DISTRIBUTED ENERGY

Wave of disruption for energy supply

New distributed energy systems (DES) are set to be one of the most disruptive trends in the energy industry. *Roberto Rodriguez Labastida*, Senior Research Analyst at Navigant Research, analyses some of the key implications.

A revolution is underway in terms of energy distribution, moving from centralised, uni-directional power generation to distributed energy systems (DES) with two-way energy flows at or near the consumer's site.

DES are energy systems installed at or near consumer premises or that can operate independently from the grid. These include residential solar installations as well as communities, hospitals or educational campuses operating a microgrid with several energy assets (such as solar, gensets, battery storage, etc).

The proliferation of DES is one of the most disruptive trends to the traditional energy industry for the foreseeable future. Most energy companies and utilities are already wrestling with revenue erosion due to improved energy efficiency, demand-side optimisation and solar photovoltaics (PV). As deployments of distributed generation and energy storage, plug-in electric vehicles (PEVs) and microgrids gain further traction, the effect on incumbent revenue will become more pronounced.

There are a number of pronounced trends.

- Energy price volatility will continue to cause uncertainty for small and medium producers, making investments in DES attractive.
- Behind-the-meter DES will provide an opportunity for businesses to cut or reduce their carbon footprints and drive sustainability targets.
- Technology agnostic companies will gain the most, as they can offer solutions across multi-brand investments.

However, securing financing is difficult for DES projects unless the return on investment is less than 1–2 years, which is uncommon for most non-utility scale solutions. Indeed, innovative financing models are gaining popularity.

Strategic impact

The key difference between DES and a traditional power generation system is that the production and consumption of energy occurs at the same location (or relatively close to each other). This has a lower impact on the electricity system and, in some cases, can resolve issues occurring in the distribution and transmission grids.

A lot of the DES technology exists, but the electric grid needs some upgrades to be able to absorb large quantities of DES. For example, DES tends to be built in clusters as opposed to being evenly spread across the grid. Therefore, certain circuits can get overloaded, which limits the ability to add DES. There is also an issue with two-way power flow from DES, which the grid was not created and planned for.

A significant issue is the need for energy market rules to be updated to accommodate DES. The rules were written for large-scale central generators like the National Grid in the UK, and they do not always apply equally to DES. In the US, the Federal Energy Regulatory Commission (FERC) has put a lot of work into creating comparable market rules for DES, particularly for energy storage.

The FERC is working to get the wholesale market operators in the US to make comparable rules for DES so that they can compete against generators. There are billions of dollars available in capacity, energy and ancillary services markets that DES could earn if the rules allow them to. DES market participation could also lead to lower power prices for all electricity consumers by increasing competition and driving technology costs down. Each of the regional transmission organisations (RTOs) in the US has a stakeholder process to integrate DES into its markets.

In the UK, the Department for Business, Energy & Industrial Strategy (BIES) is also looking closely at these issues.

Key drivers for DES

The main driver, overtaking policy support in recent years, is DES installation cost reduction. Technologies like solar PV and energy storage cost a tenth of what they did a decade ago and there are enough technology innovations in the pipeline to keep further decline coming. Another important driver is the digitalisation of the energy system. This is key to manage a system that relies on intermittent sources of energy.

Admittedly, the drivers vary by country and region. In Europe, climate change is a huge driver as countries need to meet emissions reductions targets. In the US, the big economic drivers are the bid to reduce costs and earn market revenues, although corporate sustainability is an influence as well.

The main challenge for DES players is to keep up with constant cost reductions. You need to innovate technology or processes constantly or face being squeezed by low margins. At the same time, these cost reductions help open new markets as DES become competitive versus grid-sourced electricity.

What's more, DES is often excluded from potential revenue streams, like grid services, due to size or technical requirements which were set before DES were feasible. This is slowly changing, but it will take time before DES can operate at their full potential.

Key players

DES has a complex competitive ecosystem, with large players coming from the OEM (original equipment manufacturer) world like Schneider Electric, Siemens and GE; traditional utilities such as Enel or Engie; and pure DES players like SunRun or, to an extent, Tesla and even oil companies such as Total, Shell or BP.

There has been a lot of merger and acquisition activity in the DES

space from traditional electric companies and also oil and gas companies. For example, Enel has acquired demand response company EnerNOC, energy storage business Demand Energy and electric vehicles (EV) charging company eMotorWerks. Engie has acquired energy management firms like Ecova, energy storage company Green Charge, EV charging station supplier EV-Box and DES software supplier Genbright. Meanwhile, Shell has acquired retail energy supplier/demand response company MP2, EV charging company Greenlots and energy storage technology specialist sonnen. Total and BP have investigated the space, but have not made large investments as yet.

