Innovation and disruption at the grid's edge

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On 19 June, Cornwall Insight and Pixie Energy will host an event *Innovation and Disruption at the Grid's Edge*. The title is borrowed from a recently published book, edited by Menlo Energy Economics Founder and President Fereidoon Sioshansi. It explains, in 19 chapters, how "distributed energy resources are disrupting the utility business model," and is a very worthwhile read indeed.

Edge of tomorrow

Sioshansi explains, in the opening chapter of the book, that the unifying message is one of "innovation and disruption enabled by new technologies." The "grid's edge", broadly defined as the interface between the electric distribution network and customers' premises, is being transformed by information and communication technology – themes that are revisited several times throughout the book.

Sioshansi explains emerging roles for customers in the energy system as either *consumers*, *prosumers* or *prosumagers* (someone who is a producer, consumer and who has made additional investment in distributed storage). The latter of these roles can operate virtually independently of the grid, with only sporadic reliance on balancing services and the wider grid.

Enmeshed in this new paradigm are new types of intermediary, whose role lies in aggregating flexible loads and distributed generation. These intermediaries include:

- artificial intelligence providers, which better manages energy consumption and energy service costs
- peer-to-peer trading platforms, which better manage distributed generation and storage, as well as consumption
- blockchain technologies, which enable transactions to be carried out between participants, and
- microgrids, which offer groups of customers a means to better manage their consumption, distributed generation and storage.

Sioshansi's introduction explains the new focus on distributed energy resources (DERs), and the book is split between three sections: the economics of DERs versus traditional bundled service at regulated tariffs; bifurcation of customers between those who can access their own energy and those who cannot; and the rise of aggregators, integrators and intermediaries.

American made

Generally, although DERs are proliferating owing to falling costs, the price of buying electricity from the grid continues to rise. This is partially caused by heavily regulated tariffs in many European countries, which are burdened by taxes, green levies and other surcharges. The cost of DERs in some places, however, has reached price parity, meaning consumers are better off consuming more of their self-generation.

In the US, the economics of DERs are enhanced by schemes such as net energy metering (NEM). This works in much the same way as the feed-in tariff system in Europe, with generators slashing their bills by feeding into the electricity network as much as they withdraw from it.

In California, where rates can be as high as 36¢/kWh [27p/kWh], and where retail tariffs are tiered, some customers pay virtually nothing for their electricity bills. These customers, however, still rely on the grid for balancing services, do not have fixed fee or connection charges, and therefore do not contribute to the network's maintenance.

The changing habits in consumption and generation, brought on by the emergence of prosumers and prosumagers, has given rise to tensions with non-solar customers bearing the brunt of costs created by reduced consumption from the grid by customers with solar panels. This situation has created a quandary for regulators, who feel duty-bound to tackle this alleged cost-shifting. Sioshansi argues that, if the incentives to sell excess generation into the grid are removed, then prosumers will, instead, become prosumagers. A remedy for this problem may be found in microgrids or community schemes.

Theory of everything

In his chapter on the economics of microgrids, the University of Freiburg's Günter Knieps discusses

the innovation potential of information and communication technologies in electricity networks, such as cloud connected control systems and the Internet of Things (IoT). The IoT can fill the role of connecting the physical microgrid, balanced by aggregators via low-voltage electricity networks, to the complementary microgrid, which consists of real-time information flows between aggregator and prosumager units.

Other innovations and services that could address the rebalancing issue for customers are discussed in other chapters. Yet Sioshansi argues that the impact of customers who are also producers is only in its infancy, implying that innovation in this space is set to multiply.

Risky business

Several chapters discuss the emergence of a host of new business models focused on aggregating and managing flexible loads and distributed generation. Indeed, Sioshansi asserts that the growing role of aggregators, integrators and intermediaries is likely to have "the biggest impact" on the future of the power industry.

In her chapter on virtual power plants, Next Kraftwerke's Helen Steiniger discusses her company's intent to develop a business case around an apparently emerging complex network of millions of decentralised units across Europe. This would be operated in its centre by a digital utility ensuring the balance of supply and demand.

Another company whose business model relies on disrupting the traditional electricity sector model is Tesla, which recently merged with SolarCity. In this set-up, Tesla's electric vehicles (EVs) and its Powerwall distributed storage solution combines with SolarCity's distributed generation.

The future commercialisation of EVs is covered in more detail by Queensland University of Technology's Jeremy Webb and Clevo Wilson. They argue that the rate at which Vehicle-to-Grid (V2G) integration into power grids happens is dependent on some complex cost-benefit calculations. V2G's viability as an alternative to increasing grid capacity may be hindered by the phenomenon of car battery depreciation when vehicles are used in this way.

Fiona Orton et al. describe in more detail alternative business models in Australia's National Energy Market (NEM) to integrate generation, delivery and storage devices. Here, they argue that there is an urgent need for network product and pricing reform, so that customers only pay for the services they need. In this context, Sioshansi says that the ultimate success of aggregators, integrators and intermediaries rests in better data management and convenient service offerings.

Mission impossible

As alluded to earlier, innovation and disruption at the grid's edge is likely to challenge regulators, who must protect customers' interests while facilitating innovation and the emergence of prosumers and prosumagers. Sioshansi sees them facing two key issues:

- how to adjust the existing regulated tariffs for consumers and prosumers (so that both contribute to the maintenance of the network fairly), and
- the extent to which the use of, and access to, the distribution network should be regulated.

Designing reasonable tariff rates should, as described in MIT's 2016 *Utility of the Future* report, reflect price of energy, prices of energy-related services, prices of network-related services and prices that cover costs of policy-related objectives. Sioshansi argues that, currently, these price components are all too often bundled opaquely.

As far as regulation concerning access to and use of the distributed network is concerned, New York's Reforming the Energy Vision (REV) provides guidelines on the subject. Beyond this question, stakeholders are at leisure to innovate, disrupt, and create new products and services. This, Sioshansi states, is a clear example of a regulatory arena fit for the emerging distribution network of the future.

Details of the book are here.

Register here for our event.