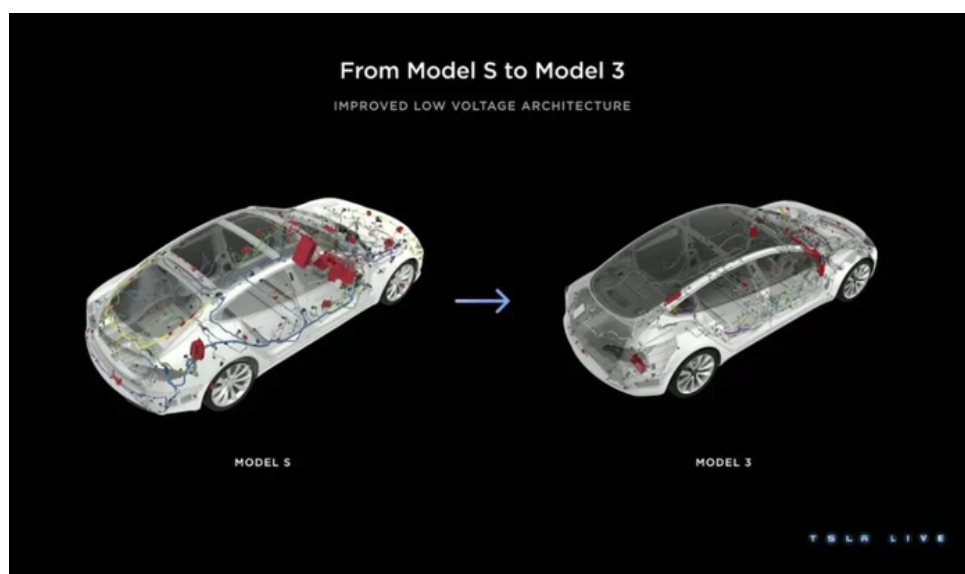
According to Cory Steuben, President of Monroe and Associates, manufacturers and suppliers will have to switch to 48 volts: "Either the customer will pay, or the car maker will take the profit loss of not adopting 48 volts."

As more automakers recognise the benefits of the 48-volt system, they will be compelled to invest in the necessary technology and infrastructure to make the switch. Failure to do so could result in a loss of market share and profitability.

EV NEWS

Tesla's vertical integration, manufacturing capabilities, and corporate structure give them an unprecedented agility to design and produce their own highly integrated components in-house, enabling a swift transition to the 48-volt system.

The implementation of this technology in the CyberTruck provides several advantages. The 48-volt system enables more efficient power delivery and handling of higher electrical loads with smaller cabling, resulting in lower overall weight and greater efficiency gains.



TESLA 48-VOLT CYBERTRUCK

“Secret” accessories team developing lighting, winches and air compressors

Moreover, Tesla's decision to use a 48-volt system gives them a significant edge when it comes to accessories and add-ons for the CyberTruck.

As reported by Matthew Donegan-Ryan, a TSLA retail investor who spoke with Tesla executives at a recent investor day at the company's Austin headquarters, Tesla has its own “secret” accessories team dedicated to developing products specifically for the 48-volt architecture, such as lighting, winches, and air compressors.

These products are designed to work seamlessly with the CyberTruck systems, offering customers a wide range of high-quality accessories that are tailored to the vehicle's capabilities. With this approach, Tesla not only aims to provide a superior product to its customers but also creates new revenue streams and strengthens its brand image as a leader in innovation and design.

The members of the CyberTruck fan site Cybertruckownersclub.com have been letting their imagination run wild over this development hoping that the ‘Secret accessories team’ would consider some of their ideas.



EV NEWS

48-volt system brings new opportunities but also risks to be addressed

While the 48-volt system offers advantages in terms of efficiency and weight reduction, it also presents new challenges in terms of complexity and safety.

These challenges could include issues such as the need for new safety features to protect against electrical shock. These challenges are likely to be behind legacy manufacturers apprehension and reticence to fully adopt 48v for parts of the vehicle a consumer would directly interact with.

Tesla's adoption of a 48-volt electrical architecture in the CyberTruck represents a significant step forward for the auto industry and aligns with the company's mission to accelerate the world's transition to sustainable energy and transport.

By designing and manufacturing their own components in-house, Tesla will be able to seamlessly transition to this innovative technology, giving them a distinct advantage in the market.

The 48-volt electrical architecture presents new challenges to reduce complexity and increase safety, but Tesla's adoption of this technology in the CyberTruck marks a significant step forward for the auto industry.

With their vertical integration, manufacturing capabilities, and corporate structure, Tesla is uniquely positioned to design and produce highly integrated components in-house, enabling a swift transition to the 48-volt system.

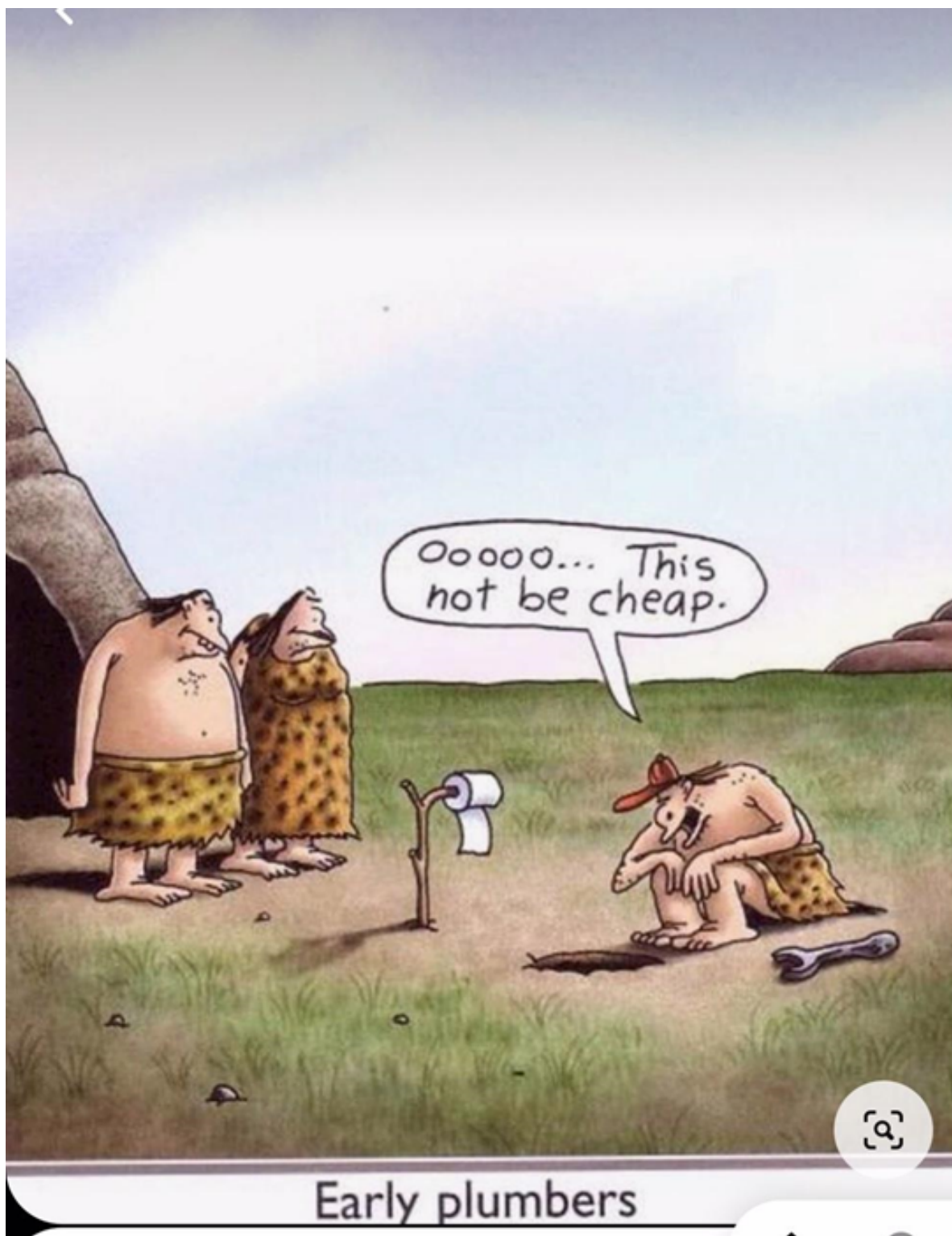
By taking advantage of the benefits offered by the 48-volt system, such as improved power delivery, handling of higher electrical loads, lower weight, and greater efficiency gains, Tesla is establishing a distinct advantage in the market.

The company's "secret" accessories team is dedicated to developing products that work seamlessly with the CyberTruck systems, which not only provides a superior product to customers but also creates new revenue streams and strengthens Tesla's brand image as a leader in innovation and design.

As legacy automakers struggle to adapt to new technologies, Tesla's gains with the 48-volt system will serve as a reminder of the importance of vertical integration, innovation in manufacturing capabilities, and corporate structure in the seamless transition to sustainable transportation.

With its continued investment in research and development, Tesla is poised to continue leading the way in the electric vehicle industry, playing a key role in the world's transition to a sustainable energy future.

HUMOR BREAK





OBSCURE SCIENCE QUESTION FOR THE MONTH

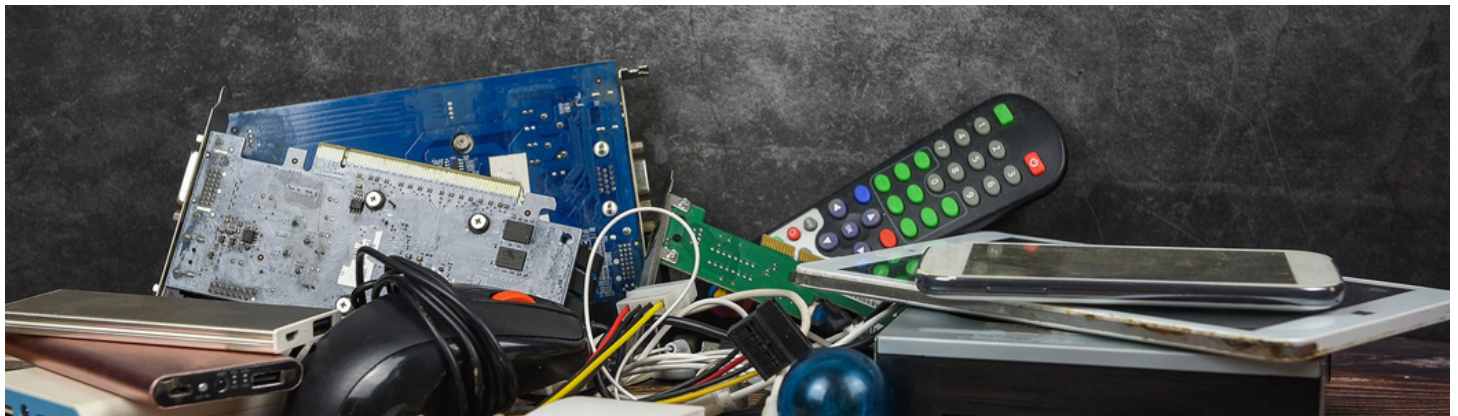
What particle is not made up of quarks: electron, proton or neutron?

