What transmission technologies are easing grid connection?

Grids | New technologies are emerging to help constrained grids integrate an increasing number of solar projects. Molly Lempriere takes a look at three case studies of where technology is helping to decarbonise the grid faster.

Solar power has surged around the world in recent years, driven by the steep decrease in the cost of the technology and the increasing number of countries looking to decarbonise their energy networks. But whilst solar is often celebrated for its ease of installation, a grid connection can often be where projects struggle.

Connection delays in countries like Australia, Spain and the UK have caused investment and development challenges for solar, as aging infrastructure struggles to keep up with diversified and distributed generation.

But a number of new technologies are being developed to ease this congestion, including Point of Connection Mast connections, Renewable Energy Zones and a new strategy for substations.

How POC-MAST enables solar farms to connect to the grid

By Martin Buckland, managing director, Freedom Professional Services

Getting their projects connected into the electricity distribution network can be a challenge for solar developers, as network operators work to expand alongside the booming renewables sector. To ease this, many are looking to innovative new technologies as an alternative to often costly traditional connections.

The Point of Connection Mast (POC-MAST) is a revolutionary way of making the connection process for generation or load projects faster, safer and cost-effective. Suitable for connecting to overhead lines up to 132kV, POC-MAST can connect to either tension or suspension towers and is revolutionising the way new connections are delivered.

POC-MAST was first developed by Freedom, an NG Bailey Group company, as a bespoke solution for a renewable energy project where a traditional connection wasn't possible. It quickly became clear that this solution overcame many common barriers associated with traditional connections and provided a range of benefits to both developers and distribution network operators (DNOs).

Credit: Freedom Professional Services

POC-MAST technology is connected to overhead lines of up to 132kV.

DNOs in the UK have an obligation to provide new customers with a connection as quickly as possible and must balance providing a timely service with ensuring minimal disruption to existing customers. Due to the significant disruption new connections can cause, these installations are often only able to be carried out during British Summer Time when demand on the network is lower, meaning projects cannot be connected on demand. Furthermore, the longer it takes for customers to get connected, the more potential revenue they lose while they wait for their projects to go live.

DNOs have seen requests for connections onto their networks increasing dramatically from a few a year to dozens a month, putting pressure on them to deliver faster connections, more frequently.

Designed to meet the technical advancements of the generation, load and battery storage markets, a key advantage of POC-MAST over traditional connections is that there is no requirement to cable back to the nearest substation or to build a new overhead line tower, which in turn speeds up the overall connection process.

POC-MAST, which is assembled on the ground, can eliminate the need to construct a new tower and temporary diversion tower when delivering new connections. As most of the work is carried out at ground level, the safety risks of working at height are eliminated. The number of times the network needs to be de-energised and the reduced construction scope associated with the POC-MAST installation saves time, reduces costs and minimises the health and safety risks – all of which make a positive difference to whether a connection scheme is viable.

The product also minimises the environmental impact of new connections. The screw anchor foundations remove the need for deep excavations and can save up to 30 tonnes of concrete on a project.

The first POC-MAST installation was for a new solar farm in the UK, which required connecting to a nearby 33kV overhead line tower in DNO UK Power Networks' region – which covers South East England, East of England and London. The overhead line tower, which was built in the 1940s, had an unusual configuration which meant alterations to the existing tower steelwork would have been problematic.

After undertaking a detailed study of the existing tower, the first POC-MAST was commissioned and produced. It provided a safe, cost-effective solution. Although this was the first time this solution was used, the design and installation were safely delivered on time and to budget.

More recently, Freedom has installed a POC-MAST for a 70MW solar farm for Scottish and Southern Electricity Network (SSEN). The 213-acre solar farm at the former RAF Lyneham base in Wiltshire had been developed by SSEN with the UK's Ministry of Defence. The location, next to an ancient woodland, presented several challenges and it initially appeared that the permanent connection would require the installation of a new pylon, diversion of an overhead line and removal of part of the woodland. The POC-MAST installation enabled a connection directly onto an existing tower without the need to disturb any of the surrounding woodland.

