How can we make the most out of wind energy with smarter grid and market integration?

SGS Wind Turbines

Words: Graham Ault, Executive Director at Smarter Grid Solutions

As we move towards net zero carbon emissions targets, significant efforts to connect more clean energy resources to the grid are being made.

Globally, the energy industry is welcoming innovations in renewable energy and Distributed Energy Resource (DER) assets. As a result, correctly managing and distributing the energy from these DER assets to enable the most efficient, clean and smart energy system is a big focus for system operators, utilities and asset owners alike.

Big strides have been made already in the capabilities of energy storage and distribution networks, with major projects testing long-term battery models. A recent study by Wood Mackenzie revealed that it is expected that cumulative capacity of distributed storage and solar in North America, Europe and Oceania will double by 2025. Similar predictions were made by The International Renewable Energy Agency (IRENA) who project that the onshore wind capacity growth rate will quadruple to more than 200 GW added annually by 2040.

Renewables by nature are intermittent. The sun does not always shine and the wind does not always blow. Add to that, the current uncertainty over the long-term implications of the Covid-19 pandemic and subsequent lockdowns and economic changes on electricity demand, there are many variables which can impact the level of renewable penetration, the decarbonisation of the grid and the operation of wind power on a daily basis.

As it stands, the UK is the world leader in offshore wind, reaching the capability to power the equivalent of 4.5 million homes per year and is currently on track to generate more than 10% of UK electricity by the end of 2020. Whereas in the US, wind accounts for little more than 7% of the energy mix, but

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its share is growing. In the past couple of years, figures are showing a significant increase and in 2019, it accounted for around 300 million MWh.

To increase the roll-out of wind generated power, it is essential that technologies are used to combat the challenges faced. Distributed Energy Resource Management Systems (DERMS) software can play a vital role in balancing the grid’s ever-evolving supply and demand. DERMS technology provides the necessary connections between clean energy producers and other low carbon technologies such as electric vehicles, wind and solar, the grid and the wider system and markets. This provides the necessary data and control infrastructure to manage the distribution and use of clean energy where it is most needed, to meet the demand of end users, curtail surplus production when demand is low and grid constraints emerge, and make use of various forms of energy storage where available.

Using DERMS to get the most out of wind power

Properly implemented DERMS can enable large scale roll-out of distributed wind energy by creating an ecosystem of DER management which provides value to a range of clean energy players of all sizes and types. It implements the three-pronged approach to both digitalise and decarbonise a grid based on increasingly decentralised energy.

DERMS come in different shapes and sizes. For example, Fleet DERMS manage the operation, customer and commercial exploitation of distributed energy opportunities by providing fleet wide visibility and controllability of diverse and geographically distributed energy assets. In this case, DERMS provides the digital backbone on which to build Virtual Power Plant (VPP) solutions that build multiple DER into grid and market significant assets.

While planning the development and grid connection of new wind power assets, the primary form of DERMS of interest to the wind industry is called, Utility DERMS. This application of the technology enables faster and less expensive grid interconnection providing benefits to DER developers and grid operators.

Utility DERMS deliver grid management functions that harness the benefits of DER in the grid while protecting against the potential downsides of supply continuity. This application can be seen in action in south-east England where a large additional capacity from wind farms, along with solar photovoltaics, has been added to the distribution grid, helping to overcome the cost and delay that would otherwise have resulted from network capacity shortfalls.

It is clear that using this software can help towards achieving net zero carbon emissions targets but what should onshore wind developers, network operators and emerging Distribution System Operators (DSOs) look for to ensure they are getting the most out of their DERMS system?

1. Integration with other network management systems

In order to create a smarter and more flexible system, DERMS software must be able to integrate with other operational systems already in place, for example, advanced distribution management systems (ADMS). This means that control room operators can operate the network through the ADMS while the DERMS can monitor and control the DER autonomously, providing visibility of DER and DERMS operation through the single operational window of the ADMS. This two-way integration unlocks much more capability in both the DERMS and the ADMS.

This also allows network operators to scale their flexible wind power integration and management solutions to the wider network with ease and without the additional system or operational costs.

2. Real-time constraint management applications

A good DERMS allows the wind power hosting capacity of the network to be increased without diminishing network security because DER can be managed in real-time based on live network conditions and with multiple layers of security and fail-to-safes. This, in turn, can also add layers of network and supply security through DSO flexibility service provision and flexible network operation in the same way that ancillary services, such as frequency response, support the operation of the energy system today.

3. Economic optimisation and scheduled dispatch

Increasingly, grid supporting services will be provided by DER, which will require DSOs to perform the same economic optimisation functions as performed by energy market operators today. DSOs will build portfolios of flexible DER service providers and contract, maintain availability and utilise the required flexibility through optimal, market-based dispatch. In time, this will include the use of generation, demand, customer and storage flexibility orchestrated through the same DERMS and associated market platform. This can provide cost-based and carbon-based optimisation of all DER and support new customer business models and objectives.

4. Forecasting

As DERs become more prevalent and load patterns and technologies change, DSOs are becoming more reliant on having reliable forecast information in order to schedule service provision by DERs, for example, demand response and flex services. Being able to forecast for real time operations creates a more resilient set of network management processes which can help DSOs adapt and plan at different timescales in advance. This will provide additional opportunity to wind farms to deliver network services as well as coordinate operations and the forecasts themselves with the DSO.

Graham Ault

Darren, Johanna and Tom from Smarter Grid Solutions Managed Services team

5. Data analytics

The DSO operating model is changing to have a more active interaction between energy customers, energy asset operators, DSOs and other service providers. DERMS users and stakeholders require greater visibility of what the system is doing in real-time and a better understanding of why these actions have been carried out. That data can also be used by both DSOs and network users to better respond and anticipate events and opportunities. Good DERMS provide support for data capture, sharing and analytics. Examples of such open, or even collaborative, approaches to operational and planning data and advanced uses of it are emerging but much more is now expected.

Powering forward

Many innovations and developments have been made in both onshore and offshore wind. The significance to system operation is growing fast. The connection between larger wind power (onshore and offshore), smaller wind farms integrated directly into distribution systems and distribution and customer flexibility is also growing in significance. Some of the core infrastructure to enable that whole system coordination and optimisation is already in place but the tools to utilise the distribution and storage of wind power needs to be taken further to meet the full requirements of a net zero system.

By ensuring that network operators, and emerging DSOs are implementing the above checklist of crucial DERMS functionality, the road to net zero could be much smoother and faster. DERMS provide scope for low carbon technology scalability and flexibility to decrease the dependence on fossil fuels and contribute towards a fully smart, decarbonised energy system.

Implementing DERMS properly lays the foundations for ongoing exploitation of DER and larger wind power flexibility. Doing that groundwork now means that DSOs will be in a stronger position to deliver multiple value streams to customers, gain more visibility and control over their systems, and deliver flexibility and further integration points into new markets with new value streams to DSOs and network users.

David Smith, Senior Engineer working on an ANM Element

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