edie EXPLAINS

Demand Response

SUPPORTING PARTNER:

Flexitricity

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WHAT IS DEMAND RESPONSE AND HOW DOES IT WORK?

At its simplest, demand response, or demand side response, financially incentivises energy users to turn down or turn off non-essential energy use at times of peak demand, allowing broader demand to be met without additional generation. It also creates a network of potential energy generators that can be called upon to switch on flexible, smaller capacity generation when needed, rather than larger generation plant at part capacity.

Why is it needed?

The National Grid has to maintain a certain level of energy production capacity above actual demand, about 2.3GW of operating margin, known as 'headroom'. This margin is maintained to cope with plant going down, or unexpectedly high peaks in demand. It is also used to deal with not just the size, but the speed of the peak, which can be equally problematic.

Maintaining this margin involves ensuring generation capacity exceeds any possible peak, which in turn means part-loading power stations (see example, over the page). However, power stations are at their most efficient when running at 100%, so this means a less efficient grid. Demand response is designed to provide the margin or headroom needed, either by generating energy or reducing usage. This would allow for fewer power stations, running at optimum rate – essentially allowing demand response to deal with any peak or outage in normal supply.

By balancing the grid, long-term, greater take-up of demand response among UK businesses could help negate the need for new fossil fuel-fired generation plant. Plus, demand response is also a green energy enabler, making the variable output of renewable generation more attractive for UK business.

The potential environmental benefits are estimated to be between 300 and 750 tonnes of CO_2 saved per MW of reserve provided by demand response.

Why do demand response? What are the benefits?

One primary business argument for demand response is cost. Demand response not only allows businesses to avoid higher energy prices during times of peak demand, it also creates revenue for those businesses when the grid draws on it.

However, there are other benefits in terms of security of supply and environmental impact. In terms of security of supply, on a macro level, balancing the grid is a win for everyone, avoiding the possibility of brownouts, or worse. At a business level, there is also normally a substantial increase in the reliability of the site's emergency power supply. Standby generators are there to provide emergency power if the mains supply fails. A demand response programme can help ensure the engine is tested 'on load', keeping the standby generator healthy, resulting in safer and cleaner running in the event of an emergency.

Environmentally, demand response reduces national carbon emissions, and by providing a more flexible system, enables and incentivises renewable generation. It also supports a greener grid by encouraging businesses to 'turn up' energy use during periods of peak renewable generation when there is an excess of green energy available, and enabling them to 'turn down' usage during periods of higher demand.

What does demand response look like in practice?

In a retail space – a supermarket, for example – it might be possible to adjust the amount of energy going into the cold stores for short periods of time without disrupting the business, or damaging stock. In a manufacturing plant, production can be cut or boosted at non-critical times to reduce or increase energy demand.

How often will demand response be activated, and how long for? Can I say no?

This depends on the type of demand response (see 'What are the different demand response options?'). It can range from 10 times per year to 250 times per year. Most services are fully automated, and site equipment responds immediately. In some cases, the site may deliver the full demand response capacity inside one second. In other cases, equipment might take up to 15 minutes to respond, depending on what it is. Events generally last between 30 minutes and four hours. Generally, the faster the response, the shorter the time the site will be asked to deliver for. Ultimately, the demand response customer can intervene and halt demand response at any time via an onsite control mechanism.

Do I need to be an intensive energy user?

Demand response is usually measured in capacity terms rather than consumption or output terms – the flexibility or capacity within the system (including both the capacity to generate and the capacity that can be switched off). Third party providers can work with sites offering a broad range of capacity, though 200kW realistically represents the lower end of the scale to make demand response economic.

There is no upper limit, though those at the higher end scale may choose to go direct to National Grid (see next section). The revenue available from demand response will depend on the individual case.

CUTTING CO_2 VIA DEMAND RESPONSE

Imagine an island with four gas-fired power stations on it. Supplying the island requires three stations to be run at full load, with the CO_2 emissions associated with that. But the fourth station also has to run, because if there's a problem, more power may be needed from another source. That means that the grid turns down three of the stations a bit, and part-loads the fourth gas-fired power station as back-up. Instead of having three power stations running at 100%, you end up with four power stations running at 75% each. The CO_2 emissions in that scenario are higher. But if demand response is used to fill in the margins, then the original three power stations can be run at optimum efficiency – 100% – cutting CO^2 emissions and ensuring continuity of supply.

