DISTRIBUTED ENERGY SYSTEMS

Flexibility is key

A flexible power grid is crucial to meeting energy transition goals in the 2020s, write *Ben Kellison*, Research Director, and *Elta Kolo*, Content Lead for Grid Edge Research, Wood Mackenzie Power & Renewables.

Over the next decade, traditional fuel-based generation will shrink as a proportion of the power mix. This will increase the need for flexibility of the distribution grid and power market. New tools will be needed to solve the increasing number of grid-balancing challenges associated with a more intermittent and renewable generation fleet.

The imperative to identify and implement these solutions will lead the industry to continue to experiment with innovative market reforms to unlock the growing and as-yet-unrealised flexibility potential of distributed energy resources (DERs*). Efforts to integrate these resources will lead to the creation of new revenue opportunities via wholesale and distribution value streams during the decade.

We see five themes to watch in the global grid edge in 2020 and beyond:

- Regulatory reform.
- Evolution of market models.
- Grid edge investment to complement electrification.
- Grid-balancing will increasingly rely on flexible resources.
- De-risking investments so the DER market can scale.

Today, the US power system alone has more than 50 GW of behind-the-meter flexible resources at its disposal from DERs enrolled in demand response programmes. Initially, flexible volume will be attained by dynamically leveraging what is already integrated into the grid. Resources already enrolled in existing demand response programmes will be the lowest-hanging fruit. Flexibility portfolios will scale with resources situated on either side of the meter.

Regulatory reform

Regulations governing how DERs are compensated for capacity and energy services are trending away from simple, fixed, time-agnostic rates, such as net energy metering and volumetric charges. This shift is expected to increase the exposure of DERs to local power markets and emerging distribution grid market constructs that dynamically determine the value of energy, capacity and ancillary services.

For example, in the US, the Federal Energy Regulatory Commission (FERC) is pushing regional market operators to formalise market designs that are inclusive of DERs. FERC has mandated operators under its jurisdiction to survey interconnection practices within their footprints and assess the economic benefits of ensuring individual resources and aggregations are on an equal footing with traditional system-balancing resources. This FERC order will shape DER participation in markets in the 2020s and will join Orders 745 and 841 as the most significant DER regulations of the last decade. (Order 745 certified the role of demand response on equal footing with bulk generation resources while Order 841 directed wholesale market operators across the US to open markets for energy storage participation.)

Like other regulators around the world, FERC recognises the value of flexibility located at the grid edge. As these distributed resources scale, their operations will begin to impact not just their owner's balance sheet but also market prices.

Meanwhile, in the UK, the full unbundling and deregulation of utilities has not stopped distribution network operators from working to leverage DER flexibility to improve network reliability and efficiency. UK Power Networks, for example, a distribution network operator for

