# Microgrids – tomorrow's power networks are already here

**The power distribution infrastructure of the future will be smarter, more flexible and more decentralised. Microgrid technologies are already helping organisations and utilities to improve energy reliability, cut operating costs and access new sources of revenue.**

The shape of power distribution systems is changing. Once, distribution networks played a simple, static role: taking power from the main electricity grid and delivering at an appropriate voltage to local loads. Increasingly, however, distribution networks are called upon to play a more active role. Renewable energy capacity is often embedded into distribution infrastructure. Large sites, from factories and data centres to healthcare facilities or university campuses, may incorporate their own power generation and storage equipment. Power users are choosing to manage their consumption proactively, by participating in the energy ancillary services such as firm frequency response (FFR), demand side response (DSR), or short term operating reserve (STOR).

### The rise of the microgrid

Small-scale power generation, and distribution systems that operate in isolation from the main electricity grid have existed for decades. Normally, they operate in areas where connection to the primary grid is technically or economically unfeasible, such as remote island communities in parts of the UK.

Today, however, there is growing interest in the development of microgrids for the industrial and commercial (I&C) and utility sectors. In these contexts, a microgrid will comprise various distributed energy resources (DERs) within a local power distribution network, such as solar photovoltaic (PV), wind, battery storage, combined head and power (CHP) and diesel/gas generator units, together with local loads, which may be controllable or uncontrollable.

An important property of the microgrid is that it can operate connected to the utility (grid connected) or in isolation (island mode). Businesses and communities may be interested in building a microgrid for a number of reasons:

- Improved energy security. In the event of a failure of supply from the primary grid, the microgrid can switch to island mode to keep local loads supplied.
- Reduced operating costs. Sites with significant renewable generation capacity, or which can generate power as a by-product of other processes (e.g. using methane produced from the anaerobic digestion of biomass in water treatment plants) may wish to rely on their own power whenever they can.
- Lower $CO_2$ emissions. The ability to maximise the use of low-carbon energy sources such as local wind or solar power can help organisations achieve carbon reduction objectives.
- Additional revenue. Sites with the ability to control flows of power to and from the utility grid can participate in a number of energy markets, selling surplus power or providing demand side response to help the main grid maintain stability.

## Technical challenges

Microgrids require control systems similar to those used for conventional power distribution systems. The microgrid is needed to ensure the following:

- Demand is always balanced by the power supply
- The voltage within the microgrid is always kept within certain defined limits. This is especially critical when the microgrid is operating in island mode
- The frequency of the microgrid is always kept within its limits. Again, this is critical when the microgrid is operating in island mode
- Control of the DERs to ensure DSR or ancillary services participation and peak shaving
- Control of the loads, for example by implementing load shedding when demand cannot be met by the distributed generation (DG) within the microgrid
- Frequency synchronisation of the microgrid with the utility
- In utility-based microgrid applications, power/load flow calculation is also required to control the DERs, and reconfigure the power network, autonomously from the central power management system. This is especially important for LV utility-based microgrids.

All the above call for high levels of automation, and tight integration between network, loads and distributed generators. Automated decision making simplifies control of the microgrid and supports local operators, helping the asset owner decide when to produce, consume, sell, or store energy.

## Easier than you think

The good news for network owners is that the technology needed to control microgrid installations is becoming much more accessible. In part, that's thanks to the demand from the conventional power distribution sector, which is adding additional intelligence and automation at the substation level to improve network visibility. The availability of sophisticated, highly autonomous control hardware and software are now available at a scale and cost that make them applicable to many site or community-level power networks.
Furthermore, the upside of microgrid investments is also becoming much more appealing. Allowing their power systems to become active participants in the energy market enables companies to earn a return on existing assets, like back-up generation or energy storage capacity, while also giving them greater control over their overall energy costs.

## How Capula can help

With over 40 years of control and systems integration experience in the power transmission and distribution sectors, Capula is ideally positioned to help organisations implement control systems for microgrids. We have designed, implemented and supported control and automation solutions for power applications of all sizes from utility scale down to individual sites. Our solutions start with simple energy monitoring systems and extend to encompass automation of the most demanding networks. By allowing distributed energy resources to provide services that support and optimise the local utility grid, our microgrid control systems capability can help industrial and commercial customers access additional revenue streams. Furthermore, as part of the EDF group, Capula can also help organisations to identify and access the right opportunities for participation in commercial energy markets, turning power assets into a source of additional profit.

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