Answer: [Click here to find out and tell all your friends](#)

INTERNATIONAL NEWS

UK GOVERNMENT 'MUST ACT URGENTLY' TO STOP THE SALE OF UNSAFE ELECTRICALS ONLINE

March 2023 | Source: [E&T Magazine](#)



Many household products such as hairdryers, heaters and phone chargers sold through online marketplaces have been found to contain unsafe electronics.

A recent survey by Electrical Safety First (ESF) found nearly four in ten (37 per cent) people are using online marketplaces to compare prices in a bid to get the best deals as the cost-of-living crisis bites.

But a new investigation by the charity has revealed that people are more at risk of buying dangerous products online than ever before.

ESF investigated listings of electrical goods across five leading online marketplaces, including Amazon Marketplace, eBay, Facebook Marketplace, AliExpress and Wish.com. It found more than 50 listings of products for use all over the home, from the driveway to the kitchen, were unsafe.

One EV charging cable purchased from eBay presented a risk of electric shock and overheating when it was tested by a specialist lab. Two other EV charging cables purchased from Amazon Marketplace also failed electric shock tests.

As households continue to grapple with soaring heating bills, ESF found that potentially lethal heaters are finding their way into people's homes via online marketplaces.

A portable heater purchased via eBay proved to be one of the most dangerous products uncovered by the charity, with 240 volts running through a heating element easily exposed or accessible through an insecure cover.

Cyclists were also found to be at risk from unsafe e-bike chargers available on Amazon Marketplace, despite a previous investigation by ESF highlighting their fire risk.



INTERNATIONAL NEWS

Lesley Rudd, chief executive of Electrical Safety First, said: "With so many people feeling the squeeze, we're concerned that more shoppers than ever could be exposing themselves to risk from supposed bargains found on online marketplaces. These products can come at a dangerous cost. People are buying everyday products like hair dryers and phone chargers online without knowing the hazards they present.

"Third-party sellers are well aware of consumers' desire to save money right now, so they are flooding the UK with cheap, poor-quality electricals through online marketplaces. We're even seeing them invest in advertising to drive sales, despite their products putting consumers at serious risk.

"That's why the government must act urgently to protect people by introducing legislation that forces online marketplaces to take reasonable steps to ensure the products they sell on their platforms are safe."

An Amazon spokesperson said: "Safety is a top priority at Amazon and we require all products in our store to comply with applicable laws and regulations.

"We have removed these products while we investigate. If customers have concerns about an item they've purchased, we encourage them to contact us directly so we can investigate and take appropriate action."



INTERNATIONAL NEWS

THE FUTURE OF CCUS: FIVE KEY QUESTIONS

By Lucy King | April 2023 | Source: [Wood Mackenzie](#)

Carbon capture capacity could increase more than sevenfold in the next decade – but there are significant risks to the outlook

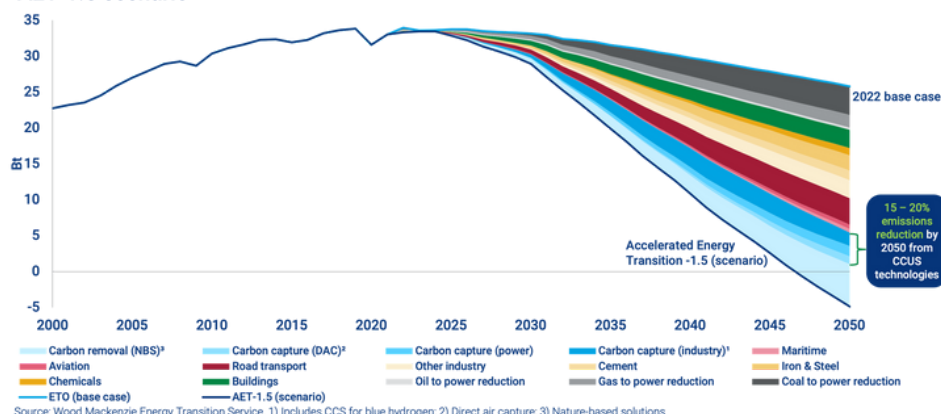
As carbon capture, utilisation and storage (CCUS) finally gathers pace, this technology looks set to become a key element of a net zero future.

We recently published our first ten-year forecast for the CCUS market, exploring the capacity build-out, and the investment required to make it happen. Fill out the form to download a complimentary extract from the report and read on for five key questions that will define the trajectory of CCUS.

1. What are the key ingredients to make CCUS happen?

We believe 2023 will be a milestone year for carbon capture and storage, with the technology finally moving from niche concept to mainstream investment theme. It's increasingly clear that CCUS has huge potential to help deliver a net zero future. In fact, under our AET-1.5 scenario – whereby global warming is kept below 1.5°C – CCUS accounts for at least 15% of the reduction in overall global carbon emissions.

CCUS would account for 15-20% of global CO₂ emissions reductions under our AET-1.5 scenario



Going forward, CCUS adoption will be strongest where five key conditions are met:

- Emission sources: Demand will be highest in areas where CO₂ point-sources with a long life ahead of them are concentrated
- Storage destinations: CO₂ can be stored on or offshore, in either saline aquifers or depleted hydrocarbon reservoirs
- Policy, regulation and funding: In most cases, government support will need to be available to help meet the cost of CCUS
- Competitive investment: Locations with competitive energy, labour and materials costs will see higher CCUS activity
- Industry readiness: Synergies with existing operations and a viable supply chain will help drive investment in CCUS



INTERNATIONAL NEWS

2. How big is the CCUS opportunity?

By 2033 we estimate carbon capture capacity will increase more than sevenfold, from 50 million tonnes per annum (Mtpa) today to around 370 Mtpa. Initial growth will be mainly in North America and the UK, with Asia starting commercial operations towards the end of the decade.

Storage capacity will continue to outstrip capture capacity until the early 2030s, surging from 75 Mtpa today to over 500 Mtpa by 2033. Current licencing hotspots in the US, the UK, Canada and Australia will continue to dominate.

Southeast Asia, the Middle East and North Africa should pick up from the late 2020s, but the four leading countries today will still account for two-thirds of global storage capacity in 2033.

3. What sectors can benefit most from CCUS?

In the near term, companies will continue to focus deployment of CCUS in low-cost sectors; that means natural gas processing, ethanol, hydrogen and upstream gas production. By 2033, blue hydrogen will be the biggest single industry source for CCUS.

Additional policy support and simpler logistics are needed to make CCUS viable in more hard-to-abate sectors. However, we expect cement, refining and steel will start to bolster capacity growth towards the end of the decade, accounting for over 60% of capture investment by 2033.

4. How much investment in CCUS is needed?

To deliver on these estimates, more than US\$150 billion will need to be invested between now and 2030. Of that, we expect over US\$80 billion to be spent on capture, mostly in high-cost industries such as power generation, oil refining and cement.

The remaining US\$70 billion will go to transport and storage projects – primarily hub developments. US transportation networks and offshore storage in the North Sea will also account for a significant proportion of this spend.

5. What are the main risks to the growth of CCUS?

While the outlook is highly positive, this level of growth isn't guaranteed. For the project pipeline to materialise, collaboration across the value chain between emitters, technology providers and hub developers will be vital.

Perhaps even more importantly, a lack of policy, regulation and support is still a significant barrier to uptake of CCUS in many countries. While North America and Europe have the most progressed policies, no country has figured out the right, fully coordinated approach yet. That will be vital if CCUS is to fulfil its potential.

Don't forget to fill out the form at the top of the page to download a complimentary selection of slides from the report with more detailed analysis.

INTERNATIONAL NEWS

GROWING DEMAND FOR NON-STANDARD HIGH VOLTAGE TESTING

March 2023 | Source: [INMR](#)

Electrical power systems have become increasingly complex and this has led to greater demand for all types of laboratory testing. At the same time, there are also growing requests for 'non-standardized' tests on objects such as HVDC valves, AC and DC cables, line insulators, cable accessories, wall and transformer bushings, optical instrument transformers and different types of station posts.

One of the factors behind this trend is that network equipment is often exposed to service conditions not covered by design and type testing. Another factor is that requirements set out in some of today's standards are regarded as not stringent enough to reflect what actually occurs in the field. All this has led to testing with increased durations, new test methodologies and more demanding pass requirements.



Non-standardized tests impose special requirements not only on the skills of testing staff but also on the test equipment itself, that needs to be flexible and easily moved despite being large and heavy. This edited 2019 contribution to INMR by experts at STRI in Sweden reviewed examples of non-standardized laboratory testing.

Transient Tests

Type and development tests are carried out on a range of equipment and components exposed to different types of HV transients during service. Such tests see creation and application of different types of transient overvoltages. While these have typically been mostly for research and development purposes, there is now also a growing requirement coming either from equipment manufacturers or from grid operators. For example, testing was performed to create a voltage wave applied to the test object with rise time of less than 20 μ s, duration of at least 1.05 s and amplitude of 1010 kV. Similarly, another test required having a DC voltage of 450 kV of opposite polarity on one side and applying the DC transient voltage on the other. Two DC generators, in combination with a circuit breaker, were used for this test.

INTERNATIONAL NEWS

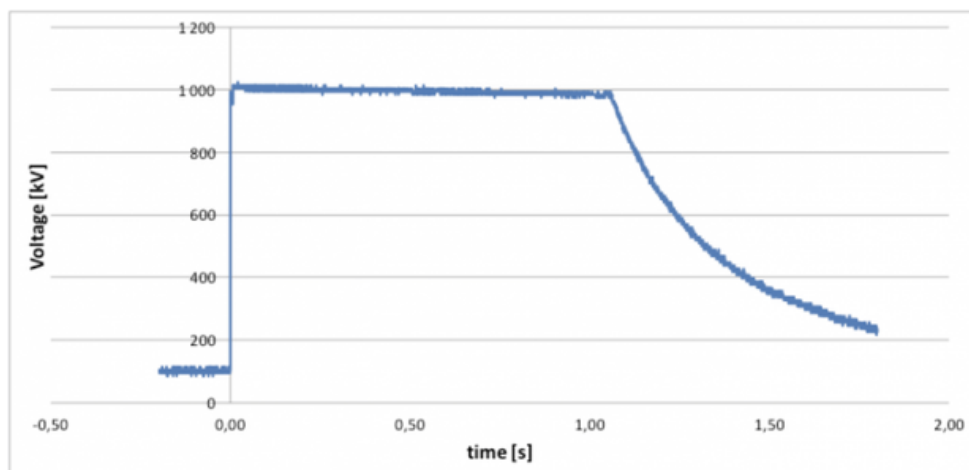


Fig. 1: DC transient voltage waveform used in non-standardized test.

During 2018, STRI received a request to perform a test to create a transient with resonance frequency, dc voltage level and time duration as close as possible to what had been measured in the field. While test circuit parameters were provided by the customer, STRI designed the test layout which consisted of an outdoor 70 m long bus bar together with a circuit breaker that was opened and closed to create the DC transient voltage.