Each of the two POC-MASTs required for the looped connection were lifted into place in just six minutes, and the total installation took 10 working days. A new tower and diversion would have taken longer, required multiple outages on both circuits and cost significantly more.

POC-MASTs have also been installed at other locations with much success. The feedback has been positive with the engineering solution bringing flexibility to the renewables grid connection. The flexibility to connect generators using a relatively lighter structure at a fraction of the time needed to connect using existing solutions is undoubtedly helping DNOs optimise utilisation of their infrastructure.

Credit: NSW Government.

Renewable Energy Zones are bringing forward gigawatts worth of renewables connection applications.

NSW Renewable Energy Zones help overcome grid congestion challenge

By a spokesperson for the Department of Planning, Industry and Environment of the Government of New South Wales

Over the next decade, the energy sector in New South Wales (NSW) will be transformed at an unprecedented scale. Renewable Energy Zones (REZ) are modern day power stations that bring together renewables with storage and network infrastructure in a coordinated way to deliver cheap, clean and reliable electricity to homes and businesses.

REZ are one of our best options to replace retiring coal-fired power stations due to the plummeting cost of renewable energy, advances in storage and firming, and the abundance of renewable energy resources that regional NSW has at its disposal. By connecting multiple renewable generators and storage in the same location, REZ capitalise on economies of scale, unlocking new energy sources at a lower cost.

The NSW Government, with its new statutory authority the Energy Corporation of NSW (EnergyCo NSW), is coordinating the development of five REZ in the Central West-Orana, New England, South-West, Hunter-Central Coast and Illawarra regions.

It's critical we act now, since four out of five of the state's coal-fired power stations are scheduled to retire within the next 15 years, starting in 2023. These power stations currently provide around three quarters of the state's annual generation and if not replaced prior to closure, consumers will face significant price hikes.

We must also urgently upgrade network infrastructure to allow new generation to connect to the grid. To put the scale of this task in perspective, existing generation and transmission took 30 years to plan and build and now we have to replace it in half the time. The expected build time for each REZ can take up to ten years and each pumped hydro project needs up to eight years to develop.

A coordinated and planned approach, central to delivering these REZs, will help address two main challenges currently impeding investment in NSW, and help unlock the scale of private investment needed to support this energy transformation.

The first challenge is lack of capacity in the network. Many of NSW's prospective renewable resources are located in parts of the state where grid capacity is low, making it difficult for investors to commit to build new energy generation and storage. At the same time, network companies cannot be certain they will recover the full cost of network upgrades to enable new energy generation and storage projects to connect, unless these projects are committed to be built.

The NSW Government's Electricity Infrastructure Roadmap aims to solve this 'chicken and egg' problem by introducing provisions for authorising the construction of network infrastructure while ensuring electricity consumers only pay the efficient costs of these upgrades.

Proposed reforms will establish a bespoke NSW regime, a Transmission Efficiency Test, similar to the regulatory investment test for transmission (RIT-T)

and National Electricity Rules cost recovery provisions for REZ network infrastructure projects, to allow scale-efficient network investments to proceed.

The second investment challenge the Roadmap is solving, is that access to the grid is not currently coordinated or controlled in a way that encourages investment. This means early movers may eventually have their projects curtailed or congested as further projects connect to the network. This 'free rider' risk creates a disincentive for investments in network upgrades and increases the upfront costs of capital.

To address this, the Roadmap will deliver access schemes to govern which generation and storage projects can connect to specified network infrastructure in the REZ and how they may use that infrastructure.

It is proposed that, under an access scheme, access to the REZ network infrastructure will be allocated through a competitive process. This will include planning the connection of energy generation and storage projects to optimise the utilisation of the REZ infrastructure and help ensure that infrastructure minimises impacts on, and delivers benefits to, local communities.

Generators would pay an access fee to connect to the REZ, which would include a component to support community and employment initiatives.