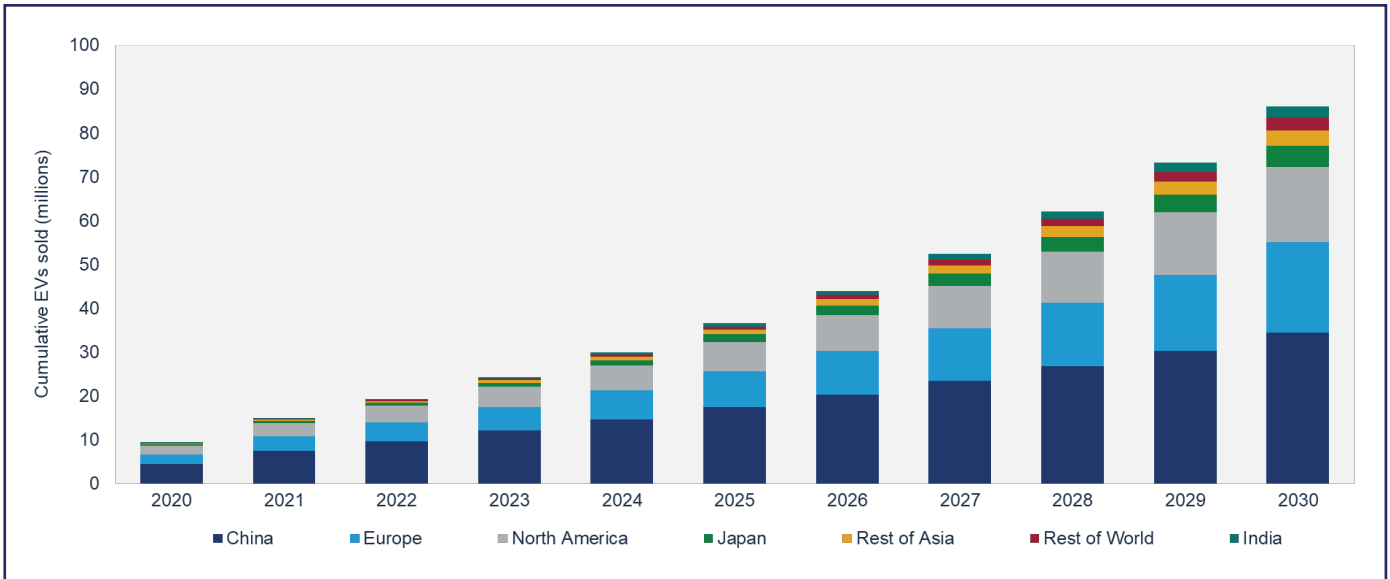

Figure 1: Cumulative estimated electric vehicle sales, 2020–2030 *Source: Wood Mackenzie*

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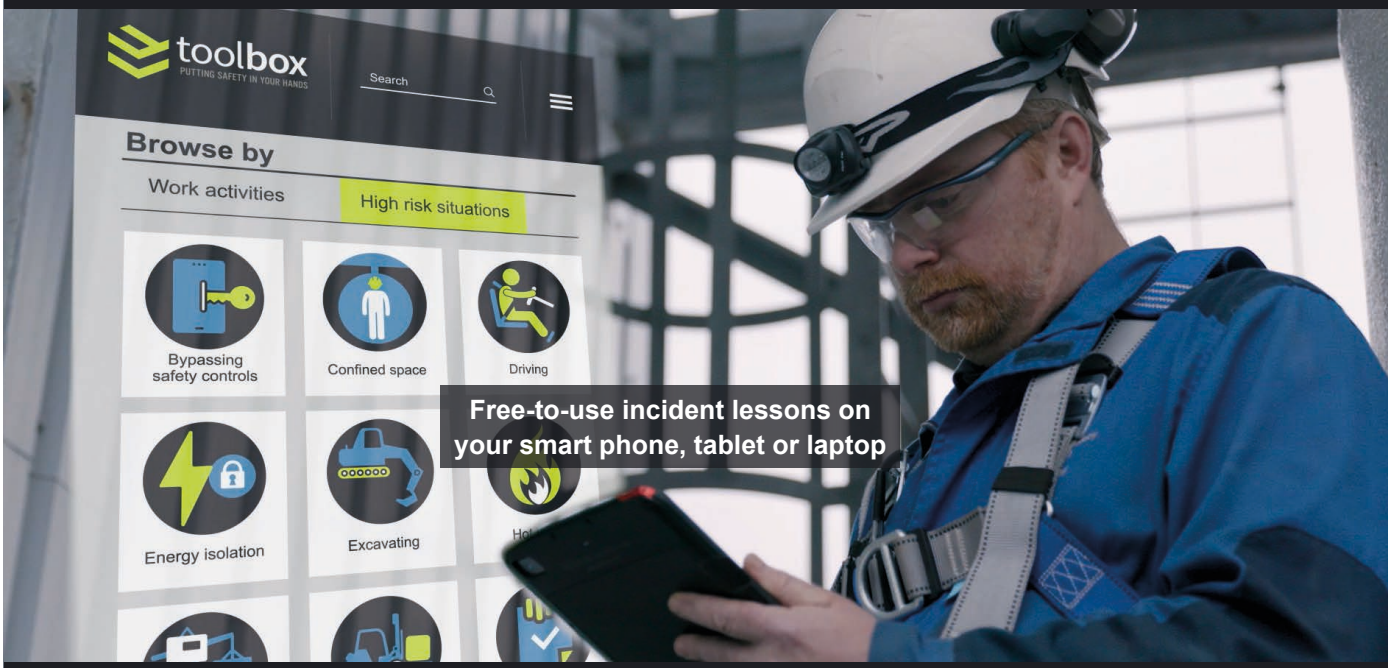

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electricity covering South East England, the East of England and London, has adopted an approach it terms 'flexibility first' in assessing the need for network capacity expansion through to the end of its next regulatory period in 2023.