Ice, Snow & Low Temperature Tests

While there are basic standards governing how to carry out tests under certain environmental conditions, such as ice, customers often want to simulate specific local conditions as closely as possible. This means going outside present standards. For example, STRI has performed a number of tests under ice, snow and low temperature conditions, as discussed below:

Development of Ice Tests

STRI has for years worked closely with customers to develop suitable test methods for ice and snow. To make such testing both representative and as cost effective as possible, the Ice Progressive Stress (IPS) test method was developed. The test consists of two phases – ice deposition under service voltage and evaluation of flashover performance by increasing test voltage to flashover. As such, results provide more information when compared to a normal withstand test. The IPS test method has been applied successfully in a number of projects and was eventually included in an IEEE Guide for ice test methods and procedures. Fig. 2 shows an example of ice deposited under voltage. In this specific case, a DC-voltage was applied to the insulator chain during ice build up. The conclusion was that this is the preferred test method since it is applicable for full-scale testing, repeatable as well as cost and time effective.



Fig. 2: Ice test on glass cap & pin insulators.

INTERNATIONAL NEWS

Development of Snow Test

Testing under snow conditions is difficult since it involves potentially large variations in key parameters that need to be controlled, such as type of snow, conductivity and temperature. Snow tests on components and equipment, including insulators, disconnectors and circuit breakers, consists basically of 4 stages: generation of snow with the specific properties, e.g. conductivity, particle size, etc.; applying the snow to the test object; increasing water content of applied snow; and finally application of voltage.

Low Temperature Test

Many TSOs these days that equipment supplied to them be tested to assess performance under extreme temperatures down to -50°C or even -60°C . A climate chamber equipped with a bushing enables high voltage tests such as AC, DC or impulse testing under these extreme cold conditions. Partial discharges can also be measured. For example, impulse and AC testing were performed on medium voltage cables and cable accessories at -50°C . Temperature was reduced to -50°C and held there for 8 to 12 hours, depending on customer specification, after which the AC or impulse test was performed (see Fig. 3). In some cases, a 'dummy' cable with temperature sensors is placed near the test cable in order to compare core temperatures in the cable conductor. Fig. 4 shows an example of a cable being tested at low temperatures in a climate chamber.

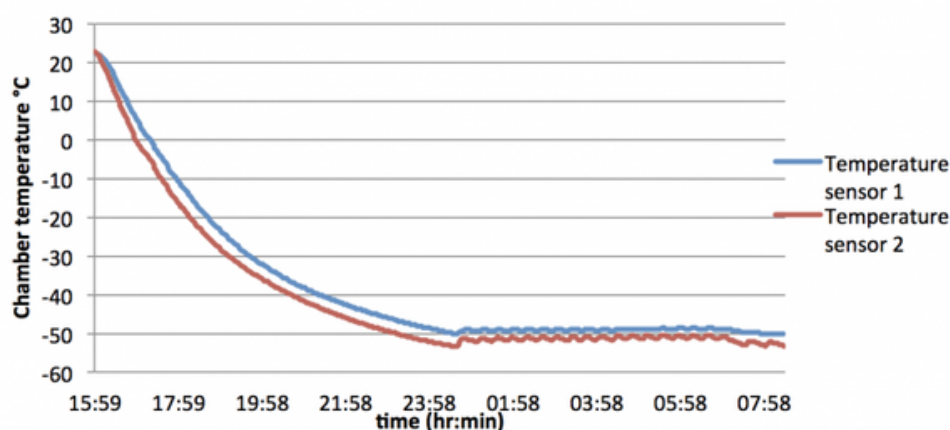


Fig. 3: Measured temperature in climate chamber.



Fig. 3: Measured temperature in climate chamber.

Dielectric Tests

Long Term Testing of HV Equipment

A manufacturer of high voltage equipment wanted to investigate how their product would withstand long-term exposure to an AC voltage superimposed on a DC voltage. A special outdoor test circuit was designed for this purpose, equipped with test transformer and rectifying circuit. The equipment, designed for 245 kV, was tested for 22 months at elevated voltage during which leakage current and partial discharges were measured.

INTERNATIONAL NEWS

Rapid Flashover

Testing HV equipment for different service conditions can be time consuming and costly, especially if it requires testing under different levels of contamination to yield a pollution performance curve. For this reason, STRI developed a rapid flashover method modelled on the principle of applying pollution to an insulator followed by application of voltage. If the insulator withstands the voltage level, voltage is increased to flashover at the end of the test.

Impulse Test After One Year Pre-qualification Test on HVDC Cable

After performing the 1-year pre-qualification test, guidelines from CIGRE require that superimposed impulse testing be conducted on a 30 m section of cable. The special requirement of one customer, however, was that the complete 120 m cable system, with all accessories, be tested. Applying superimposed impulses on DC-voltage for a full-length cable system places extremely high requirements on the test circuit as well as on individual components such as the DC-generator and impulse generator (see Fig. 5). Superimposed lightning and switching impulses were then successfully performed. In the case of lightning impulses, it is not possible to fulfil the requirements in the standard in regard to front time. In fact, CIGRE has now begun updating Technical Brochures regarding cable testing such that requirements on front time will be changed to a higher value than what is specified in IEC 60060-1.



Fig. 5: Superimposed impulse testing of HVDC cable.



Fig. 6: Experimental set-up for evaluating static charging.

Effects of Electric & Magnetic Fields

TSOs sometimes receive complaints from the public regarding effects of electric and magnetic fields around power lines. One issue, for example, has involved activities such as bicycling and riding horses near lines. To investigate whether riding a bike under power lines can be an issue, STRI was asked to simulate this with an experiment and measurements. First of all, actual electric fields were measured under a 400 kV power line and results showed an enhancement of electric field by 50% when bicycling under the line. Based on this, the energy in a possible discharge was estimated as 1.1 mJ – a level that, while without real danger, could nonetheless be felt. Still, these measurements could not explain some of the phenomena experienced in the field. One possible explanation could be type of clothes being worn. To simulate this, a test engineer cycled with different clothes to evaluate possible difference between synthetic and cotton materials. The contribution to discharge energy from static charging of clothes can roughly be 0.5 mJ which, if added to the 1.1 mJ, would yield a clear increase. The influence of clothes was that cotton gave a positive electric field and synthetics a negative field. In addition, influence of magnetic and electric fields on equipment working around energized lines was also evaluated. Lifting insulator strings with a helicopter, for example, could potentially be an issue when working in and around energized lines. This was simulated by lifting a hook with a crane while, at the same time, exposing it to different electric and magnetic fields.



INTERNATIONAL NEWS

Temperature Rise Testing at Elevated Temperatures

Some customers, such as from China, require that bushings be tested in a test hall with 50°C ambient temperature. One of the test halls at STRI used for temperature rise testing is able to perform such tests at elevated temperature. Recently, an ABB wall bushing rated for 1100 kV DC was tested at +50°C ambient temperature and current of 5839A DC. Similarly, a wall bushing was tested with +45°C on the outdoor side and +60°C on the indoor side. Such conditions place high requirements not only on the test equipment (in this case installed at +45°C) but also on testing staff.

Summary

Requests for non-standardized tests are coming both from specific user requirements (e.g. service environment, system, etc.) and the fact that many standards are not up-to-date and have to be revised to reflect more stringent conditions. These types of tests impose high requirements on test equipment that needs to be easily moved around as well as on skills of test engineers.

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INTERNATIONAL NEWS

THE GOLDEN AGE OF STARTUPS

By Perry Sioshansi | April 2023 | EEnergy Informer

In the latest edition of the Eenergy Informer Perry Sioshansi writes that aggregating behind-the-meter assets and turning it into VPPs is a compelling business.

According to Shwan Lamei, the CEO and co-founder of Emulate Energy (photo) this is the golden age of startups to disrupt the lethargic electricity business. Very little – capital or assets – is needed to start a business and – thanks to the Cloud, artificial intelligence plus rapid digitalization of behind-the-meter assets – viable ideas can easily and quickly be scaled up. If the idea works on a pilot project involving 50 customers, it can be quickly expanded to 5,000 or 5 million. The innovative services offered can be disruptive – substituting for what the incumbent utilities do, or they can be complementary – expanding and improving the services that are currently offered.

Emulate Energy, for example, allows virtually any BTM device, be it an electric vehicle, an electric water heater, battery, heat pump, a dishwasher, dryer, etc., to be remotely monitored and controlled via its intelligent software. Since most devices are now digitalized, that is they have an IP address and are connected to the Internet, they can easily be aggregated in large numbers. That allows smallish loads, storage or self-generation assets such as rooftop solar panels to be aggregated into significant sized resources which can be remotely dispatched, turning them into virtual power plants (VPPs).

Virtually all electricity using devices have substantial built-in flexibility which can be captured, utilized and monetised. Water heaters can be turned on and off, for example, to take advantage of price signals without inconveniencing the user. The same applies to EVs, which can be charged when prices are low.

The list of opportunities to turn dumb and mundane devices into smart assets with demand flexibility is virtually untapped, which explains the interest.

And as the proportion of variable renewable resources rises, the urgency to absorb the plenty of solar- and wind-generated power when they are available and coast through the periods when they are not becomes compelling. Many of the start-ups are focused on soaking up the excess solar and wind energy by increasing demand while doing the opposite when the sun is not shining and the wind is not blowing. It is not only possible to create demand flexibility with available software and technology, but it makes perfect business sense. What devices are targeted and how they are monitored, controlled and aggregated is the so-called secret sauce.

Until recently, the devices to be managed had to be hard-wired, which is labor-intensive and expensive. It only made sense for large devices, customers with lots of devices or in cases where they could easily be aggregated, such as in apartment buildings or commercial and industrial applications. The Cloud, the Internet, the digitalization of devices plus sophisticated software has made it much cheaper, faster, and easier to remotely aggregate ever large number of assets without hard wiring. Size, location, or the number of devices to be aggregated is no longer a limiting factor. In fact, the more the merrier. The secret sauce is to be able to scale up quickly and cheaply and to turn the aggregated portfolio into a flexible and reliable VPP. More sophisticated startups are now relying on customized easy-to-use apps that are as simple to use as ordering pizza on a mobile phone – that is what we are told.



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Shifted Energy, a Hawaiian startup, has equipped over 3,000 households with its cellular-connected smart-water-heater control modules. It offers participating customers \$3 per month in utility bill credits for allowing Shifted Energy to turn their water heaters on and off to help balance the grid. The company claims its VPP can offer the Hawaiian Electric Co (HECO) up to 2.5 MW of flexible fast-response capacity. As far as HECO is concerned, the aggregated water heaters act and are as reliable as a power plant in terms of flexibility and control – if not better, cheaper and far less polluting.

Hawaii is the first state in America to pass a 100% renewable target, virtually all water heating is electric, and it is the first state which actively rewards customers for using more power when there is a surplus and less when there is a deficit. More states and countries are moving in the same direction as grids generate a surplus of renewable energy at certain times of the day while experiencing peak demand after the sun goes down, usually in the 4-9 pm period. Virtual power plants make perfect sense and are far cheaper than physical batteries.