Who does it?

There are two main options: work directly with the National Grid or work with a third party aggregator who will work with it on your behalf.

The benefits of a direct relationship include businesses gaining experience of direct contract management with National Grid. There are also no fees to pay to a third party, meaning companies can potentially make more money through this arrangement. However, it means having the understanding, resource and responsibility for in-house demand response management.

Working with a demand response aggregator means the above is looked after by a third party company specialising in electricity demand side participation. The demand response aggregator will contract with the individual demand sites – industrial, commercial or residential consumers – and aggregate them together to operate as a single demand response provider, to help balance the grid.

The demand response aggregator then receives a percentage of the value created by reducing peak demand, balancing intermittent generation, providing a balancing service, or increasing security of supply.

The Association for Decentralised Energy (ADE) is developing an industry-backed code of conduct for demand side response aggregators. This is intended to ensure high standards, so businesses enjoy peace of mind when choosing how they provide demand response.

What will implementing demand response involve on my site?

First the business or its demand response provider must ensure that site processes, and the site itself, are suitable for demand response participation. Intelligent 'outstations' are then configured to each site and are taught the 'rules of engagement', including how to measure power and dispatch electricity reserve, or frequency response. The outstation will also know the 'no go' areas in terms of demand response and the site's operations to ensure critical operations are not affected.

The system needs to be tested to ensure the site responds to a STOR or demand turn-up call (see 'What are the different demand response options?'), or a frequency event, as appropriate for the site. Staff must be trained to know how demand response will operate, when and how to communicate with the provider, and how to opt out if they need to.

What are the different demand response options?

Short Term Operating Reserve

Short Term Operating Reserve (STOR) is needed because at certain times of the day National Grid requires a greater store of reserve power – in the form of either generation or demand reduction – to be able to deal with actual demand. This can be because overall demand is greater than forecast, or because of generation plant unavailability. If frequency response cannot provide the required total power, the grid may issue a call for STOR, involving shutting down consumption, or turning on generation, depending on the demand response site and what it has to offer. Ideally, the grid requires a response within 20 minutes to get a good price for the electricity generated.

Frequency Response

Frequency Response is required in order to cope with large deviations in frequency caused by the loss of power generation on the grid. It is a fast-acting demand response service, which responds in under a second in some cases. It is unusual for this activity to last more than half an hour.

WHAT DEMAND RESPONSE ISN'T

- **A panacea for all your energy problems: there is a huge variety of demand response resources available, and none of them can do everything**
- **A substitute for energy efficiency initiatives: energy efficiency remains highly desirable for any business – and the grid – and should be used in tandem with demand response**
- **A 'quick-win' solution: demand response requires careful planning and implementation in order to be a success**

Frequency response is provided to the electricity grid through the interruption of demand at demand response customer sites. The electricity demand is automatically interrupted when the system frequency transgresses the low frequency relay setting on the demand response provider site. Demand side customers who provide a frequency response service are prepared for their electricity demand to be interrupted for a 30-minute duration. Interruptions such as these may occur 10-30 times a year, according to National Grid.

Frequency response can be either static or dynamic. Static frequency response waits for an event to happen on the grid – an outage at a power station, for example. When this occurs, the 50Hz 'heartbeat' of mains power drops because there is a loss of energy. A demand response provider will 'clip' industrial processes that are consuming electricity – i.e. turn them off – to compensate in the wake of the outage. Companies are compensated for providing the service.

Dynamic frequency response involves continually changing demand – either up or down – In response to variations in grid frequency. This is more technically challenging, and is only suitable for some sites. For example, with dynamic frequency response, a 1MW installation on a site might run at 75% of capacity to give a + or – 30% swing. Companies can charge more to provide this type of demand response.

Triad management

Triads incentivise customers to do everything they can to reduce demand during peak periods of electricity consumption in the winter.

Triads are the three half-hour periods of peak demand on the electricity transmission network during the winter, from November to February. The transmission network uses triads to distribute higher charges between electricity suppliers. These charges are based on how much electricity is being consumed by the supplier's customers during the triad periods. The energy supplier will reduce the burden of this additional cost by charging its customers a portion of the charge.