EnergyCo NSW is also investigating potential innovative network infrastructure solutions, such as technology solutions, that could optimise the performance of the REZ by increasing export capacity, complementing proposed network augmentation, improving network resilience or providing additional system strength.

For each REZ, we are following a thorough, engagement-led and evidence-based process.

We are ensuring they are supported by communities and industry and will complement the Australian Energy Market Operator's Integrated Systems Plan, other NSW REZ and the objectives of the broader Roadmap.

While each REZ will be developed differently to reflect each area's unique opportunities and challenges, EnergyCo NSW will follow the principles of early and open engagement with all stakeholders and the community.

Despite the immense scale of the challenge, we are already making significant progress.

Recent industry Registrations of Interest processes undertaken for the Central-West Orana REZ and New England REZ received an overwhelming response from investors, with proposed projects totalling nine times and four times the intended network capacity required for each REZ, respectively.

The transformation has begun, and we are on track to reach our ultimate goal for NSW to enjoy some of the cheapest, most reliable and cleanest energy in the world by 2030.

Developing regional 'hubs' to solve infrastructure challenges

By Steve Serpant and David Williams, directors, Gridmode

The UK has been among the first countries to set a legally binding target of net zero by 2050 and has aspirations to decarbonise its power system by 2035. The Net Zero Strategy, published on 19 October 2021 by the Department for Business, Energy and Industrial Strategy, binds us to building a secure, home-grown energy sector, with a reduced reliance on fossil fuels and exposure to global wholesale energy prices.

Not only do we need to rapidly increase power production from self-sufficient sources, such as solar and wind to achieve this, but also – as we are heavily reliant on gas to produce electricity utilising synchronous power generators – we require a large programme of conversion or replacement.

The UK needs to quickly shift to renewable sources for its electricity production whilst balancing the intermittent nature of power generated using wind or solar. At present, balancing is partly carried out by gas (or even coal) fired power generation to support demand. Some batteries are employed in this, but there is a need to increase battery infrastructure on the grid many fold.

As we've seen in recent months we need to protect the UK from gas price increases, so reducing our gas 'fleet' is key. This leaves a huge gap in the power generation needed to meet our increasing demand, particularly so with the growth of electric vehicles. In addition, the current status of importing energy from other countries exposes us to a huge shortfall of low-price energy.

Gridmode is an energy infrastructure start-up, born from solar project development established to design and develop 'hubs' that solve specific regional grid infrastructure issues, in turn unlocking renewable connection capacity on a large scale.

Whilst developing utility-scale solar projects in the UK, Gridmove – the renewables development arm of Gridmode – was forced to connect to the UK's transmission grid because the regional distribution network operator (DNO) was unable to accommodate such a development. This is a common theme across the UK presently and a real issue when considering the UK's net zero ambitions.

A strategy of unlocking further sites was put into motion, something more holistic than one incorporating just solar PV or battery energy storage systems. No single technology was deemed capable of resolving specific grid issues or power flows, and instead new ways were considered as an alternative to traditional grid infrastructure asset ownership.

To date, Gridmode has implemented a strategy designed to help ease grid-level constraints and then address capacity connection issues across the UK. The strategy works by targeting restricted areas of the country's electricity networks – identified via the company's experience as a developer, coupled alongside known development of new generation – and then unlocking megawatts of spare capacity per site. Specific constraints are identified through a site-specific connection study, which isolates what is likely to have caused or continues to cause the constraint on the network. Specific connection strategies are then determined to ease constraints and unlock capacity.

Collectively, and through the rollout of a proposed £1 billion capital programme to invest in a private network of 400kV substations, it's estimated that as much as 8GW of new renewable energy capacity could be unlocked over the next decade. More than 30 400kV substations are planned for throughout the UK, with development aimed to commence in early 2023. Independent specialists including TLT Solicitors and market research firm Cornwall Insight have been engaged in the project.

Moreover, the scheme would also create around 3GW of battery energy storage infrastructure connected to the UK's transmission grid, which would then be able to provide services to further support the migration to non-synchronous power generation, such as inertia. ■