

Unlocking Flexibility for Net Zero

Dr Alastair Martin, Flexitricity Limited

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The name 'Flexitricity' means flexible electricity. As the energy system has transformed over the company's history, the interpretation of this name has likewise developed.

Origins

Unlike any other commodity, supply and demand for electricity must match one another in real time. This makes the balancing of electricity systems the most critical task in supply security, and a major factor in the economy and environmental performance of the electricity industry.

Flexitricity's approach – using flexibility on the customer side of the electricity industry to balance supply and demand – grew from a recognition that, in large-scale power generation, flexibility and efficiency are often enemies. In fossil power, this is seen in the efficiency penalty associated with running a power station at partial output. In combined cycle gas turbines (CCGTs), per-unit emissions increase by approximately 20% when a station is operated at 50% load.¹ High-efficiency (ultra-supercritical) coal stations have limited ability to follow variations in electricity demand, due to thermal cycling limits of the advanced materials required compared to traditional coal.² Meanwhile, nuclear asset lifetimes are protected by minimising output variations, as shown by the reported £50m cost of turning off one half of Sizewell B during the Covid-19 lockdown.³

However, if electricity customers are flexible, large power stations can be more efficient. Since launching live operations in 2008, Flexitricity has used flexible customer demand and small generation to help National Grid keep the lights on, dispatching over 13,000 demand response events from its 24-hour control room in Edinburgh. These have been delivered by cold stores, greenhouses, district heating schemes, hospitals, batteries, chemicals plants, datacentres, commercial buildings and small hydro generators. This virtual power station, now close to 500MW in size, responds to events from quotidian 'trimming' of demand to major events like the blackout on the 9th of August 2019. The vast majority of the resources making up this capability today are industrial, commercial or public sector premises.

Green revolution

The recent explosion in renewable energy generation surpassed all expectations. The UK's solar resource is now larger than its nuclear fleet, while wind capacity is likely to exceed that of gas within the next few years.⁴ The ambient nature of these resources creates a new balancing task and increases the role of customer-side flexibility. Nevertheless, the need to cater for large-scale events, such as interconnectors or nuclear failures, remains.

Today, customer-side flexibility is required to answer many needs, individually and collectively, and each resource has a different role.

- **Speed** – A green electricity system runs with low inertia, hence large failures must be dealt with very quickly. Flexitricity has deployed batteries, manufacturing load, pumping and wastewater treatment processes in this context.

¹ Structure and Performance of Six European Wholesale Electricity Markets in 2003, 2004 and 2005, Appendix I. Presented to DG Comp, 26th February 2007

² Thermie 700 – <https://cordis.europa.eu/project/id/SF.-01001-97>

³ <https://www.thetimes.co.uk/article/big-is-not-so-beautiful-in-grid-talks-to-power-down-8w0qxbtgg>

⁴ https://en.wikipedia.org/wiki/Wind_power_in_the_United_Kingdom

- **Reliability** – Certain industrial and commercial processes are highly predictable and can be relied upon to offer an interruptibility service. Many such processes also offer high speed. Participants may prefer infrequent interruptions, and are paid mainly for being available.
- **Activity** – District heating, horticulture and pumping can tolerate modulation of their electricity consumption several times a day. The same is true to a varying extent of retail buildings and emerging domestic consumers, such as electric vehicle charging and storage heating. Such resources are suitable for active market trading, including the real-time Balancing Mechanism, where long-term commitments are not required but economic advantage can be gained by accessing rapidly changing electricity prices on an ad-hoc basis.
- **Location** – Some resources can answer specific, local needs, such as distribution network constraints. Others can respond to north-south wind power flows, or solar power flowing from south west England and south Wales to major conurbations.
- **Green motivation** – Within both business and domestic customer groups is a growing body of consumers wishing to go beyond green certificate schemes (e.g. ROCs, REGOs) as a means of reducing their carbon footprint. Such consumers will, generally with technological help, adapt their consumption to use electricity when it is at its greenest.

We believe that a combination of inherent green motivation and strengthening market forces is able to deliver the flexibility required to achieve net zero.

Moving to net zero

The net zero target became UK law in June 2019. We will see a net zero update of National Grid's Future Energy Scenarios (FES) this summer, but in the meantime, it is instructive to consider the numbers projected for 80% emissions reduction from 1990 levels.⁵

To a system delivering 300TWh to consumers annually, some 150TWh of new demand in electric vehicles (EVs) and home heating will be added. Wind and solar generation will more than treble to over 300TWh, and nuclear generation will rise by half to over 90TWh. Industrial and commercial demand response capability will multiply by six – but even this does not keep pace with the growing requirement for flexibility.

A smart, flexible power system – one which minimises cost and puts green energy to work – must therefore embrace domestic flexible energy consumption. This is not an obstacle but an opportunity. The near-complete electrification of heat and transport is not only an essential part of net zero; it also creates a resource with the capability to balance itself. This is true provided a small number of conditions are met:

1. **Smart** – BEIS has already stated that future domestic EV chargers must be smart; this is equally required in home heating. Smart means able to respond when needed and – crucially – to be rewarded for doing so. The key role of the smart meter is to make customers' elective responses to price and to green signals visible, so that value can accrue to those customers. Smart meters need not have a role in dispatch.
2. **Customer-centric** – Flexitricity has never seen any place for obligation in flexible electricity. Our experience has been that the customer who is able to opt out rarely does so. In sufficiently large populations, outcomes are reliable. The security of the electricity industry has always been based on this: in the UK, the capacity of electric

⁵ National Grid ESO Future Energy Scenarios 2019, Two Degrees. <http://fes.nationalgrid.com/fes-document/>

kettles alone is likely to exceed the highest electricity demand ever seen; a clear demonstration of the power of diversity.⁶

3. **Open markets** – It was to open the Balancing Mechanism and other near-real-time electricity markets to flexible consumers that Flexitricity became a business energy supplier and, more recently, the first to deliver customer flexibility as a Virtual Lead Party under new market rules known as BM Wider Access.⁷ BM Wider Access is one of the main routes by which we expect domestic electricity customers to earn value from their flexibility.
4. **Efficiency** – After 12 years of live operations, Flexitricity has never encountered a conflict between energy efficiency and flexibility. Rather, an efficient consumer is a more flexible consumer. For example, it is the relative thermal efficiency of large-scale cold stores that makes them ideal sources of demand response, and the (until recently) relative inefficiency of retail refrigeration that has held back this potential resource.
5. **Consistency** – We do not argue for regulated prices or long-term contracts: given the speed at which technology develops, such mechanisms risk locking in a solution which becomes outdated.⁸ Persistence with open markets, a progressive removal of barriers and a consistent forward direction deliver better outcomes.

We do not argue that flexible electricity will provide all of the optionality required for net zero. Some is likely to come from hydrogen, green gas, biomass and carbon sequestration. However, flexibility is the prime low opex, low capex resource. Flexibility in electricity will enable the UK to electrify heat and transport, put green energy to work in British businesses and keep the lights on in a net zero future.

⁶ 25m homes in UK; typical kettle 2.5kW to 3kW; cf Digest of UK Energy Statistics, ONS

⁷ <https://www.flexitricity.com/blog/another-flexitricity-first-balancing-mechanism/>

⁸ Diesel farms in the Capacity Market: <https://www.bbc.co.uk/news/business-35035717>