Global uptake

The DES industry started in the US and Europe, but the Asia-Pacific region is now leading the way. Australia is probably the most advanced country in this area, but DES is expected to surpass large-scale solar in China this or next year (see **Figure 1**.)

One of the key DES-related initiatives is the European Energy Union package. Under the terms of the package, the EU protects the rights of energy consumers, making it easier for them to produce, store or sell their own energy. Though it will take time for all member states to adopt these rules, it should create a better environment for DES.

In the US, California's Self Generation Incentive Program has already paid $1.4bn and will pay more than $2bn toward DES by 2025. Many US states have incentives for solar, and several have energy storage and EV incentives now as well. Massachusetts recently became the first state to include battery energy storage eligible for energy efficiency funding incentives.

Storage technology

Electricity is one of the few resources/commodities that cannot be easily stored. Energy storage has been called the 'Holy Grail' for energy transformation. If battery storage becomes widely economic, it will replace a lot of the need for large-scale generation.

As global electricity grids embrace the new energy economy, energy storage is becoming a necessity in grid infrastructure. Energy storage grants stakeholders flexibility on the generation, transmission, distribution and end-use sides of the grid. As a result, the energy storage landscape has grown increasingly sophisticated, marked by new types of projects that are being monetised by innovative business models.

New companies have entered the market across the energy storage value chain while legacy companies have sought to bolster their presence. The growing need to modernise global electricity grids and the evolution of business cases for deploying storage ensure that this market will continue to grow quickly over coming years.

Several factors encourage the increase of energy storage deployments:

- The restructuring of electricity markets creates new value streams for energy storage (eg FERC Order 841 and UK ancillary services markets). The regulatory and economic structure of these markets will support valuation of the flexible benefits of energy storage deployments.
- The development of new distributed, intermittent variable generation sources, such as solar PV and wind, which are connected to power grids worldwide, will require increased load balancing against demand.
- Areas with relatively unstable grids and frequent outages (eg Australia and small island territories) will benefit from distributed energy storage systems (DESS) and microgrids with storage. Operators of stable grids will look to apply utility-scale energy storage systems to minimise the impact of outages affecting large numbers of customers.
- Load profiles will play a critical role in the structure and operation of the power grid, which will influence the development of energy storage markets (eg Canada's Global Adjustment fee). Energy storage will increasingly become a viable option to costly grid and substation upgrades to meet changes in load.

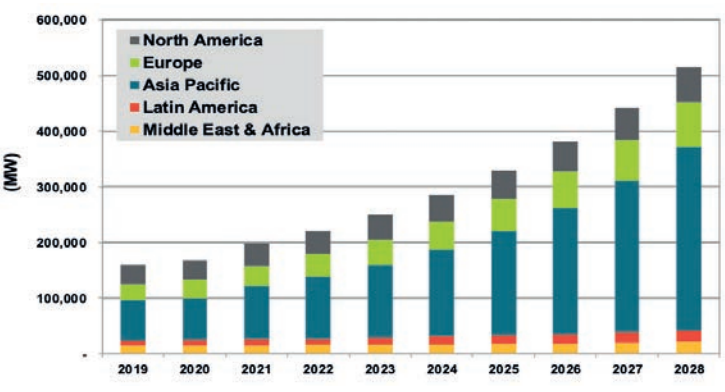

Figure 1: Annual installed total DES power capacity by region, world markets, in 2019–2028

Source: Navigant Research

Impact on oil and gas sector

In terms of the gas sector, regulators and investors are now re-assessing the need of new integrated gasification combined cycle (IGCC) plants and even 'gas peakers' (power plants that generally run only when there is a peak demand for electricity). The domestic gas sector will also face competition from electrification as DES can work well with technologies like heat pumps. This excludes the impact of EVs in the DES sector; if included, the impact could be huge.

The concept of beneficial/strategic electrification needs to be considered – moving from oil and gas-based devices/appliances to electric, with the assumption that the electricity will be produced from clean sources. EVs are the biggest component here, shifting away from internal combustion engine (ICE) powered vehicles. It also involves using electric heat pumps for heating, ventilation, and air conditioning (HVAC), moving away from oil and gas-fired systems. The third aspect is industrial electrification, moving from fossil fuel-power based machinery to electric. In addition, the growth of DES and renewable energy will decrease the need for gas-fired electricity generation and fewer pipelines will be built.

The big question

Finally, will energy costs come down with DES? Navigant Research thinks it will vary from region to region, but eventually, the average price of a KWh will fall. ●