Another company A. O. Smith recently announced that they have integrated their technology to create seamless online connections to water heaters and EVs with software developed to react to electricity prices by switching thousands of devices from charge to discharge mode on demand. The company claims it can easily enroll customer-owned devices into a distributed energy resource management system (DERMS), which can be managed by utilities or others.

Clearly there are more than one way to skin the VPP cat, and it appears that multiple variations of the same idea are popping up everywhere – suggesting eventual consolidation as the business evolves and the space gets crowded. It may be the golden age of startups yet one must be mindful of the fact that the space is littered with many who started but did not scale up quickly enough to stay ahead of the competition.



INTERNATIONAL NEWS

PORTLAND GENERAL ELECTRIC DEPLOYS AI, ADVANCED TECH TO REDUCE WILDFIRE RISK

By Dan Nunez | April 2023 | Source: [T&D World](#)



The Pacific Northwest utility is advancing its wildfire mitigation plan by hardening the grid and enhancing situational awareness with detection systems.

Wildfire risk reduction, wildfire mitigation and wildfire resilience are now common descriptors used to encapsulate the strategic investments, operational modifications and public partnerships utilities throughout the West are leveraging to keep communities safe. An ongoing process, this work is laying the foundation for long-term solutions that will enable utilities to deliver reliable and resilient power to customers through extreme weather events, including wildfires.

Portland General Electric (PGE) is in a multiyear phase of advancing its wildfire mitigation plan, from crunching data to better understand where the greatest and most impactful wildfire threats in its service area currently exist to executing on large capital system-hardening efforts to reduce the chance its equipment is the source of a potentially catastrophic wildfire event.

In 2019, PGE developed its first wildfire mitigation plan and, shortly thereafter, stood up a dedicated wildfire mitigation and resiliency (WM&R) team. This team is the big-picture planning and boots on the ground that reflects the utility's commitment to wildfire risk reduction. While focused on numerous actions to tackle potential wildfire risks, the team also works closely with key partners across the region, including local and state emergency management and other electric service providers, to foster a coordinated effort to mitigate a risk that potentially impacts everyone.

"There is no one-size-fits-all response to wildfire," said Bill Messner, PGE's director of WM&R. "We have a deeper understanding of where the greatest risk is and we're delivering risk-reduction plans based on that analysis. But this work extends beyond wildfire season — ensuring system resiliency and making risk-management decisions is a year-round, multifaceted effort."



New conductor ready to install in the Willamette Valley.



INTERNATIONAL NEWS



A utility worker clips in a new conductor to a distribution crossarm. Long-term system hardening projects — including overhead-to-underground conversion, covered wire and intelligent reclosers — are critical to the reduction of wildfire risk.



PGE is investing about US\$110 million over five years in technologies, capital hardening of the electric system.

AI Camera Detection System

As of today, PGE is investing approximately US\$110 million over five years in technologies, capital hardening of the electric system, data platforms and expertise to enhance its resiliency and situational awareness. These investments are an integral part of the utility's compliance with North American Electric Reliability Corporation standards and enable better geographic information system data quality, thereby improving operational efficiencies — whether that is managing vegetation, surveying, or design and engineering.

As an example, PGE's remote sensing program, a capital investment, uses light detection and ranging data, aerial imagery and hyperspectral imagery. The PGE team then uses analytics to inform predictive modeling for wildfire, asset management and geographic risk modeling. PGE also collaborates with fire and state agencies to make iterative improvements to the modeling. As a result, the technology helps PGE to make decisions that consider public safety, environmental and customer impacts, and costs in high-risk fire zones and public safety power shutoff areas.

Wildfires are caused by a wide array of factors, and another of PGE's remote sensing investments is a cutting-edge Pano HD artificial intelligence camera detection system, which can detect ignitions and triangulate their location in real time. PGE has 26 Pano AI cameras that cover high-risk fire zones, and the company shares this increased situational awareness with nearly 40 land management and fire agencies across Oregon.

Minutes matter when managing a fire. In the summer of 2022, PGE's array of AI cameras detected a fire south of Hagg Lake 140 minutes before traditional 911 and satellite detection methods. Fire crews with the Oregon Department of Forestry were able to drive directly to the incident, whereas in the past, it could take hours to identify the location of a fire.

"The Pano AI cameras enable PGE to keep up with the pace of climate change and wildfire risk while system hardening projects go from planning to execution," Messner noted. "We are contributing to wildfire risk reduction across the state of Oregon and are serving as a leader in game-changing wildfire management and situational awareness."



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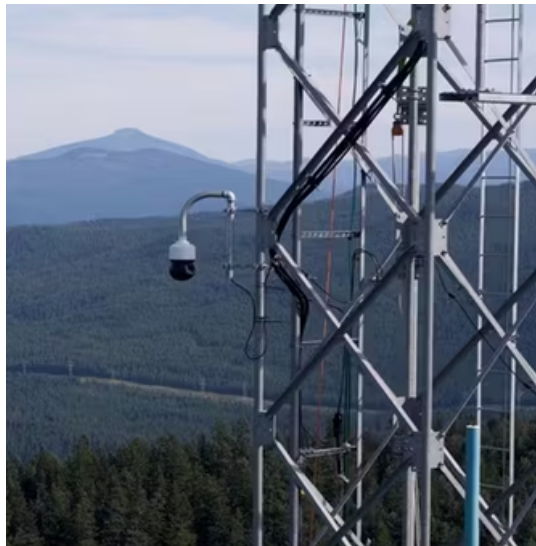
Early Fault Detection System

PGE has deployed an early fault detection (EFD) system, enabling operators to detect abnormalities in equipment or operations before a failure occurs. These cutting-edge risk management devices listen to the electrical noise coursing through power lines, which helps to reduce wildfire risk and improve reliability by minimizing outage time and, more importantly, allows for proactive intervention to correct faults before they occur.

PGE put this new system to use in the summer of 2022, when a power line sustained damage in a high-risk fire zone near Mount Hood, Oregon. Understanding what was going on and where enabled PGE crews to correct the issue before a downed-wire ignition event could take place. PGE is placing EFD sensors in high-risk fire zones, which will help to minimize outage time by reducing the time it takes to travel to the fault location, which, depending on conditions, can take hours.



A power pole equipped with a new conductor, X-arm and cutouts.



PGE has 26 Pano AI cameras that cover high-risk fire zones.

Rooted in Safety

Even in historically wet, mild Oregon, summers are getting hotter and drier, resulting in longer fire seasons and an overall increased risk of wildfires. PGE is working harder than ever to reduce that risk while delivering reliable service.

Looking to the future, the company continues to enhance its situational awareness through advanced AI and tech, as well as using data analysis to improve on tried-and-true system hardening tactics for quicker and efficient project delivery. Whether these strategic investments live under the terms risk reduction, mitigation, or resilience the fact remains that this important work is rooted in a core company principle: Safety.

INTERNATIONAL NEWS

SOLID-STATE BATTERY HAS 2X THE ENERGY—AND NO ANODE

By Charles Q Choi | April 2023 | [IEEE Spectrum](#)



This prototype anode-free all-solid-state lithium battery can store twice as much energy as conventional, liquid-electrolyte or gel-based-electrolyte lithium-ion cells.
YIXIAN WANG/UNIVERSITY OF TEXAS AT AUSTIN

A new all-solid-state lithium battery can not only store nearly twice as much energy as a standard lithium-ion battery, but it's also not prone to catching fire like its present-day, commercial counterparts. The secret behind this novel prototype's success? Getting rid of one of a battery's usual electrodes, a new study finds.

Conventional batteries supply electricity via chemical reactions between two electrodes—the negatively charged anode, where electrons flow out of a battery, and the positively charged cathode, where electrons can enter a battery. A typical lithium-ion battery's electrodes are made of substances whose structures can store and release electrically charged lithium ions. The anode is often comprised of graphite, while the cathode is very often a metal oxide. These electrode materials are coated onto metal foils that collect the generated current—for the anode, this metal is often copper, and for the cathode, aluminum.

The electrodes in lithium-ion batteries typically interact through liquid or gel electrolytes. All-solid-state batteries instead employ solid electrolytes made of materials such as ceramics.

Solid electrolytes are more compact than liquid or gel electrolytes. This means that all-solid-state batteries can produce more energy than conventional batteries for the same amount of weight or space. In addition, all-solid-state lithium batteries are much safer than their conventional counterparts, which use organic liquid electrolytes that are typically flammable.

Much remains uncertain when it comes to the best way to create a stable, useful, all-solid-state battery. For example, previous research found sulfide-based solid electrolytes could help create batteries that can store a lot of energy. However, the sulfides in these electrolytes can react with both electrodes, generating compounds that impede the flow of electricity within the batteries.

One way scientists have sought to improve all-solid-state batteries is by replacing their conventional graphite anodes solely with a copper-foil current collector. This strategy could significantly boost how much energy these batteries might hold. "You are in effect eliminating half of the battery's internal material," says study senior author David Mitlin, a materials scientist at the University of Texas at Austin. Using less material also reduces their cost, he adds.



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However, a key challenge that research on anode-free, all-solid-state batteries has faced is the problem they face going through cycles of discharging and recharging in a stable way. Now, in a new study, researchers show a new coating may overcome this problem.

The scientists experimented with an anode-free, all-solid-state battery with a sulfide-based solid electrolyte. They explored coating its copper current collector with ultrathin lithium-activated tellurium. The aim was to control the way in which lithium metal spread across or “wetted” the copper. They found this new coating helped lithium metal deposit and dissolve from the copper current collector in a thin uniform layer.

Without this new coating, the researchers found the copper foil became covered with irregular microscopic structures during recharging and discharging. These include spiky dendrites that “can, and will, lead to battery short circuits between the anode and cathode, which in turn can cause battery fires,” Mitlin says. They also include lumps of “dead metal” and crusts of honeycomb-like material that impeded the battery’s performance. “It’s like having an engine that is covered by a thick layer of rust on the inside,” he says.

The new battery can hold 72 percent more energy by weight and 95 percent more energy by volume than commercial lithium-ion batteries. The researchers note they could produce the new coating on these copper current collectors using standard fabrication techniques. This could help make it straightforward to scale up the production of these new batteries, they add.

“These findings may provide key missing links for wide-scale commercialization of anode-free and all-solid-state batteries,” Mitlin says.

Still, although this research may solve one critical problem with anode-free all-solid-state lithium batteries, a great deal of development is needed to actually bring them to market, Mitlin cautions. “There is a huge amount of work that is still needed to have anode-free all-solid-state lithium batteries go from lab scale to even prototype scale, never mind to car scale,” he says.

The scientists detailed their findings online 23 February in the journal *Advanced Materials*.

INTERNATIONAL NEWS

A CULTURE SHIFT IN NUCLEAR POWER

By Chris Warren | January 2023 | Source: [EPRI Journal](#)

Non-standard tests impose special requirements not only on the skills of testing staff but also on the test equipment itself, that needs to be flexible and easily moved despite being large and heavy. This edited 2019 contribution to INMR by experts at STRI in Sweden reviewed examples of non-standard laboratory testing.