Electrification growth

Electrification will continue to grow as governments and customers seek to reduce their emissions. Both electric vehicles (EVs) and electric heat are expected to see record growth in the 2020s. Heating and transport offer massive opportunities for electrification and with these opportunities will come complementary grid edge technologies to manage electricity use, increase resilience and integrate these new loads into the electric grid.

At the end of 2019 there were 7.8mn EVs in the global stock, representing less than 1% penetration. Currently, developing an adequate charging infrastructure network remains the largest challenge to growth due to high dependence on public funding to improve economics that don't yet pencil out and technological uncertainty. Nevertheless, commitment to mobility electrification still stands and is expected to see record growth in the 2020s. As an example, Wood Mackenzie expects EV growth to add 51.8 GWh of energy in 2030 in the US alone, as more than 86mn EVs hit the road globally. (See **Figure 1**.)

At present, heating electrification is picking up steam in Europe and parts of Asia as decarbonisation and pollution-reduction efforts are tipping the scales. Meanwhile, in the US, 24 municipalities have taken steps to promote or mandate heating electrification in the last year. In ISO New England territory, heating electrification is expected to have a 50% greater impact on load growth than EV adoption through 2029. Customers may be pushing for more aggressive measures for electrification to mitigate carbon emissions as countries around the world have experienced the benefits of emission reductions resulting from the COVID-19 restrictions.

Reliance on electricity for heat and transport also increases the negative impact of outages and major storms, thus compounding the disruptive impact on business continuity – and, more importantly, the risks to human health caused by extended outages, particularly in the winter.

More investments in DERs will be prompted by the adoption of EV fleets and building electrification in order to mitigate these price and continuity risks. For example, the Antelope Valley Transit Authority in California is procuring a microgrid to complement its transition to a fully electric bus fleet.

Balancing act

Grid-balancing will increasingly rely on flexible resources that can enable load to better match variable generation output.

Electrification offers an unprecedented opportunity for utilities and industry partners to promote investment in equipment and software that can help shape customer load for decades to come. Utilities and grid operators are taking note and investing in ways to address the generation-demand mismatch and follow renewables production to lower system costs. Active management and the oversizing of heating and EV chargers create additional flexible capacity for energy managers to pick and choose when and how to cycle use across portfolios to lower costs for customers.

Transport offers a massive opportunity for electrification

Source: Shutterstock

Flexibility from EVs will move from demonstration projects to everyday reality over the next decade due to the sheer scale of the available storage capacity (measured in kWh). North America alone could have more than 54.8 GWh of EV battery capacity by the end of this year. Based on a conservative assumption that the average EV will have 30 kWh of flexible capacity in both 2020 and 2030, that figure is expected to surge to 453 GWh by 2030.

The scale of DERs that materialises will be imperative to incorporate these generation, load and storage devices into wholesale and local markets to address flexibility challenges while balancing customer demand with overall grid system costs.

Grid edge shopping spree

The likes of Centrica, EDF, Enel, Engie, Shell and Southern Company have been aggressively investing in the distributed space through a series of mergers, acquisitions and venture capital. The result of this investment spree in the past decade has been the creation of vertically integrated businesses ready to execute on customers' evolving energy needs under the consideration of distributed energy resource offerings. This activity is expected to continue and more formalised practices such as those of Centrica Business Solutions and Enel X are expected to come to market as these majors seek to evolve and diversify into new revenue growth areas.

However, as yet, none have succeeded in proving they can scale a DER offering that relies on acquiring customers and customising offers across highly fragmented regulatory and policy environments.

Achieving scale

All the drivers are in place to bring to fruition the energy transition with a distributed energy landscape. However, achieving scale is key.

The entry of energy majors is signalling optimism for bringing in capital to catalyse the scaling of DER and begin to create a foundation of new markets on the horizon.

However, this year will see some setbacks in the growth of DERs as solar, storage, and EV markets are expected to contract due to global supply chain disruptions and project development stalling as a result of the coronavirus pandemic. Some impacts are expected to trickle into 2021, but by the end of the year deployments are estimated to return to pre-pandemic figures. ●

*DER refers to a distributed energy resource. Distributed energy systems (DES) comprise a number of DERs.