If consumers can reduce their electricity demand during these three peak periods, their charges will also reduce. Sites that can generate power can earn revenue based on payments from the transmission network, as opposed to charges.

Triad periods are not known in advance but are calculated after the fact. Predicting when a triad will occur is therefore complex. Demand response providers provide triad management to help customers save money in the winter. If demand is not reduced during a triad, customers will be charged extra for their electricity use.

Ofgem is currently undertaking a review of all network charging mechanisms, including triads.

Negative reserve

Operating margin is sometimes referred to as 'headroom'. Negative reserve is known as 'footroom' or 'demand turn-up'. Demand turn-up is about soaking up excess renewable energy and using it to power useful processes. For example, it can mean adjusting manufacturing schedules to make best use of available renewable energy. The demand response provider may receive signals from the National Grid requesting that it start up energy-consuming processes in order to make use of intermittent generation via renewable energy such as wind or solar.

The Capacity Market

The Capacity Market is part of the Government's Electricity Market Reform package. The Capacity Market is intended to secure electricity supplies by paying extra for reliable sources of capacity. The full cost of this is now being recovered from Britain's electricity consumers – including businesses – from October 2016. ■

> One primary business argument for demand response is cost. Demand response not only allows businesses to avoid higher energy prices during times of peak demand, it will also create revenue for those businesses with onsite generation capacity when the grid draws on it.

FLEXITRICITY CASE STUDY: **THAMESWEY**

CASE STUDY

Thameswey Central Milton Keynes (TCMK) was set up in 2005 to build and operate a low carbon Combined heat and power (CHP) energy station. Thameswey supplies nearly 20,000 MWh of low carbon electricity per year to local homes and businesses.

Thameswey and Flexitricity

Thameswey has been reliably providing reserve energy to National Grid through Flexitricity since 2011. Along with providing Short- Term Operating Reserve (STOR) and triad management, Thameswey has played a key role in supporting Western Power Distribution (WPD) with Project FALCON.

STOR and triad management

Using two gas CHP engines which can be made available to Flexitricity when not required for local generation, Thameswey is able to provide 6MW of generating capacity to help support National Grid during times of system stress and to support the transmission system during winter peaks.

STOR is one of National Grid's most important tools for securing the national electricity system in real time. Fast-acting generators are held in readiness so that Flexitricity can start them when National Grid runs short of electricity. This can happen if a power station fails, or if demand is unexpectedly high.

Reserve energy is delivered to National Grid through a fully automated control and monitoring system. The two gas CHP units, each capable of providing 3MW of capacity, at Thameswey are remotely operated in response to a national or local requirement. The fully managed service optimises revenue through tight management controls and intelligent arbitraging between services.

Triad management at Thameswey is complementary to its STOR participation. During the November to February triad season, Flexitricity remotely starts generation during likely triad periods. This lowers site consumption and reduces the triad charges on the site's electricity bills.

Project FALCON

Through Flexitricity, Thameswey has been able to participate in WPD's project FALCON (Flexible Approaches for Low Carbon Optimised Networks), an initiative to support the UK's move to a low carbon economy. The aim is to test innovative, low carbon solutions for the growing problem of network constraints. As an experienced DSR provider, Thameswey generated electricity when called upon by Western Power Distribution. By doing so, Western Power Distribution were able to defer network infrastructure upgrades and reduce costs while Thameswey earned revenue.

The future

Through Flexitricity, Thameswey is currently participating in National Grid's Enhanced Frequency Control Capability (EFCC) trial. EFCC is developing techniques to help National Grid manage growing renewable generation. Flexitricity is currently measuring Thameswey's contribution of 'spinning inertia' to the system, aiming to create a new value stream for distributed CHP generators. ■

"THE ENTIRE PROCESS HAS BEEN FLAWLESS FROM START TO FINISH, WITH NO INTERFERENCE ON OUR CORE BUSINESS ACTIVITIES. IT PROVIDES A VALUABLE SOURCE OF REVENUE, AND HAS ENABLED THAMESWEY TO PLAY ITS PART IN CONTRIBUTING GREENER RESERVE POWER SUPPLIES TO THE GRID."

Sean Rendall, Operations Manager Thameswey Energy

KEY FACTS

6MW
of generating capacity can be automatically turned on for short periods

Reduces
national carbon dioxide emissions

Over
£100,000
earned every year

No disruption
to core processes