How a culture of innovation can help nuclear power play a major role in the transition to a decarbonized world

Wynter McGruder has been to enough nuclear power industry conferences to know what to expect. Inevitably, she says, a succession of smart engineers will stand up and deliver scripted and formal presentations about weighty matters, such as advances in reactor design and materials science.

It's what the audience demands. "You always have an audience of technical people who have spent their careers deeply focused on serious work," said McGruder, an EPRI principal technical leader in the nuclear sector who previously spent about a decade as a reactor pressure vessel engineer for the utility Xcel Energy.



In other words, nuclear conferences can be counted on to feature serious people talking about serious topics. To put it mildly, last summer's Global Forum for Nuclear Innovation (GFNI) in London did not follow that familiar script. At the event's kickoff, a stage was set up with a speaker's rostrum and a grouping of chairs suitable for roundtable discussions. But into that familiar setting strode Jon Chase. Clutching a microphone and casually dressed, Chase walked right past the rostrum and began to rap.

"There's a crisis with the climate that's affecting the globe, and we're looking for solutions that are ready to go, but as you know, they take a little time to evolve, so let's grow and innovate until the problem is solved," Chase began. "We've gotta be bold, become the agents of change, and think about the four behaviors that we can arrange. It starts with you, so let's keep the target in view and gather all our energies to make the future nu-cleeeeeeeaaaar."

Later, Chase initiated a call and response with the audience, asking them, "are you clear, nuclear?" and then encouraged attendees to answer, "what we're here to do!" Those who paid close attention to Chase's lighthearted lyrics, though, couldn't miss the seriousness of the message. In short, Chase told his audience that the world desperately needs nuclear power to address the climate crisis. But also layered into the lyrics were reminders that those assembled in the room had to do things differently than they had in the past.

Indeed, in just a few words, Chase illustrated the balance that must be struck for nuclear to play the role it can in building a decarbonized future. "So, on the one hand, there is safety. On the other is innovation. One relies on caution and the other inspiration, but the two must function hand in hand for any operation to succeed," he sang. "How to find the balance is the vital question. We need the brightest minds, but we have to build them first through an education system that is thriving and diverse, then attract them to the sector and make room for them to grow, so they broaden the perspective and challenge the status quo."



INTERNATIONAL NEWS

A Growing Recognition of the Need for Change

To be sure, discussions about the need for innovation in nuclear are nothing new. In fact, at the 2019 GFNI in South Korea, the first day of the conference was devoted to learning about what drives innovation outside the nuclear industry, including lessons from astronauts and the researchers behind breakthrough pharmaceuticals. The gathering also featured feedback from nuclear industry regulators, who emphasized their strong desire to collaborate on innovation.

An important insight that crystallized at the 2019 GFNI was that past efforts around innovation had been too focused on technology and not enough on building the kind of industry culture that breeds consistent and transformative innovation. The 2019 GFNI identified four essential behaviors needed to foster an innovative culture: courage, a challenger mindset, diversity, and role modeling.

While important, the mindset shift that occurred in South Korea four years ago was about building momentum to shift the day-to-day behaviors that constitute culture. What Chase's rap and other activities at the GFNI in London did was to move beyond theoretical discussions of innovation into the often uncomfortable and messy reality of thinking, acting, and collaborating in new and innovative ways.



Embracing and Cultivating the Discomfort of Innovation

McGruder felt that discomfort acutely at first. "I have crippling second-hand embarrassment," McGruder recalled with a laugh. "When the rap started, I didn't want to see it. But it ended up loosening things up, and it was fun, demonstrating that it is OK to think outside the box." Subsequent activities illustrated some of the mental barriers that prevent innovation. For example, Emma Wong, an EPRI technology and innovation advisor to the Organization of Economic Cooperation and Development (OECD), led an activity illustrating the importance of questioning status quo beliefs.

The activity was a competition to build a sailboat car using a few simple materials (like paper and a paper towel roll) and see which one could speed across a table fastest. But the instructions and example participants were given subtly introduced limitations on innovation. "We introduced bias by calling it a car and showing an example that had four wheels and a sail on a boat," said Sam Johnson, a senior project manager at EPRI, who attended the GFNI. "And everyone made slight variations of the car. Nobody challenged what could make it better. And that was the point. Pre-conceived notions, biases, and terminology can hinder our creativity in solving the problem at hand. The main problem is mindset."

Of course, even the most innovative GFNI conference is just one step towards driving genuine change in the culture of the entire nuclear industry. What's important is that the ideas and behaviors unveiled and modeled at these infrequent gatherings are then shared, reinforced, questioned, and evolved at institutions across the entire industry.



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Understanding Barriers to Innovation

Driving the changes in mindset that will result in meaningful and consistent innovation also requires being clear-eyed about some of the real and understandable barriers that have prevented it in the past. “To understand innovation in nuclear, you have to think about the nature of the nuclear industry,” McGruder said. “It has thrived and been safest when it is highly procedural. It’s not just about highly trained people. It also is highly rules-driven. That does not facilitate much room for risk-taking and innovation.”

McGruder says that most innovation in nuclear in the past has been technology focused and incremental. For example, she points to the decade-plus the industry took to transition from paper-based work packages to digital. Another example: The reluctance to embrace 3D printing to produce complicated design parts used in reactors. “3D printing was in existence and required less welding and was safer, but it was hard to get people on board because it was a new technology,” McGruder said. “The industry was excited by the technology, but because parts are such an important part of a plant’s safety strategy, you have to be so cautious that any change is going to be safe.”

But both McGruder and Johnson say there are plenty of signs that the industry is serious about fostering an innovative culture. For example, Johnson says many more utilities have initiated innovation programs with dedicated staff and budgets in recent years. This helps keep innovation at the top of a utility’s priority list. “Innovation can be a low priority when you have 10 things to do each day,” Johnson said. “Having a dedicated staff and a forum for communicating what you’re learning matters.”

The nuclear industry has a unique opportunity to shift its culture to become more innovative. Like the rest of the utility industry, large numbers of seasoned nuclear employees are either in retirement or nearing the end of their careers. Newer employees, many of whom are attracted to nuclear because of the big role it can play in the transition to a decarbonized power system, are eager to contribute new thinking.

“Innovation has been grassroots in the industry over the past few years. A lot of early career folks are willing to speak up and say, ‘I have a good idea,’” McGruder said. “And leadership in organizations increasingly see the value in innovation and what it can do in other industries and are letting people run with ideas and funding them. That wouldn’t have happened 10 or 15 years ago.”

Continuing the Push to Innovate

EPRI is also focused on cultivating an innovative culture among nuclear sector researchers and helping member utilities as they work to become more innovative. For example, in January 2021, EPRI launched the Nuclear Innovation Working Group. The group’s mission is to create a community of nuclear innovation leaders to build support, coordination, and awareness of the industry’s past, current, and future innovations and technologies. The group, which meets twice annually, has discussed a range of topics, including drones, submersibles, machine learning, robotics, digital twins, advanced manufacturing, and artificial intelligence (AI).



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Coming out of the London GFNI, EPRI staff are also leading ongoing research and collaboration around four Grand Challenges. The industry has identified these areas as important to cultivating innovative cultures and mindsets. The Grand Challenges are:

- **Think Tank: No talent, no sector**—The nuclear industry must recruit and retain talented and innovative people to thrive in the future. This work will look at the actions the industry can take to ensure it has both enough talent and the right type of talent.
- **Brain Bubble: Operating a lean machine**—Lean operation is nothing new in the nuclear industry. However, building on past successes remains important, and this initiative will take a close look at efficient operations and modernization.
- **Energy Pod: Safe doesn't have to be slow**—Safety will always be the number one priority in nuclear. The work around this challenge will examine how safety can remain the top priority while still cultivating rapid and disruptive innovation.
- **Power Hub: Beyond electricity**—From hydrogen production to district heating to desalination, there are myriad opportunities for nuclear to deliver more than baseload electricity. This initiative will investigate potential regulatory and operational changes necessary to seize those opportunities and how the industry will need to change to do business with new stakeholders.

Success in these important areas relies on an innovative culture, which is why EPRI's Johnson hopes that the next GNFI in 2024 will include a hard look at what has been accomplished and what remains to be done. "Hopefully, we will build on what we have learned and continue to develop culture across the industry. I think we need to come back and look at what we have done, how we have applied what we learned in London and pushed the industry forward, and how we grow in the future?" Johnson said. "We have to review what we have done because, without self-reflection, we won't make progress."



INTERNATIONAL NEWS

WHY UTILITIES NEED TO CARE ABOUT 5G ROLLOUTS

By Chris Warren | January 2023 | Source: [EPRI Journal](#)

EPRI research investigates potential radiofrequency exposure of workers and the public

Successful and abundant TV advertising has guaranteed that the average person can recite the purported benefits of 5G mobile networks. Commercials featuring both regular people and celebrities like Saturday Night Live's Kate McKinnon and singers Dolly Parton and Miley Cyrus extol how much 5G accelerates the speed of video downloads and minimizes the delay (also known as latency) that occurs after requesting data from a network.

The very name "5G" is meant to convey progress. Indeed, 5G refers to the fifth-generation technology standard for cellular networks—the successor of 3G and 4G. Given the ubiquity of smartphones, it's hardly surprising that wireless network providers are eager to promote the benefits of 5G. For a wide range of reasons, though, the utility industry should also care about the rapid deployment of 5G antennas and other infrastructure.

At one level, a secure and modernized grid depends on robust communications. For example, the grid is integrating larger and larger amounts of distributed energy resources (DER) like solar photovoltaics, wind, and energy storage. As DER deployments accelerate, communications become more critical as a tool to connect utilities, customers, and marketplaces in ways that drive decarbonization and enhance grid reliability and resilience.

5G technology also has the potential to improve the future electric grid by advancing everything from augmented reality to automated drones and vehicles. Some utilities are already exploring implementing private 5G networks to enhance security against cyberattacks and to aid remote monitoring and control of grid assets, such as substations and solar power plants.

Concerns About Health Impacts of 5G

Even if utilities haven't fully strategized how 5G can aid grid modernization and security, they must consider its deployment. One reason: the infrastructure required to support 5G will often be installed on existing grid assets. "Utilities should be thinking about this, and some definitely are, because some have been mandated to install antennas on transmission towers and distribution poles," said Phung Tran, an EPRI program manager.

Utilities also need to be aware of potential customer and worker exposure to radiofrequency (RF) electromagnetic fields emitted by newly installed 5G equipment and the mobile devices it supports. Concerns over potential health and environmental effects of RF exposure have triggered calls for bans and moratoriums on 5G rollouts as well as debates about the science behind some of the concerns.

INTERNATIONAL NEWS

To better understand typical exposures for workers and those using devices that receive data via 5G networks, EPRI recently conducted a pilot study that combined real-world measurements from 5G base stations in Belgium and developed a methodology for measuring exposures. This research, released in 2022 (5G Exposure Measurement Pilot Study, EPRI report 3002021620), sought to better understand the typical user and worker exposures near small cell 5G New Radio base stations. These are low-power base stations installed in locations where utility workers and smartphone and other device users could come in close contact with them while they are operating.



