Hub Guide 6 – Transforming the Power Network

Introduction

This Hub guide is an introduction to how the power network is changing in the UK with the adoption of new technologies and ways of managing electricity use. It covers electricity generation, storage, the emergence of smart grids and new solutions to connecting to the grid.

This guide is intended to inform and support those who would like to develop projects either to consume or generate power. Other Hub guides are available on this topic. Hub Guide 5 introduces the power network and explains some of the terms used in this note. Hub Guide 7 explains how to benefit from new power technologies. Hub Guide 8 focuses on grid constraints.

If you have any further queries after reading this guide, please visit the Greater South East Energy Hub website www.energyhub.org.uk or contact info@energyhub.org.uk.

The changing network

The UK power network is undergoing transformation, from one that is managed centrally, to one that is managed interactively at a local level. This change has corresponded to an increase in local power generation and storage, which is being connected into local distribution networks. The rise of local energy is in response to three fundamental challenges:

- Ensuring energy security – the power network is aging and needs to be upgraded to meet our supply needs
- Providing affordable power – the projected cost of upgrading the network is likely to make it difficult to keep the cost of electricity affordable to the consumer
- Delivering low carbon electricity – there is a need to reduce carbon emissions as part of international climate change obligations.

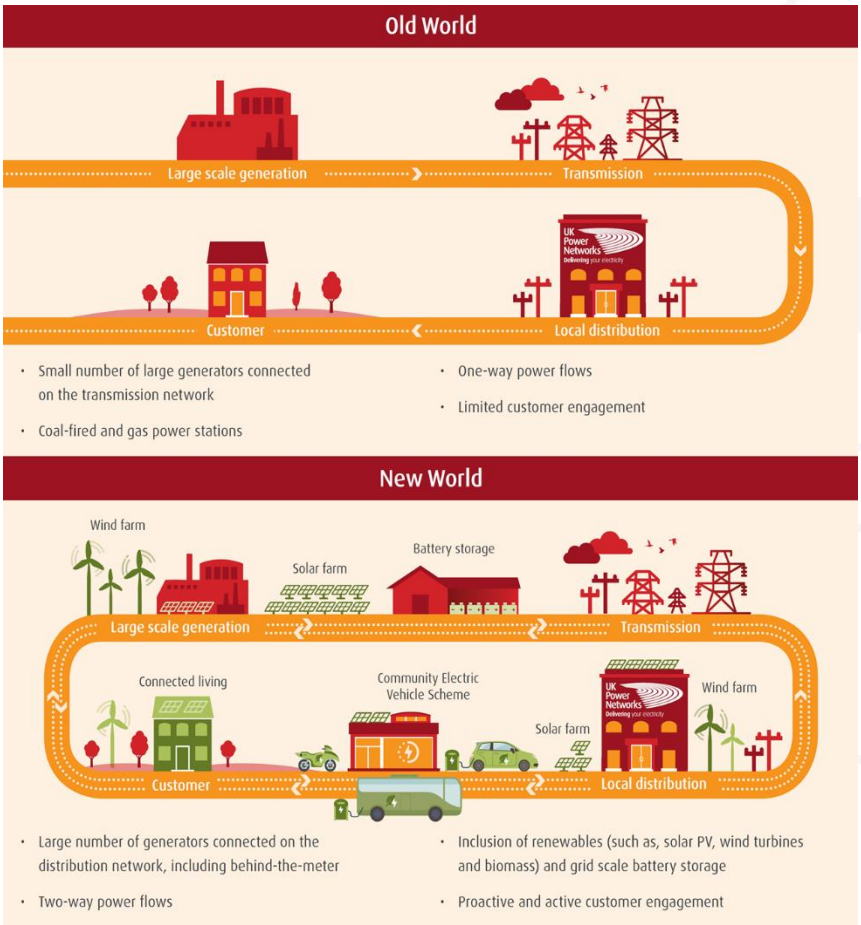
These challenges are heightened in the UK because we are increasing the ways we use electricity. This is because electricity provides us with greater choice about the way that its power can be used compared with gas, which tends to be used primarily for heating.

Developing a smarter grid

A smart grid is defined as a power network that can, using internet-based technologies, efficiently balance the power network's demand. As such, it can deliver more environmentally-sustainable, economic and secure electricity supplies. Developing a smart grid approach across the power network in the UK is seen by the industry regulator, Ofgem, and those operating the current network, as key to achieving a cost-effective, resilient, low carbon approach to our future power supply.

The main difference between our current grid and a smart grid, is the way in which demand and supply are kept in balance using information communication technology. Currently this is done by the existing, limited number, of large generating stations having to adjust their output to meet consumer demand, through the distribution network. The smart grid uses more detailed information about consumer usage and proactive control across the power network, to respond and adjust the balance of demand and supply, second by second.

How the Power Network is Changing



Courtesy of UK Power Networks

Use of smart grids is also predicted to save some of the cost of investment in new and replacement wires and sub-stations and allow the connection of more locally generated electricity, using low carbon energy sources.

Distributed generation

Distributed generation refers to electricity generating plants which are connected to a lower voltage distribution network nearer to consumers. This contrasts with the more traditional arrangement for supply, which is provided by the high-voltage transmission network, powered by centrally-located, large-scale power stations, for distribution to consumers across the country.

There are many types and sizes of energy technologies suitable for distributed generation. These are predominantly energy efficient or low carbon technologies, and include Combined Heat and Power (CHP), wind, solar, hydro-electric and fuel cell. However, one of the challenges of wind and solar technologies is that they depend on the right weather conditions to produce their full output. This means that they are not always able to match consumer demand.

Power storage

Storage can help to smooth out imbalances between generation and demand. Storage can help to solve the problem of fluctuations in power generation from sources like wind and solar. Batteries are only one type of storage technology, others include water (either through pumped or thermal storage), compressed air, fly wheels and capacitors.

Storage can give consumers, whose activities are susceptible to power fluctuations, whether through temporary power losses or variations in the quality of the power that they receive, the confidence that their power supply can be maintained locally. Batteries provide a more responsive back-up supply than traditional diesel generators and have been shown to improve efficiency and reduce supply costs. This is achieved by shifting consumer demand away from more expensive tariff periods.

However, storage currently comes at a cost, which may be prohibitive for those who want to install it, although it is widely recognised that storage will be needed to create a truly smart grid.

Demand-side management

Consumers can take active control of their electricity consumption. This is termed demand-side management and can be achieved through both technology and changes in people's habits. The effects can be to reduce or shift demand to periods when electricity is less expensive.

Demand response is an approach which uses on-site power controls connected to the internet, to automatically manage demand, to tailor it to the amount of power the network can supply. This can benefit the consumer by reducing site consumption, and the wider network by balancing supply and demand. This service is offered by a range of organisations, commonly called *aggregators*, since they bring together individual opportunities for flexible use across the power network, which are then managed together.

New solutions

New solutions are being used to avoid the need to upgrade the aging power network to meet supply needs. These include:

- Flexible connections – a connection agreement approach where the Distribution Network Operator will permit a connection that can be disrupted at times when the network is experiencing excessive high or low demand. This takes stress off the local network.
- Connecting directly to the Transmission Grid – this approach to connection disregards the local distribution network, which supplies electricity at low voltage, by connecting to the high voltage part of the network.
- Islanding or micro-grids – where a viable grid connection cannot be achieved, it may be possible to develop a site that can manage to balance its power requirements locally, for example, through a mix of on-site generation and power-demand management and battery storage. The micro-grid approach is at an early stage of commercial development.

Legal Disclaimer