Big Differences with 5G and Research Results

It's important to understand just how different 5G is from previous 2G, 3G, and 4G systems. One big difference is that, though most of the 5G being installed will be implemented in the same frequency band as the previous systems, some 5G applications may be implemented in the higher-frequency millimeter wave RF band. Less is known about RF exposure levels for millimeter waves, though basic physics has shown that they don't penetrate human skin as much as lower-frequency waves.

Another important difference is that 5G equipment typically provides coverage to smaller geographic areas than previous technologies. As a result, 5G infrastructure can be installed at a lower height on utility poles, and the base stations don't need as much power to transmit data to users. In general, this means that RF exposure should be less from these lower-power base stations than from older networks.

But there are some nuances that make accurate measurements of exposure challenging. For example, some 5G antennas have what are known as beamforming capabilities. "In legacy networks, the base station doesn't 'know' where the user is located: it broadcasts uniformly over the expected coverage area," Tran said. Beamforming capabilities, by contrast, allow power to be directed depending on where a user is located. "This ability for 5G antennas to direct power to facilitate communication makes it hard to assess exposure. It's not as simple as before," Tran said.



INTERNATIONAL NEWS

To account for those differences, EPRI's research took a different approach than past efforts to measure exposure. Instead of assuming exposure to a uniformly distributed RF field, this study included information about the location of users and non-users of the system. It encompassed a wide range of scenarios, including active users and non-users at different locations and different numbers of active users.

The measurements also accounted for how far someone was from a base station, how high the antennas were installed, and what direction the beam was pointing. "We went through and identified user scenarios and types of users to make measurements more relevant than just maximum theoretical exposures," Tran said. "That is more representative than what has been done in the past."

EPRI found that all exposure levels for workers and the public for the two 5G base stations studied were well within established limits. Another finding: 5G antennas with beamforming capabilities produce lower RF exposures.

However, there are limits to these findings and more work to be done. "This is good news for 5G, but we have to caution people that the two systems we took measurements from operate at a lower frequency range that overlaps with an existing 4G system and not in the millimeter wave range," Tran said. "We need to do a separate study to look at the higher frequency range, but we can't do that until we get access to these systems."

Even before that research can be initiated, however, there are ways for utilities to begin using these results. In particular, the findings of this study can help inform how utilities communicate with their employees and provide RF safety awareness training. They can also help answer customers' questions about potential RF exposures from utility-involved 5G deployments.

INTERNATIONAL NEWS

THESE 5 ISSUES ARE HOLDING BACK THE ENERGY TRANSITION, EXECS SAY

By Jennifer Runyon | April 2023 | Source: [PowerGrid International](#)



Energy execs discussed the greatest challenges facing the electric grid at recent grid-edge event.

In a super session called, Shaping Utilities of the Future, at the IEEE Grid Edge conference and expo in San Diego, senior energy executives outlined the biggest challenges in front of electric utilities as they navigate the road to a net-zero energy system.

Panelists Shay Bahramirad senior vice president of Engineering, Asset Management, and Capital Programs at LUMA Energy; Jeff Bladen, Meta's Global Director of Meta Platforms; Caroline Winn, CEO of San Diego Gas and Electric; and Curt Mansfield, SVP of Power Delivery at PacifiCorp gave their perspectives on how to meet the net-zero challenge in front of electricity providers. The panel was moderated by Wayne Bishop.

Mansfield, a power system operator, said the challenge is inertia, which is a physical property important for the electricity grid's stability. Today, if a generator suddenly loses power, the inertia of other generators in the grid will help to keep the grid's frequency stable. Indeed, the electric grid was built on generators that are able to provide inertia. However, the changing power capacity mix means technologies like wind and solar, which are inverter-based resources, are unable to provide that much-needed inertia.

The second challenge he identified is managing the incredible volume of data that will be needed to efficiently manage the grid.



INTERNATIONAL NEWS

For Winn, it's all about affordability. SDG&E calculated what it said was the true cost of a fully decarbonized and electrified energy system and found it clocked in at \$2.7 trillion. "Doing that on the backs of customers is unsustainable," she said. Winn said she believes federal dollars will help and said that her utility has applied for some of the IIJA funds but it won't be enough. Affordability is a big challenge, she said.

In addition to affordability, a third challenge is planning, especially when it comes to electric vehicle adoption. How does a utility know when "you and your neighbors all have EVs and plan to charge at the same time," she asked. "We need that clairvoyance to know where the EVs are."

Bladen, who is responsible for strategy and execution of the energy footprint for Meta (Facebook), praised Winn for the work that SDG&E has done in figuring out the true cost of the transition and creating a roadmap toward that goal. For him, collaboration and partnerships are the key to making sure that plans set out by utilities are as robust and verified as possible. Planning in silos is at best inefficient, he said, and at worst it won't work.

Transmission was a fourth major issue. Bladen expressed dismay at the effort that goes into fighting against building new transmission lines. He said he'd love to flip the script, in which communities fight instead over the benefits that new transmission will bring them.

For Bahramirad, whose company is responsible for electric service in Puerto Rico, the biggest issue is talent and workforce. She said she needs engineers who have analytical and communication skills so they can explain challenging and complex topics to regulators and policymakers.

"As much as technology leads," she said, "policy rules." Engineers must be able to communicate.

Over the course of the IEEE Grid Edge event, many speakers expressed concerns about the slow speed of adoption of new technologies that will help with the energy transition. Transmission must be expanded more quickly, EVs chargers must be installed faster and interconnection bottlenecks must be alleviated if decarbonization goals are going to be met.



CIGRE UPDATE

CIGRE AUSTRALIA - NEW CEO APPOINTED

Member Update

CIGRE Australia is delighted to announce Peter McIntyre as their new Chief Executive Officer (CEO) commencing in July 2023.

CIGRE Australia was established in 1953 and boasts over 100 member organisations, and almost 400 active individuals participating in industry events as well as supporting 16 technical domains and corresponding panel activities. These professionals are focused on sharing and developing the right skills for today but with an eye to the challenges of tomorrow.

Peter McIntyre joins CIGRE Australia after leading high profile professional bodies, The Royal Australasian College of Physicians and Engineers Australia as Chief Executive Officer. This followed an extensive career in the electricity sector culminating in his appointment as the Managing Director of TransGrid, a critical participant in the National Electricity Market. Peter is a degree qualified Electrical Engineer with passionate views on the energy transition and developing the next generation of engineers and industry leaders.

CIGRE Australia Chair, Sean McGoldrick, announced Peter McIntyres' appointment today following a comprehensive recruitment process by a specialist energy sector search firm.

"The CIGRE Australia Board join me in welcoming Peter to lead CIGRE Australia at a critical time in the energy transition for all stakeholders," Sean McGoldrick said.

"CIGRE Australia has been the first point of call for power-network "know-how" for many years, and it will continue to be critically important in the energy transition."

"We look forward to Peter leading us in this journey and challenging our Board, members, and stakeholders to remain relevant and influential in the development and delivery of power-network "know-how" which will support the energy transition".

Sean McGoldrick thanked the outgoing CIGRE Australia CEO, Terry Killen for his long service and dedication in developing and protecting the CIGRE Australia brand. He will retire post facilitating the Cairns Symposium in September 2023. <https://bit.ly/3JLjxQd>

"Terry has played a central role in the development of CIGRE Australia as a critical party in the local and international energy markets. The members and Board have benefited from his leadership. We wish him every success in his future endeavours." Sean McGoldrick said.



CIGRE UPDATE

THE FUTURE ENERGY SYSTEM OF SYSTEMS

An article from Electra 327 April 2023

GLOBAL CONNECTIONS

The safe and reliable supply of electricity and other forms of clean energy to billions of people is becoming an increasingly complex and challenging task as the world transitions to renewable energy generation. A major challenge is the growing gap between central system operations and participating units. Transforming the energy system's organisational structure into a hierarchically ordered system of subsystems is a promising approach to keeping the energy system manageable and making the units accessible for system operation. Within each subsystem, the number of actors and degrees of freedom for optimisation remain manageable. At the same time, the exchange of energy and information between the subsystems allows for system-wide techno-economic optimisation.

by Felix Flatter, Stefan Goetz, RPTU Kaiserslautern-Landau, Germany
CIGRE NGN

The energy sector is undergoing a transformation with the increasing integration of renewable energy sources and decentralised energy units into the existing power grid. In recent years, it has become clear that the physical structure of the energy system with its hierarchical layers will remain unchanged and that most, if not all, technological prerequisites have been developed. An unsolved issue, however, is the coordination of millions of small, decentralised units in low and medium voltage levels on one side and larger units in high and extra high voltage levels for active power balancing on the other. The challenge lies in the gap between the decentralised units and the central system operation. These challenges primarily involve market integration, grid integration, ICT connections, measurement availability, and bi-directional communication for trading. The interaction between grid operators at different hierarchical levels also remains unclear, and the exponential growth of data in combination with the high number of units adds to the complexity of the situation.

To overcome these challenges, previously widely centralised coordination and quasi-global optimisation may not be appropriate. Groups of energy professionals and researchers worldwide have widely independently developed the idea of reorganising the energy system into somewhat self-sustaining and autonomous subsystems. These subsystems—acting internally under some level of self-rule and interacting with the outside as one entity passing on anything that cannot be solved locally—are sometimes referred to as autonomous energy systems or simply energy cells, after their biological model. They are organised in a hierarchical order, with each level solving local tasks locally whenever feasible. Notably, this solution within a subsystem does not necessarily imply a specific goal, such as enforcing power balance within subsystems as much as possible. For example, the operator of a subsystem may use flexibilities in its area of responsibility to solve local network congestion. The residual power of a subsystem is exchanged with the next higher subsystem (or vice versa), while ensuring that all necessary information for the operation of the grid and the market is included. On that higher level, tasks are solved that require a greater overview of the overall system, e.g., active power balancing across all top-level subsystems or optimisation of sector coupling units as well as (seasonal) storage. This nested exchange of power and information that bridges the gap between technological units and system operations. In most instances, the number of participants—may they be subsystems themselves or atomic elements—in each subsystem remains within the same order of magnitude across all hierarchical levels, typically between 100 and 1000.



CIGRE UPDATE

Since this manageable number of participants only needs to be connected to the relevant subsystem management unit, the complexity of the necessary information, communication, and measurement infrastructure is greatly reduced. In contrast to other aggregation schemes, this solution, however, still promises solutions closer the global optimum of the entire system.

This general concept has emerged and progressed in several embodiments and under various key words. Autonomous Energy Systems, developed by the United States National Renewable Energy Laboratory, represent a new approach to the operation of energy networks in which super-fast, real-time optimisation is achieved on all levels, each using all its available flexibilities. Thus, on each level, energy generation and production are balanced as much as possible at any given moment, and the remaining energy exchange is handled by the next higher level. This hierarchical power and energy exchange avoids the need for sequential markets. It furthermore simplifies operation as it does not require balancing power, allowing locally autonomous operation. However, it is important to note that local optimisation is dominant in this approach and does not necessarily lead to the global optimum.

Cellular Energy Systems, as proposed by the German research consortium in the publicly funded project ZellNetz2050, represent an evolution of traditional energy grid operation, incorporating day-ahead and intraday markets with trading intervals of 15 minutes to 1 hour. Deviations from forecasts or predicted grid states are likely to occur within these intervals, requiring sequential operation to compensate and thus leading to the need for balancing power. In this approach, the overall system management uses all flexibility across hierarchical levels as each subsystem management first gathers, processes, and eventually forwards all bids along the hierarchy to the top level, where the central management entity performs the optimisation. Nodal pricing serves as an economic incentive to ensure efficient energy allocation and grid usage. Thus, from the perspective of another energy cell, each energy cell is a black box with minimum information exchange. Each energy cell inherently accounts for all internal grid constraints during market clearing, resulting in an integrated market and system operation that produces a naturally congestion-free system at each market step. Another major advantage of this approach is its compatibility with solutions such as the European Energy Communities, where nearby consumers trade energy and support the democratisation of the energy system. If an Energy Community or similar entity adopts the standardised interface to the next higher-level energy cell, the management within the Energy Community is of no relevance to the overall system.

When implemented according to specific technological, economic, and regional requirements, the subsystem approach allows for more efficient use of all available resources, resulting in a more resilient and flexible power system. It is also applicable to ancillary services, such as frequency control and reserve provision, which are a focus of future more-electronic grids. Further research is needed in the area of truly distributed optimisation, i.e., solving an optimisation problem with distributed units while reaching a global optimum.



EVENT RECAP

ENGINEERS AUSTRALIA INTERNATIONAL WOMEN'S DAY LUNCH REPORT

Engineers Australia celebrated International Women's Day (IWD) in Sydney on 7th March 2023. The theme for this year was #EmbraceEquity. It aimed to spread the word about creating an equitable world or in other words, a fair and equal world and where everyone everywhere can play a part.

The keynote speaker at the event was Michelle Payne OAM. She is the first and only female jockey so far to win the Melbourne Cup in 2015, riding on Prince of Penzance, and made 'the race that stops a nation' a race that inspired one. She is an incredible sportswoman and has also had her life's journey made into a film called "Ride Like a Girl".



Her's is a story of true grit and single-minded determination to fulfil her crystal-clear dream of winning the Melbourne Cup that she had since she was the ripe young age of 5.

This dream came with many challenges and great sacrifices. Michelle had to drop out of school, something she loved, to train full time and she faced serious physical injuries during races and training.

But this did not act as a deterrent to her path in reaching her peak form for the Melbourne Cup. Her work ethic and humility inspired the entire room – while she acknowledged the arduous nature of her efforts, she followed it up with the message to have a hunger for the prize and the willingness to put in the hours preparing for it.

Her story has something for everyone, from highlighting the need to provide not only the opportunities but the support to allow women (and men) to take them on well. In the engineering context, equity of opportunity as well as support in all career stages was a key takeaway.

We are all very familiar with the need for our workplace cultures to be more inclusive and supportive. For women in particular, it sometimes requires a little added encouragement and support to overcome the self-doubt and pressing family responsibilities that creep in and hinder professional growth.



EVENT RECAP

The other key takeaways for me were around shaping visible role models and great mentors and also owning the differences in the approach to working that are influenced by our gender. This provides a framework where the environment is encouraging and peers are able to collaborate while bringing diverse perspectives to the table, without feeling the need to over-compensate to meet an imagined standard.

A great afternoon full of life-lessons!

Pallavi Singh
Electrical Engineer, Aurecon





CORPORATE MEMBER CONTRIBUTION

HIGH-QUALITY DATA IS THE FOUNDATION OF A DIGITAL TWIN

BY ALICIA FARAG, Co-Founder & President, Locusview

Building the next-generation energy grid will require utilities to embrace digital twin and Building Information Modeling (BIM) technologies. BIM is an interactive 3D design model of a building or other built infrastructure assets, such as a bridge or nuclear reactor. BIM models typically focus on the design phase of a project to enable stakeholders to analyse constructability and track progress.

Interactive 3D models for the operational phase of an asset or system of assets are commonly referred to as digital twins. Digital twins combine data from multiple sources, including the original engineering design, construction, inspections, and real-time operational data, including sensors. This article focuses on creating digital twins.

WHAT IS KEEPING THE UTILITY INDUSTRY FROM IMPLEMENTING DIGITAL TWINS?

One of the primary barriers to implementing digital twin technology is the lack of high-quality data. A digital twin requires data from various lifecycle phases, including engineering design, product manufacturing, construction as-builts, and commissioning and test reports. All of this data exists, so why is it so hard?

Stakeholders throughout the supply chain create, store, and exchange data based on their unique needs and the needs of their downstream users:

- Engineers create CAD design drawings with Compatible Units (CUs) and a Bill of Materials (BOM) in a spreadsheet.
- Supply Chain purchases products with catalogue IDs using unstructured item descriptions. Manufacturers provide PDF specification sheets using internal product IDs and their own terminology.
- Construction contractors create redlined as-builts on paper drawings using their own terminology and symbols.
- ERP systems store accounting data based on CUs and unitisation models.
- GIS systems store data for geospatial analysis but don't have complete engineering datasets.
- Engineering systems store full specifications but don't have traceability data such as serial numbers.
- Other data, such as test reports and warranties, might be stored in a PDF format in a shared drive—and these PDFs might be scanned hand drawings!

A digital twin needs all of these datasets to support modelling, analysis, and preventative maintenance. Extracting data from PDFs, spreadsheets, and hand-written forms is time-consuming and prone to human data entry errors.

While there are many gaps in the data flow from one phase of the asset's life to the next, construction and as-building are typically where the data flow commonly breaks down. There are two reasons for this:

- What gets installed in the field may be different from what was initially designed to account for constructability liability issues. All as-built changes require field users to precisely document as-builts with information about installed assets, including substitute materials.



CORPORATE MEMBER CONTRIBUTION

- Field crews manually create redline as-builts on paper drawings under harsh environmental conditions. Data legibility, accuracy, and completeness can be compromised.

HOW CAN WE SOLVE THE DIGITAL TWIN AND CONSTRUCTION AS-BUILDING GAP?

Digital as-building is the process of capturing as-built data in a way that allows data to flow from one phase of the asset's life to the next—a Digital Thread. With a Digital Thread, as-built data can flow seamlessly from the field during construction into systems of record without manual data entry to ensure accuracy and fidelity. The key to digital as-building is automated data capture that is feasible for use by construction field crews.

The ideal Digital Thread workflow would look something like this:

- Engineers create a digital graphic work design (GWD) with a digital BOM.
- Manufacturers label products with a traceability barcode that links to digital product specification data and other essential datasets.
- Construction crews create a digital as-built by updating the digital GWD with asset data, using automated capture with barcodes and GPS.
- Digital as-built data is delivered to systems of record such as ERP, GIS, OMS, and ADMS for streamlined integration.
- O&M crews leverage the traceability barcode to attach inspection, performance, and repair data to the correct asset in the system of record.
- Advanced digital twin and analytical tools leverage the systems of record populated with high-quality asset data.

This workflow promotes a continuous flow of data through an integrated Digital Thread from design to systems of record.

STEPS REQUIRED TO IMPLEMENT A DIGITAL THREAD

The ideal workflow described above requires coordination and integration of multiple steps throughout the supply chain and the asset's life cycle, including:

- Engineering GWD and the BOM need to be structured to enable linking to the manufacturer's product IDs and digital specification datasets.
- Manufacturers must provide product specifications in a standardised format accessible from a barcode with a unique product ID.
- Construction crews need digital designs that can be updated easily with data from product barcodes.
- Digital as-builts need to be structured to deliver data seamlessly to various systems of record (and this might mean sending different datasets on the same asset to different systems).

Implementing the coordination and integration described above is challenging because it requires a holistic view of an asset's lifecycle from design through decommissioning. It requires looking beyond the typical silos of engineering, supply chain, construction, and operations. It requires a start-with-the-end-in-mind mentality.



CORPORATE MEMBER CONTRIBUTION

Implementing the coordination and integration described above is challenging because it requires a holistic view of an asset's lifecycle from design through decommissioning. It requires looking beyond the typical silos of engineering, supply chain, construction, and operations. It requires a start-with-the-end-in-mind mentality.

- Envision a digital twin that performs advanced analytics and provides meaningful actions using artificial intelligence and machine learning.
- Ask, "What type of data would this digital twin require?"
- Work backward to ensure the data is collected, stored, and exchanged in the design and construction phases.

Exchanging data from one phase of the asset's life to the next requires coordination and sometimes standardisation among stakeholders with different goals and incentives. A digital twin needs a Digital Thread that enables data to flow from design to manufacturing, construction, and operations.

To support this vision of the future, we are leading a new IEEE work group focused on creating an industry practice for Supply Chain and Asset Traceability for Electric (SCATE). The end goal is to develop standards and technology that will enable manufacturers of electric grid equipment and materials to apply barcodes with unique IDs to their products to allow stakeholders along the supply chain to access product specification data in a standardised format. Asset traceability barcodes applied by the manufacturer are an important component in bridging the gap between design, construction, and operations.

CONCLUSION

The promise of digital twin and related technologies of artificial intelligence, advanced analytics, and augmented reality for energy infrastructure will only be possible with high-quality data. The industry needs to invest in the seamless transfer of data from design to manufacturing to construction through decommissioning. Digital Threads and smart barcodes based on open industry standards are two key enabling technologies that can make this vision a reality.

Find out more about how Locusview is enabling High Quality Digital Twins through our SCATE (Supply Chain and Asset Traceability for Electric grid) project with the IEEE and EPRI in our EESA webinar on Tuesday 13/06/2023 at 11 am.





CIREP PAPER

REINFORCEMENT OF ELECTRIC NETWORKS TO ENHANCE THE ADOPTION OF ELECTRIC VEHICLES: AN UNCERTAINTY-BASED CONDUCTOR RESIZING APPROACH

CIREP, Porto, June 2022 - Paper number 1397

Lewis WASWA Munyaradzi Justice CHIHOTA Bernard BEKKER
Stellenbosch University Stellenbosch University Stellenbosch University
waswa@sun.ac.za justicechihota@sun.ac.za bbekker@sun.ac.za

ABSTRACT

This paper demonstrates the application of an uncertainty based conductor resizing approach in reinforcing low voltage electricity networks with high penetration of electric vehicles (EVs). The approach applies a three-step uncertainty-based procedure to determine the technical performance of the existing networks under varying EV penetration scenarios. Risk-based performance of individual network elements (i.e., nodes and conductor branches) are assessed to provide insight into the locations with potential congestion and power quality issues, thereby allowing the planning for appropriate reinforcement strategies. A simplified case study illustrates the approach's efficacy in improving feeder hosting capacity to EVs by resizing conductors.

[DOWNLOAD PAPER](#)

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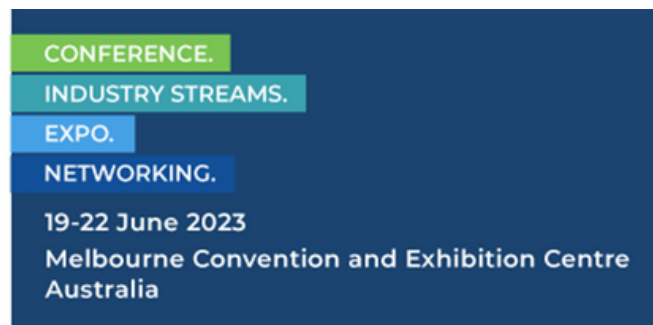
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UPCOMING EVENTS



Australian Energy Week is the major annual conference and expo for the entire energy supply chain, bringing together generators, networks, retailers, end users and government to help shape the energy transition.

A new addition to **Australian Energy Week**, the **Machines2023** conference focuses on the latest trends and development for energy asset engineering and critical electrical machinery.

It is the place to hear from industry leaders, make connections, and do business, with representatives from the whole energy value chain, from CEOs to analysts, energy traders to engineers. And everyone in between.

This is where the big discussions happen and the tough questions are answered. Join us to be part of the industry's major annual event.

There are over 100 speakers at the Australian Energy Week 2023, including:

- Anna Collyer, Chair, Australian Energy Market Commission (AEMC) and Energy Security Board (ESB)
- Clare Savage, Chair, Australian Energy Regulator (AER)
- Damien Nicks, Managing Director & Chief Executive Officer, AGL Energy
- Jason Willoughby, Chief Executive Officer, Squadron Energy
- Rik De Buyserie, Chief Executive Officer, ENGIE Australia & New Zealand
- Stephanie Unwin, Chief Executive Officer, Horizon Power
- Marie Jordan, Executive General Manager, Network Planning, Transgrid

View the full speaker line-up [here](#).

Why you need to be at Australian Energy Week 2023:

- Be an industry player - from CEO's to analysts, energy traders to engineers - AEW attracts the entire energy value chain. If you're not there, you're not part of the conversation
- Grow your network with over 20 hours of networking including the event gala dinner, networking drinks and Women in Energy breakfast
- Meet the businesses with the solutions you need in the energy transition, at the select exhibition of 40 + exhibitors
- Engage with the people that matter, by joining C-suite speakers and senior delegates from every energy business in Australia, with 80% + from the energy supply chain
- Update your knowledge by hearing the current developments and innovations with 35+ case studies from game-changing technologies and projects
- Grasp the latest thinking and strategies from the innovators transforming the energy industry

Register with **VIP code 'EESA10'** to save 10% off the registration fee for **Electric Energy Society of Australia (EESA)** members. Book online [here](#) or call +61 (0)2 9977 0565.



UPCOMING EVENTS

MURDER ON THE HIGH SEAS

FRIDAY 5 MAY 2023

QLD

[VIEW EVENT](#)



Overview:

Join us for a thrilling evening aboard the luxurious "Murder on the High Seas" cruise ship, where a murder has taken place, and it's up to you to solve the crime!

Time: 5:30 PM AEST

Location: Engineers Australia
Level 9, 340 Adelaide Street, Brisbane City

Cost: Member: \$25.00
EA Member \$35.00
Non-member: \$35.00

QUEENSLAND MOCK INTERVIEWS

MONDAY 8 MAY 2023

QLD

[VIEW EVENT](#)



Overview:

Looking to sharpen up your interview and resume skills? Get real feedback from industry representatives at Queensland's upcoming mock interview event and networking with your fellow cohort over some nibbles.

Time: 5:30 - 7:30 PM AEST

Location: Engineers Australia
Level 9/340 Adelaide St, Brisbane City QLD 4000

Cost: Member: \$0
EA Member \$15.00
Non-member: \$20.00

CIRCULARITY FOR SOLAR ENERGY: FUTURE OF ENERGY THROUGH SOLAR PANEL REUSE

WEDNESDAY 10 MAY 2023

SANT

[VIEW EVENT](#)



Overview:

Due to the increasing uptake of solar panel installations in Australia, a growing number of panels are stockpiling at landfill sites. Megan will describe her investigation of the recycling and reuse potential for these panels and how she has uncovered a significant issue for industry; that of premature obsolescence of solar panels.

Time: 6:00 PM NSW/VIC/ACT/QLD |
5:30 PM SA/NT | 4:00 PM WA

Location: Online webinar

Cost: Member: \$0
EA Member \$10.00
Non-member: \$10.00



UPCOMING EVENTS

THE IMPORTANCE OF GENERATOR CIRCUIT-BREAKER (GCB) SELECTION IN PUMPED STORAGE AND SYNCHRONOUS CONDENSER INSTALLATION

WEDNESDAY 10 MAY 2023

QLD

[VIEW EVENT](#)



Overview:

With the increased penetration of renewables in the market and the subsequent need to ensure grid stability, pumped storage power plant & synchronous compensator projects are gaining considerable momentum in Australia. In addition, to increase system strength synchronous condensers are also being installed in our transmission networks. A critical piece of equipment for these types of projects is the generator circuit-breaker.

Time: 3.30 - 5 PM AEST

Location: Online webinar, or, in-person at Aurecon Brisbane Ground Floor, 25 King St, Bowen Hills QLD 4006

Cost: Member: \$0
EA Member \$20.00
Non-member: \$30.00

SITE VISIT (1ST OF 2 IDENTICAL SESSIONS): H2XPORT PROJECT, REDLANDS

WEDNESDAY 17 MAY 2023

QLD

[VIEW EVENT](#)



Overview:

Led by QUT in collaboration three other universities and six industry partners, the ARENA-funded Hydrogen for Export project aims to develop a generic, scalable and systematic process to evaluate the operational viability of decentralised and/or regional-scale renewable energy (RE) hybrid systems to generate hydrogen (H2) for export and ultimately, for domestic use.

Time: 10:00 - 11:30 AM AEST

Location: QUT Redlands Research Facility
26-40 Delancey St, Cleveland QLD 4103

Cost: Member: \$0
EA Member \$88.00
Non-member: \$88.00

IS CYBERSECURITY A PHYSICS-BASED PROBLEM?

THURSDAY 18 MAY 2023

WA

[VIEW EVENT](#)



Overview:

Many assume that cyber vulnerabilities are a function of mistakes and errors in design of systems and software. This talk proposes the idea the cybersecurity is a function of complexity that has its roots in the world of physics. We will discuss the theory behind this idea and the practical implications this may have in design of systems that support critical infrastructure.

Time: Webcast starts 4:30 PM | Food and networking starts 4:00 – 4:30 PM

Location: Online webinar, or, in-person at Western Power Auditorium, 363 Wellington St, Perth 6000

Cost: Member: \$0
EA Member \$20.00
Non-member: \$30.00



UPCOMING EVENTS

SITE VISIT (2ND OF 2 IDENTICAL SESSIONS): H2XPORT PROJECT, REDLANDS

FRIDAY 19 MAY 2023

QLD

[VIEW EVENT](#)



Overview:

Led by QUT in collaboration three other universities and six industry partners, the Hydrogen for Export project aims to develop a generic, scalable and systematic process to evaluate the operational viability of decentralised and/or regional-scale renewable energy (RE) hybrid systems to generate hydrogen (H₂) for export and ultimately, for domestic use.

Time: 10:00 - 11:30 AM AEST

Location: QUT Redlands Research Facility
26-40 Delancey St, Cleveland QLD 4103

Cost: Member: \$0
EA Member \$88.00
Non-member: \$88.00

"STAYING FLUID" – UNDERSTANDING TRANSFORMER OILS AND MAKING THE RIGHT CHOICE

WEDNESDAY 24 MAY 2023

QLD

[VIEW EVENT](#)



Overview:

With the rapid changes in the energy industry, asset owners and operators are faced with a multitude of choices in solutions and components, best suited to their organization strategy, values, assets and their usage. These choices, more and more a balancing act between sustainability, asset life, performance, and economic considerations, extend to the selection of the "right" insulating fluids.

Time: In person: 3:15 - 5:00 PM AEST |
Online: 3:30 - 5:00 PM AEST

Location: Online webinar, or, in-person
at Brisbane Room, Level 1, 26 Reddcliff St,
Newstead QLD 4006

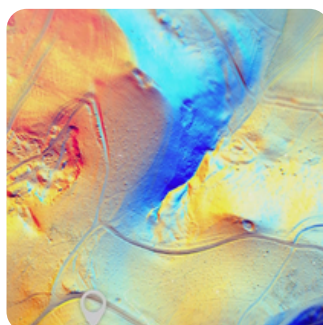
Cost: Member: \$0
EA Member \$20.00
Non-member: \$30.00

AGILE SURVEY – LIDAR AND THE POWER INDUSTRY

THURSDAY 25 MAY 2023

NSW

[VIEW EVENT](#)



Overview:

LiDAR, or Light Detection and Ranging, allows for the rapid collection of high-precision 3D point cloud information. It has swifter, more flexible acquisition and processing times than traditional techniques, and can reduce the need for teams to access dangerous areas.

Time: 11:00 AM - 12:00 PM AEST

Location: Online webinar

Cost: Member: \$0
EA Member \$20.00
Non-member: \$30.00



UPCOMING EVENTS

FUTURE OF LONGER DURATION BATTERIES AS STORAGE MAKES A MARK ON THE GRID

THURSDAY 8 JUNE 2023

WA

[VIEW EVENT](#)



Overview:

Neoen Australia is a leading independent producer of renewable energy in Australia. Neoen Australia develops, owns and operates renewable energy assets across the country, including solar, wind, and battery storage projects. The company has a diverse portfolio of projects, including the Collie Battery in Western Australia which will be a stand-alone battery up to 1 GW, potentially built in stages of 200 MW each.

Time: Webcast starts 4:30 PM | Food and networking starts 4:00 – 4:30 PM

Location: Online webinar, or, in-person at Western Power Auditorium, 363 Wellington St, Perth 6000

Cost: Member: \$0
EA Member \$20.00
Non-member: \$30.00

EESA VIC TECHNICAL SITE VISIT: WILSON TRANSFORMER

FRIDAY 21 JULY 2023

VIC

[VIEW EVENT](#)



Overview:

Established in 1933 with a proud history, Wilson Transformer Company is Australia's largest manufacturer of power and distribution transformer solutions operating two state-of-the-art manufacturing facilities in Melbourne and regional Victoria and service facilities across Australia and in the UK.

Time: 09:30 AM - 12:30 PM AEST

Location: Wilson Transformer 310 Springvale Road Glen Waverley, Vic 3150, Australia

Cost: Member: \$0
EA Member \$20.00
Non-member: \$30.00



THANKS TO OUR CORPORATE MEMBERS

PLATINUM



MISSION

"Through our passion for innovation and always finding a better way, we are taking reliability, customer service and product value- for-money to a new level in the transformer industry."

GOLD



SILVER



BRONZE

